

# CRANIAL NERVES

## OVERVIEW

### Types of function

Motor	Voluntary	Includes general somatic and branchial somatic <sup>1</sup>
	Involuntary	Include Visceral motor (parasympathetic) ie smooth muscle/glands Presynaptic fibres synapse outside CNS
Sensory	Somatic <sup>2</sup>	Carried by CN V (VII, IX, X also)
	Visceral	Receptors include carotid body, sinus, pharynx, larynx, trachea, bronchi, lungs, heart, GIT
	Unique	Special Senses

<sup>1</sup>Muscles from pharyngeal arch ie of mastication

<sup>2</sup>General

### Types Of Nerves

Pure Motor <sup>1</sup>	III, IV, VI XI, XII, V <sup>2</sup>
Pure Sensory	V <sup>3</sup>
Mixed <sup>4</sup>	V, VII, IX, X
Visceral Motor	III, VII, IX, X

<sup>1</sup>Also have some proprioception fibres from ganglia in *mesencephalic nucleus* of CN V

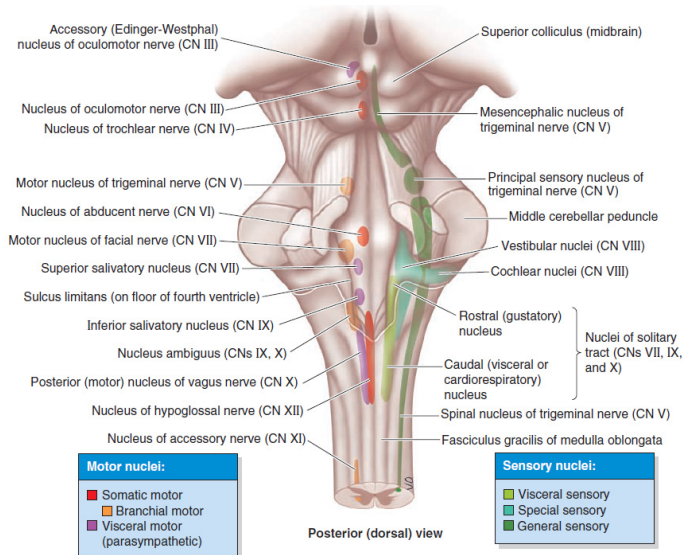
<sup>2</sup>Motor root

<sup>3</sup>Sensory root

<sup>4</sup>Branchial somatic & somatic sensory

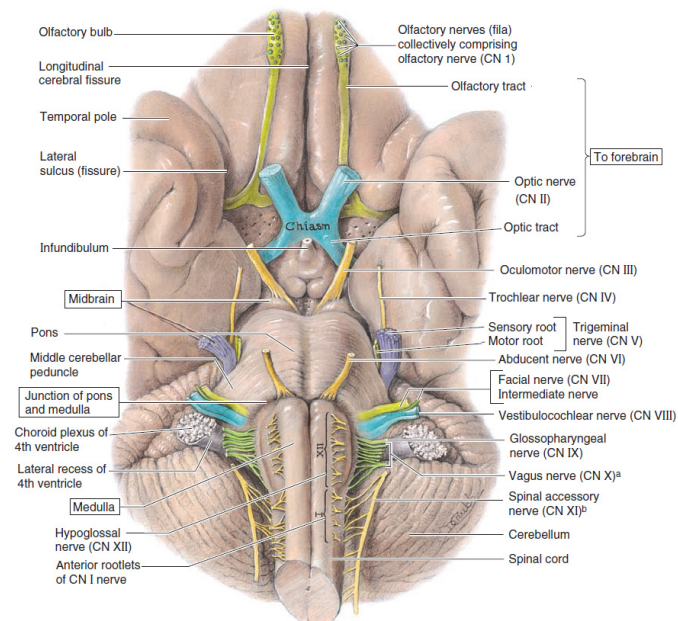
### Origin of Cranial Nerves: Nuclei

- **CN I & II** are essentially extensions of forebrain ∴ no brainstem nuclei



### Cranial Nerve Exits

- CN IV only CN that exits posteriorly from brainstem



## CN I: OLFACTORY

Function	Special Sensory: <b>SMELL</b>
Cell Bodies	Olfactory receptors coalesce into ~ 20 olfactory nerves
Extracranial Course	→ R & L olfactory <b>nerves</b>
Cranial Entry	<b>cribriform plate</b>
Intracranial Course	→ olfactory <b>bulb</b> <sup>1</sup> (ant cranial fossa) (synapse with mitral cells here) → olfactory <b>tract</b> → lateral olfactory <b>striae</b> → <b>Piriform cortex</b> → medial olfactory <b>striae</b> → <b>contralateral olfactory structures</b>

<sup>1</sup>Extension of forebrain

## CN II: OPTIC

Function	Special Sensory: <b>VISION</b>
Cell Bodies	Retina <sup>1</sup>
Extracranial Course	Become Myelinated deep to the optic disc
Cranial Entry	Optical canal
Intracranial Course	Middle fossa → chiasm → optic tract → <b>lateral geniculate body</b> (thalamus) → <b>visual cortex</b> (occipital lobe)

<sup>1</sup>Meninges/subarachnoid space extend to retina.: optic a.v. within CSF

## CN III: OCULOMOTOR

Function	Somatic Motor	Visceral Motor
Cell Bodies	Midbrain	Midbrain/Ciliary Ganglion
Intracranial Course	pierces dura lateral to sellar diaphragm (housing pituitary)	
Cranial Exit	<b>superior orbital fissure</b>	
Extracranial Course	<i>Superior Division</i>	<i>Inferior Division</i> → Ciliary ganglion & ciliary body
Target	Sup, med, inf recti & inf oblique + levator palpebrae superioris	Sphincter pupillae (accommodation)

<sup>1</sup>Dorsal to rostral 2/3 of somatic nucleus

## CN IV: TROCHLEAR

Function	<b>Somatic Motor</b>
Cell Bodies	midbrain caudal to Oculomotor
Intracranial Course	<b>Emerges from dorsal midbrain</b> (all others ventral surface) <sup>1</sup> Pierces dura @ <b>margin of tentorium cerebelli</b> → lateral wall of <b>cavernous sinus</b>
Cranial Exit	<b>superior orbital fissure</b>
Extracranial Course	-
Target	superior oblique (ie SO4) <sup>2</sup>

<sup>1</sup>: Also longest course

<sup>2</sup>Only ocular muscle with trochlea

## CN V: TRIGEMINAL

- 1 motor 3 sensory nuclei (mesencephalic, primary sensory, spinal nuclei of trigeminal)

Sensory	Ophthalmic (V1)	Maxillary (V2)	Mandibular (V3)
Function <sup>1</sup> & Extracranial Course	Forehead & nose skin, mucous membranes, conjunctiva	Upper jaw mucous membranes & skin <sup>2</sup>	Lower jaw mucous membranes & skin <sup>3</sup>
Cell Bodies	Trigeminal ganglion <sup>4</sup>		
Cranial Entry	Superior Orbital Fissure	Foramen Rotundum	Foramen Ovale
Intracranial Course	Emerges from lateral aspect of pons as large sensory nerve and small motor		
Cell Nuclei	Mesencephalic, principal sensory, spinal nuclei of trigeminal nerve		

<sup>1</sup>Little overlap vs dermatomes

<sup>2</sup>Pterygopalatine ganglion nerves travel in V2 to supply lacrimal, nasal glands (parasympth)

<sup>3</sup>Otic & submandibular ganglion nerves travel in V3 to supply salivary glands

<sup>4</sup>Within dural recess (trigeminal cave) lateral to cavernous sinus

### Somatic (Branchial) Motor

Cell Bodies	Pons
Intracranial Course	Emerges from lateral aspect of pons as large sensory nerve and small motor → joins V3 before exiting cranium
Cranial Exit	Foramen Ovale
Extracranial Course	Passes inf to trigeminal ganglion along floor of cave
Target	muscles of mastication, Mylohyoid, ant belly digastric, tensor veli palatine, tensor tympani

## CN VI: ABDUCENS

Function	Somatic Motor
Cell Bodies	Pons near midbrain
Intracranial Course	Emerge between pons and medulla → Traverse pontine cistern next to basilar artery → Pierces dura and runs over petrous part of temporal bone, (through cavernous sinus)
Cranial Exit	Superior orbital fissure
Target	Supplies lateral rectus

# CRANIAL NERVES

## □ CN VII: FACIAL

- 2 motor and 1 special sensory function

Motor	Somatic	Visceral
<b>Cell Bodies</b>	Motor Nucleus <sup>1</sup>	Superior Salivatory Nucleus <sup>1</sup>
<b>Intracranial Course</b>	jcn of pons/medulla as <b>motor and intermediate</b> (sensory, parasympathetic) nerve → join as CN VII	
<b>Cranial Exit<sup>2</sup></b>	→ internal acoustic meatus → facial canal → styloid foramen of temporal bone	
<b>Extracranial Course</b>	→ Parotid  Branches <b>1. Temporal</b> <b>2. Zygomatic</b> <b>3. Buccal</b> <b>4. Marginal mandibular</b> <b>5. Cervical</b>	Geniculate ganglion → Greater petrosal → <b>Pterygopalatine ganglion</b> → <b>V2 → lacrimal gland</b>  Branch to <b>Stapedius</b> within styloid foramen  <b>Chorda Tympani</b> just distal to Stapedius nerve in styloid foramen → <b>V3 → submandibular ganglion</b> → <b>submandibular/lingual glands</b>
<b>Target</b>	Facial expression, auricular, Stapedius, digastric (post belly), Stylohyoid	Glands: lacrimal, submandibular, sublingual, nose, palate

<sup>1</sup>Lateral Pons, motor superior

<sup>2</sup>Visceral branches emerge within temporal bone, geniculate ganglion within temporal bone

### Sensory

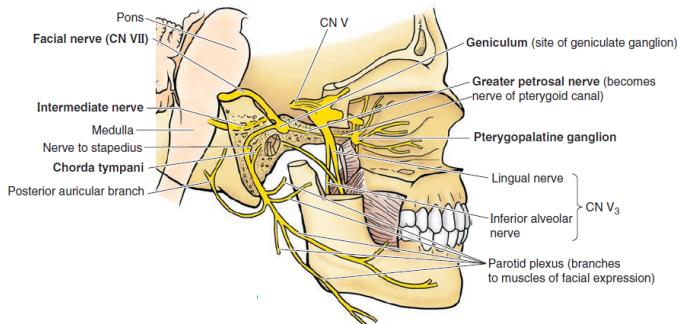
<b>Function<sup>1</sup> &amp; Extracranial Course</b>	taste ant 2/3 tongue & soft palate → Chorda tympani (VII) + lingual nerve (V3)
<b>Cranial Entry</b>	→ internal acoustic meatus → facial canal <sup>1</sup> → styloid foramen of temporal bone <sup>2</sup> → post cranial fossa
<b>Cell Bodies</b>	Geniculate ganglion <sup>3</sup>
<b>Intracranial Course</b>	Enter at jcn of pons/medulla as motor and intermediate nerve (sensory, parasympathetic)
<b>Cell Nuclei</b>	Solitary tract of medulla (taste) Spinal nucleus of trigeminal nerve (general sensation)

<sup>1</sup>Sharp turn here where geniculate ganglion sited, medial wall of tympanic cavity

<sup>2</sup>Post auricular branch prior to entering parotid gland

<sup>3</sup>Within temporal bone during cranial entry

NB Some somatic Sensory: concha of auricle



## □ CN VIII: VESTIBULOCOCHLEAR

<b>Function</b>	Special Sensory: <b>HEARING &amp; MOVEMENT</b>
<b>Cell Bodies</b>	Vestibular ganglion → semicircular canals Spiral ganglion → cochlea
<b>Extracranial Course</b>	Splits as exits IAM → vestibular nerve → cochlear nerve
<b>Cranial Entry</b>	IAM <sup>1</sup>
<b>Intracranial Course</b>	Vestibulocochlear nerve → Cochlear nuclei in medulla → Vestibular nuclei floor of 4 <sup>th</sup> ventricle (junction of pons/medulla)

<sup>1</sup>CN VII motor and intermediate root accompany and labyrinth artery

## □ CN IX: GLOSSOPHARYNGEAL

Motor	Somatic	Visceral
<b>Cell Bodies</b>	Nucleus Ambiguus	Inf salivary nucleus
<b>Intracranial Course</b>	Emerges from lateral medulla	
<b>Cranial Exit</b>	Jugular foramen	
<b>Extracranial Course</b>	Tympanic branch → middle ear → < petrosal branch arises → middle cranial fossa → foramen ovale → otic ganglion	
<b>Target</b>	Stylopharyngeus	Parotid gland

Sensory	Visceral	Special Sensory: Taste <sup>1</sup>
<b>Function<sup>1</sup> &amp; Extracranial Course</b>	Parotid, carotid sinus/body, pharynx, middle ear	Post 1/3 tongue
<b>Cell Bodies</b>	Superior Ganglion	Inferior Ganglion
<b>Cranial Entry</b>	Jugular Foramen	
<b>Intracranial Course</b>	Lateral Medulla	
<b>Cell Nuclei</b>	Nuclei of Solitary Tract	

<sup>1</sup>Also cutaneous sensation external ear (same nerves)

## □ CN X: VAGUS

Motor	Somatic	Visceral
<b>Cell Bodies</b>	nucleus ambiguus	dorsal vagal nucleus
<b>Intracranial Course</b>	Rootlets emerge from lateral medulla and join	
<b>Cranial Exit</b>	Jugular foramen (btwn CN IX, XI)	
<b>Extracranial Course</b>	Descends within carotid sheath	
<b>Target</b>	Soft palate, pharynx, intrinsic laryngeal, Palatoglossus, sup 2/3 oesophagus	Visceral descends through oesoph hiatus Synapses with visceral ganglion Thoracic/abdo

Sensory	Visceral & Somatic	Special Sensory: Taste
<b>Function<sup>1</sup> &amp; Extracranial Course</b>	Somatic: inf pharynx & larynx Visceral: thoracic/abdo	internal laryngeal → root of tongue & epiglottis
<b>Cell Bodies</b>	Sup ganglion in jugular foramen <sup>1</sup>	Inf ganglion inf to jugular foramen
<b>Cranial Entry</b>	Jugular foramen (btwn CN IX, XI)	
<b>Cell Nuclei</b>	nuclei of solitary tract	

<sup>1</sup> Branches to CN IX and superior cervical ganglion

## □ CN XI: SPINAL ACCESSORY

Function	Somatic Motor
<b>Cell Bodies</b>	Nucleus of Accessory Nerve as Spinal accessory nerve (ant horn motor neurons in C1-5/6)
<b>Intracranial Course</b>	Superior most rootlets traverse jugular foramen in vagus nerve
<b>Cranial Exit</b>	<b>Jugular Foramen</b>
<b>Extracranial Course</b>	Descends on internal/common carotid
<b>Target</b>	SCM & Trapezius

NB Some sensory from C2-4 for proprioception/pain in muscles

## □ CN XII: HYPOGLOSSAL

Function	Somatic Motor
<b>Cell Bodies</b>	Nucleus of Glossopharyngeal nerve C1-2 and C2 ganglion join to provide motor and sensory within nerve to hyoid
<b>Cranial Exit</b>	hypoglossal canal
<b>Extracranial Course</b>	Branches include <b>Meningeal</b> (goes back into cranium through hypoglossal canal) for sensory of C2 Superior root of <b>Ansa cervicalis</b> (Infrahyoid) fibres from cervical plex (C1-2) <b>Lingual</b> (supply other muscles of tongue)
<b>Target</b>	Intrinsic & Extrinsic muscles of tongue