

## **Cranial nerves: functional classification of their nuclei and fibres**

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### **Nuclear groups:**

(Motor nuclei are located medially, sensory nuclei are found laterally.)

### **Motor (or efferent) nuclei**

**they contain multipolar neurones; their axon leaves the brain and terminates on the target (muscle, gland)**

**SM:** Somatomotor nuclei (or GSE, general somatic efferent) form the *dorsomedial* nuclear column (CN III., IV., VI., XII.). The multipolar neurones send their axons to innervate striated muscles derived from *somites* (of the eye and tongue).

**BM:** Branchiomotor or special visceromotor (SVM, SVE) nuclei form the *ventrolateral* nuclear column (CN V., VII., IX-X-XI.). Like somatomotor neurons, they innervate striated muscles (but these muscles developed from *branchial arches*): muscles of mastication, facial expression, pharynx and larynx muscles. The other name is special visceromotor because they innervate the wall of viscera (mouth, nose, larynx, pharynx) but striated muscles [instead of smooth muscles, see the next group] there.

**GVM:** General visceromotor (GVM or GVE) / parasympathetic, secretomotor (CN III., VII., IX., X.). They innervate *viscera*: smooth muscles or glands (e.g. the sphincter muscle of the pupil, salivary glands, glands and smooth muscles of abdominal and thoracic viscera).

The innervation of viscera occurs always\* in 2 steps:

- 1) the cranial nerve nuclei contain the *preganglionic* parasympathetic neurones – their axon leaves the brain and ends in an autonomic (in case of cranial nerves: parasympathetic) ganglion; there it synapses with the multipolar neurone located in the ganglion -
- 2) and the axon of this [postganglionic] neurone will reach the target cells.

\* the only exception is the adrenal medulla: it receives direct preganglionic fibres from the spinal cord (explanation: the adrenal medulla can be classified as a modified sympathetic ganglion)

## Sensory (or afferent) nuclei

**they contain also multipolar nuclei\*\* but they receive inputs (=afferent fibres) from sensory nerves – these fibres synapse on the neurones**

\*\* the only exception is the *mesencephalic trigeminal nucleus*: it contains *pseudounipolar* neurones (= “a ganglion which was put into the brainstem”). Their peripheral processes arrive from the muscle spindles of the muscles of mastication; the central processes terminate on the motor trigeminal nucleus (See also at the proprioceptive reflex – “masseter reflex”).

**GVS:** General viscerosensory (or GVA) relay neurons lie lateral to the visceral motor. They *receive* afferent fibres input from interoceptors / chemo- and baroreceptors (carotid sinus, carotid body, abdominal and thoracic viscera).

**SVS:** Special viscerosensory (or SVA): for taste (an organ of *special* senses). Also relay neurons - they *receive* afferent inputs from the taste fibres coming from the taste buds (e.g. from the tongue).

**GSS:** General somatosensory (or GSA) relay neurons - they *receive* afferent fibres from somatic (body) receptors: mechano-, noci- or thermoreceptors (from the skin, muscles and joints of the head). Three different sensory subtypes exist:

1. epicritic: fine / discriminative touch and pressure, vibration
2. protopathic: vitally important informations:
  - pain
  - rough (non discriminative, crude) touch
  - temperature
3. proprioceptive: the position of the muscles, joints (information from the body of the subject: „proper”=self) – afferent inputs from muscle spindles, tendon organs

**SSS:** Special somatosensory (or SSA) relay neurons form the most lateral nuclear column in the brainstem. They receive afferent fibres carrying vestibular and auditory signals (from the ear). They belong to organs of *special senses* (hearing and balance).

## Nuclei and fibre types of cranial nerves

Real cranial nerves: CN III-XII. (The spinal nerve fibre types are listed for comparison.)

	SM -dorsomedial-	BM (=SVM) -ventrolateral-	GVM (= parasympath.)	GVS (from e.g. baroreceptors, chemoreceptors)	SVS (= taste)	GSS	SSS
III.	Oculomotor nucl.		Accessory oculomotor nucl. (Westphal-Edinger)				
IV.	Trochlear nucl.						
V.		Motor. trigeminal nucl.				<ul style="list-style-type: none"> <li>• <b>Mesencephalic</b> trigeminal nucl. (<i>ganglion cells in the CNS!</i>) Proprioceptive.</li> <li>• <b>Principes sensory nucl.</b> (pontine nucl.) of trigeminal nerve. Epicritic.</li> <li>• <b>Spinal</b> trigeminal nucl. (receives fibres from CN V.,VII.,IX.,X.) Protopathic.</li> </ul>	
VI.	Abducent nucl.						
VII.		Facial nucl.	Sup. salivatory nucl.		Solitary tract nucl.	(+)	
VIII.							- Cochlear nuclei (dors. and ventral) - Vestibular nuclei (sup., inf., med., lat.)
IX.		Ambiguus nucl.	Inf. salivatory nucl.		Solitary tract nucl.	(+)	
X.			Medial ala cinerea nucl. (=dorsal vagal nucl.)	Lat. ala cinerea nucl.	Solitary tract nucl.	(+)	
XI.	(C <sub>1-6</sub> motoneurons)						
XII.	Hypoglossal nucl.						
Spinal n.	+		+	+		+	

*Dr. Réthelyi Miklós, dr. Altdorfer Károly, 2007.*

- **SM:** Somatomotor
- **BM:** Branchiomotor or special visceromotor (SVM)
- **GVM:** General visceromotor
- **GVS:** General viscerosensory
- **SVS:** Special viscerosensory
- **GSS:** General somatosensory
  - epicritic
  - protopathic
  - proprioceptive
- **SSS:** Special somatosensory

(+): these nerves contain protopathic fibres but don't have separate (own) nuclei; their protopathic fibres terminate on the Spinal trigeminal nucleus.