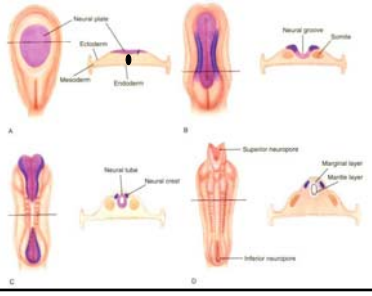
Brainstem II

Medical Neuroscience
Dr. Wiegand

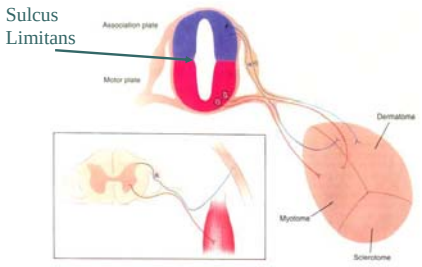
Internal Brainstem

- Cranial nerve nuclei
- Location of selected tracts
- Reticular formation

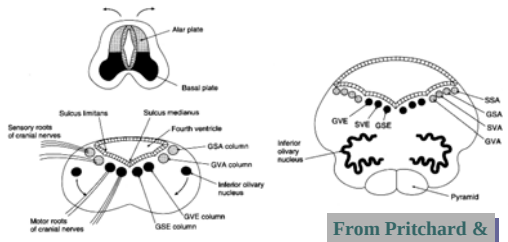
Developmental Organization



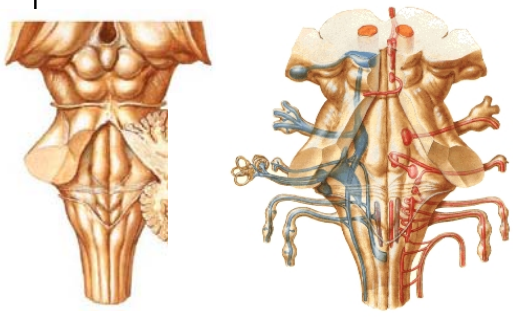
Developmental Organization



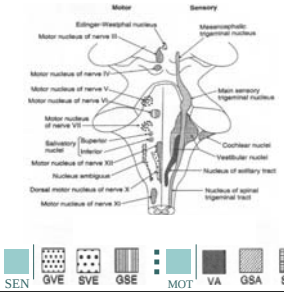
Developmental Organization



From Pritchard & Alloway: Fig. 4-1



Cranial Nerve Nuclei Organization



- Medial to sulcus limitans
  - GSE ⇒ SVE ⇒ GVE
- Lateral from sulcus limitans
  - VA ⇒ GSA ⇒ SSA

From Pritchard & Alloway: Fig. 4-4

Generalizations

- Sensory nuclei lateral to sulcus limitans
- Motor nuclei medial to sulcus limitans
- Visceral nuclei are on either side of sulcus
- Innervation of skeletal muscle (GSE & SVE) most medial
- General and special visceral afferent nuclei in same column

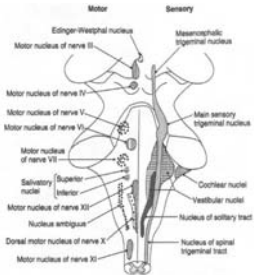
I, II

Cranial Nerves – Telencephalon & Diencephalon

- Olfactory –
  - smell (SVA)
- Optic –
  - vision (SSA)

III, IV

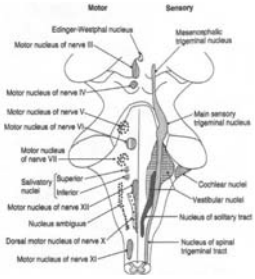
Cranial Nerves – Mesencephalon



- Oculomotor –
  - extraocular eye muscles (GSE) – **oculomotor nucleus**
  - PSNS to eye (GVE) – **Edinger-Westphal nucleus**
- Trochlear –
  - extraocular muscle (sup. oblique) (GSE) – **trochlear nucleus**

V, VI

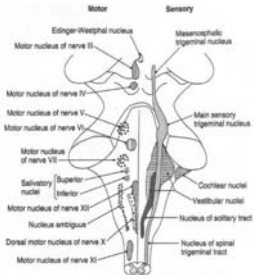
Cranial Nerves – Metencephalon



- Trigeminal –
  - Masticatory muscles (SVE) – **trigeminal motor nucleus**
  - General sensation of the head and face (GSA) – **trigeminal complex**
- Abducens –
  - extraocular muscle (lat. rectus) (GSE) – **abducens nucleus**

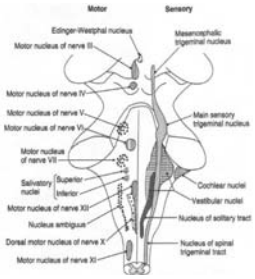
VII

Cranial Nerves – Metencephalon



- Facial –
  - Facial expression muscles (SVE) – **facial motor nucleus**
  - Glands (submandibular, sublingual & lacrimal) (GVE) – **superior salivatory & lacrimal nucleus**
  - Taste (SVA) – **rostral solitary nucleus**
  - General sensation of ear (GSA) – **trigeminal complex**

VIII Cranial Nerves – Metencephalon

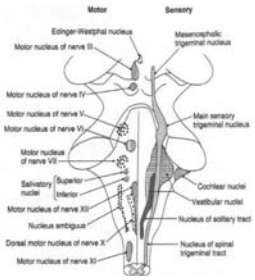


Vestibulocochlear –

- Hearing (SSA) – **dorsal and ventral cochlear nuclei**
- Balance (SSA) – **vestibular nuclei**

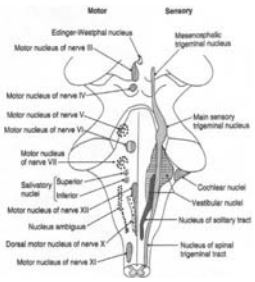
IX Cranial Nerves – Mylencephalon

- Glossopharyngeal
  - Stylopharyngeus muscle (SVE) – **n. ambiguus**
  - PSNS to parotid gland (GVE) – **inferior salivatory n.**
  - Taste (SVA) – **rostral solitary n.**
  - Carotid body sensation (GVA) – **caudal solitary n.**
  - General sensation from ear & tongue (GSA) – **trigeminal complex**



IX Cranial Nerves – Mylencephalon

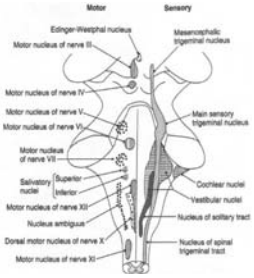
- Vagus
  - Muscles of larynx & pharynx (SVE) – **n. ambiguus**
  - PSNS to thorax and upper abdomen (GVE) – **dorsal motor n. of X (DMV)**
  - Sensory from viscera (GVA) – **caudal solitary n.**
  - Taste (SVA) – **rostral solitary n.**
  - General sensation from ear (GSA) - **trigeminal complex**



XI, XII

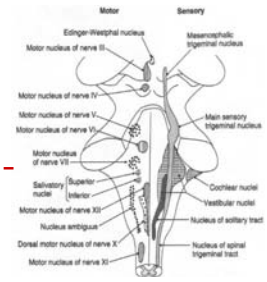
Cranial Nerves – Mylencephalon

- Accessory –
  - innervates trapezius and sternocleidomastoid (SVE or GSE) – **motor nucleus of XI in upper cervical cord**
- Hypoglossal –
  - tongue muscles (GSE) – **hypoglossal nucleus**



Cranial Nerve Nuclei Groups

- GSE & SVE – Motor Nuclei of:
  - III, IV, V, VI, VII, XI, XII
  - ambiguus
- GVE – Parasympathetic Nuclei
  - Edinger-Westphal nucleus
  - Lacrimal & salivatory (superior, inferior) nuclei
  - Dorsal Motor Nucleus of X
- SVA (Taste) – Rostral Solitary nucleus
- GVA – Caudal Solitary nucleus
- GSA – Trigeminal (TBNC)
- SSA – Cochlear and Vestibular nuclei

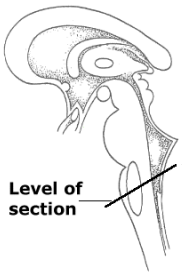


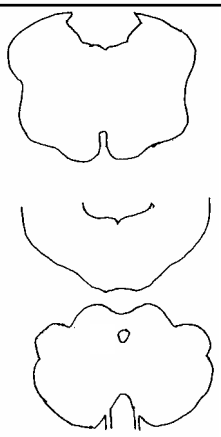
Number	Name	Function	Nucleus	Peripheral Ganglia	PeripheralTarget
I	olfactory	smell	-	olfactory bulb	Nasal cavity
II	optic	vision	lateral geniculate body	retina	Retina
III	oculomotor	Motor PSNS	oculomotor Edinger-Westphal	none ciliary	Extraocular mm Constr. Pup & ciliary
IV	trochlear	Motor	Trochlear	None	Superior oblique
V	trigeminal	Motor Sensory	motor V SpV, PrV, mesV	none trigeminal	Mm of mastication Sensory of face
VI	abducens	Motor	abducens	none	Lateral rectus mm
VII	facial	motor PSNS taste sensory	facial superior salivatory - rostral solitary trigeminal	none submandibular and sphenopalatine geniculate	Mm facial express Lacrimal gland Submandibular/lingual Tongue External ear
VIII	vestibulocochlear	hearing balance	cochlear (dorsal, ventral) & vestibular	spiral vestibular	Cochlea Vestibular app
IX	glossopharyngeal	motor PSNS taste sensory sensory	n. abiguus inferior salivatory rostral solitary caudal solitary trigeminal	none otic inf. (petrosal) of IX inf. (petrosal) of IX	Mm of larynx Parotid gland Tongue Soft palate & pharynx External ear
X	vagus	motor PSNS taste sensory sensory	n. ambiguous dorsal motor rostral solitary caudal solitary trigeminal	none multiple inf. (nodose) of X inf. (nodose) of X sup. (jugular) of X	Mm of larynx/pharynx Viscera Epiglottis Viscera sensory External ear
XI	accessory	motor	accessory nucleus	none	Trap & SCM
XII	hypoglossal	Motor	Hypoglossal	None	Tongue mm.

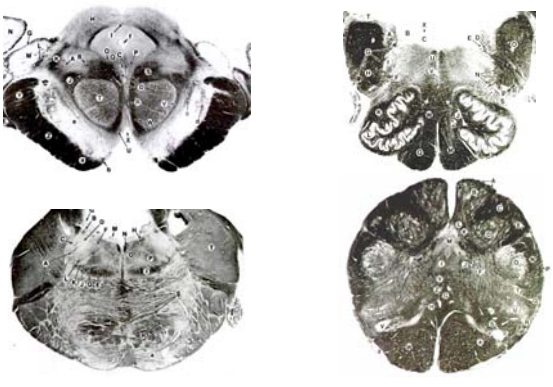
http://lansing.bellarmine.edu/pt/atlas/cover.html

Learning Internal Anatomy

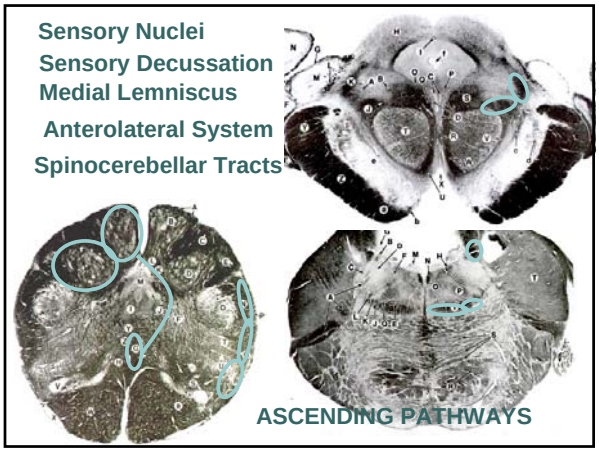
- Recognize outline of brainstem
  - Midbrain
    - Inferior vs. superior colliculi
  - Pons
  - Medulla
    - Open vs. closed
- Place nuclei in correct level
- Recognize orientation of slice
- Learn Pathways
  - Relationship of tracts
  - Places of decussation





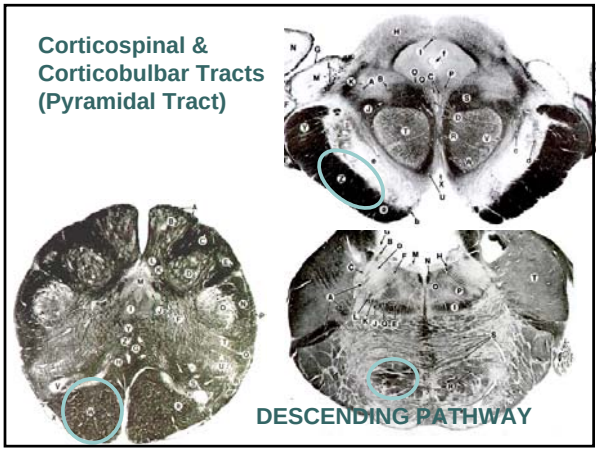


Sensory Nuclei
Sensory Decussation
Medial Lemniscus
Anterolateral System
Spinocerebellar Tracts



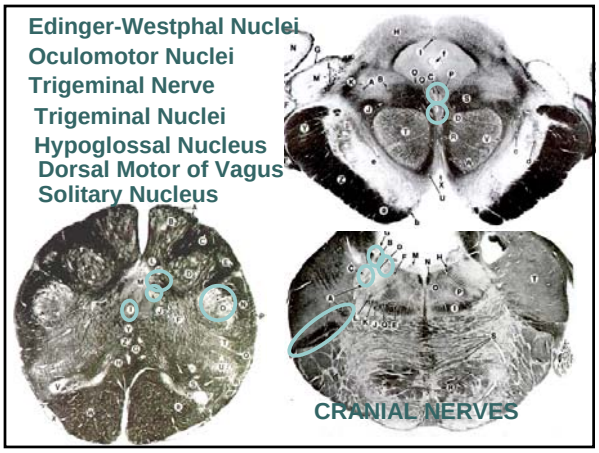
ASCENDING PATHWAYS

Corticospinal &
Corticobulbar Tracts
(Pyramidal Tract)

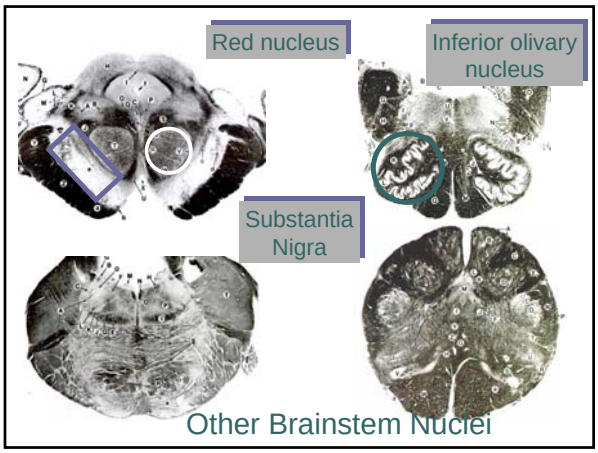


DESCENDING PATHWAY

Edinger-Westphal Nuclei
Oculomotor Nuclei
Trigeminal Nerve
Trigeminal Nuclei
Hypoglossal Nucleus
Dorsal Motor of Vagus
Solitary Nucleus

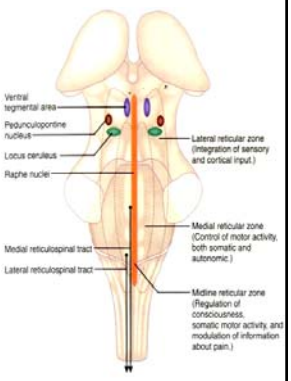


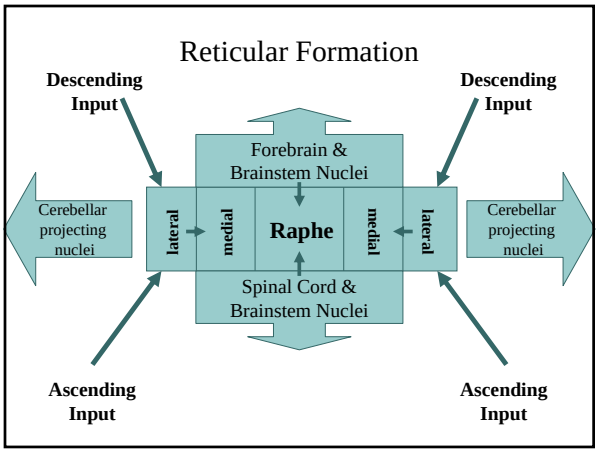
CRANIAL NERVES



Reticular Formation

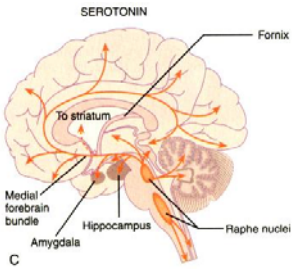
- Diffuse, poorly differentiated brainstem nuclei
- Occupies tegmentum of brainstem
- Modulates:
  - Pain
  - Muscle tone and reflexes
  - Autonomic functions e.g. respiration, blood pressure, cardiac function
  - Arousal, awareness and attention





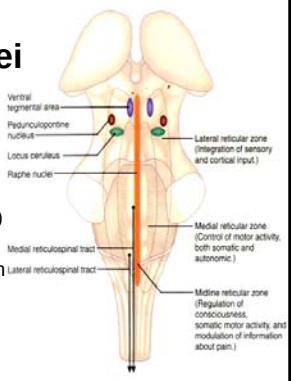
Midline Raphe Nuclei

- Mostly serotoninergic cells – send and receive extensive ascending and descending projections
- Regulate pain, arousal and sleep



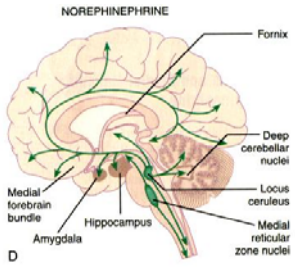
Parasagittal medial nuclei

- Motor regulation
  - Medial (facilitates extensors) reticulospinal tract
  - Lateral (facilitates flexors) reticulospinal tract
  - Also autonomic regulation
- ARAS exerts excitatory input to cortex for consciousness and attention



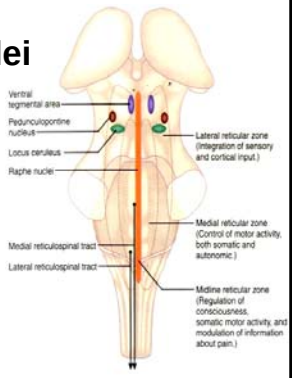
Locus Ceruleus & Medial Reticular Zone

- Regulates attention
- Inhibits pain at spinal cord level
- Regulates autonomic function



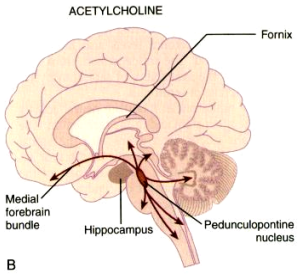
Parasagittal Lateral Nuclei

- Receives input to mediate visceral and cranial nerve reflexes
- Projects to parasagittal medial nuclei
- Pedunculopontine n.

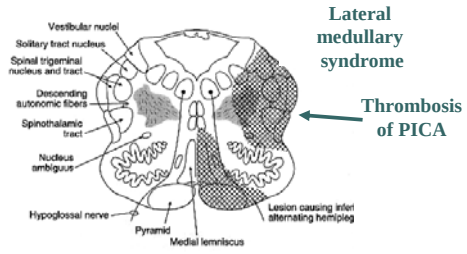


Pedunculopontine Nucleus

- Acetylcholine projecting cells
- Ascending projection to inferior frontal cortex/intralaminar n.
- Input from basal ganglia output nuclei
- Projects to brainstem motor nuclei (VST, RST)



Wallenberg's Syndrome



Lateral medullary syndrome

Thrombosis of PICA

Wallenberg's Syndrome

- Structures involved:
  - Inf. Cerebellar peduncle (ipsilateral ataxia)
  - SpV tract & nucleus (ipsilateral loss pain & temperature)
  - Anterolateral system (contralateral loss of body pain & temperature)
  - N. ambiguus (dysphagia & dysphonia)
  - Vestibular n. (nystagmus and postural instability)