

BASICS OF NEUROBIOLOGY

CRANIAL NERVES

ZSOLT LIPOSITS

Basics of Neurobiology: Cranial nerves

FUNCTIONAL IMPORTANCE OF CRANIAL NERVES

THERE ARE TWELVE PAIRS OF CRANIAL NERVES WITH WIDESPREAD SENSORY, MOTOR AND AUTONOMIC FUNCTIONS

THE OLFACTORY (I) AND OPTIC (II) NERVES ARE ASSOCIATED WITH PROSENCEPHALIC DERIVATIVES, THE REST OF THE CRANIAL NERVES BELONGS TO THE BRAINSTEM

CRANIAL NERVES WITH PRIMARY SENSORY FUNCTIONS (I, II, VIII) MODULATE SMELL, VISION, BALANCE AND HEARING

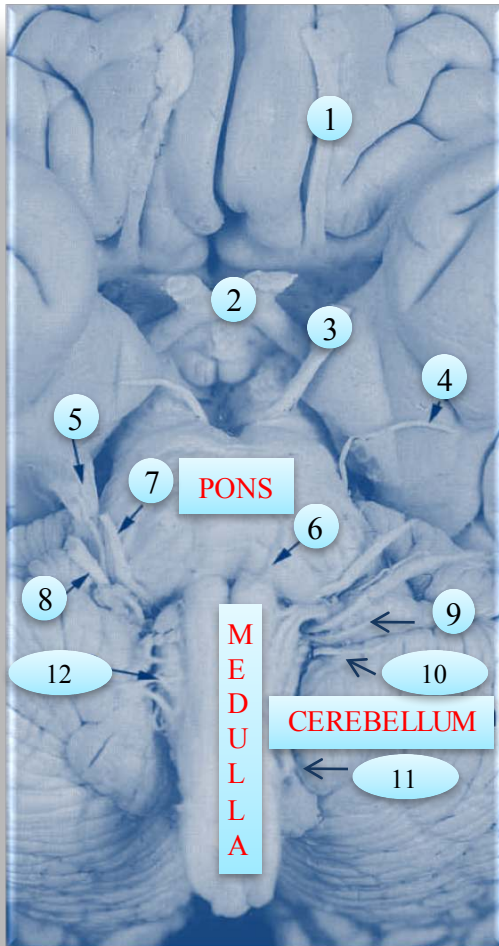
FOUR CRANIAL NERVES (IV, VI, XI, XII) SERVE SOMATOMOTOR FUNCTIONS ENABLING EYE MOVEMENTS, MOVEMENT OF THE SHOULDER GIRDLE, SWALLOWING AND SPEECH

FIVE CRANIAL NERVES ARE MIXED REGARDING THEIR FUNCTIONS. THE TRIGEMINAL NERVE (V) CONTROLS MANY SENSORY PROCESSES OF THE HEAD REGION AND REGULATES THE MUSCLES OF MASTICATION. THE OCULOMOTOR (III), FACIAL (VII), GLOSSOPHARYNGEAL (IX) AND VAGUS (X) NERVES HAVE DOMINANT PARASYMPATHETIC COMPONENTS

THE VAGUS PROVIDES PARASYMPATHETIC CONTROL IN THE BODY INCLUDING THE REGULATION OF LUNGS AND THE HEART

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NOMENCLATURE AND LOCATION OF CRANIAL NERVES



1. OLFACTORY NERVE
2. OPTIC NERVE
3. OCULOMOTOR NERVE
4. TROCHLEAR NERVE
5. TRIGEMINAL NERVE
6. ABDUCENT NERVE
7. FACIAL NERVE
8. VESTIBULOCOCHLEAR NERVE
9. GLOSSOPHARYNGEAL NERVE
10. VAGUS NERVE
11. ACCESSORY NERVE
12. HYPOGLOSSAL NERVE

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FUNCTIONS AND TESTING OF CRANIAL NERVES

CRANIAL NERVE	FUNCTION	TESTING
I	olfaction	with an odorous substance
II	vision	vision chart
III	most eye muscles	"follow the moving finger"
IV	superior oblique	look down at the nose
V	facial sensation	touch the face
	muscles of mastication	clench the teeth
VI	lateral rectus	look to the side

CRANIAL NERVE	FUNCTION	TESTING
VII	facial expression	smile, raise the eyebrows
	taste	sugar or salt
VIII	hearing	a tuning fork
	balance	look for vertigo
IX	pharynx sensation	gag reflex
X	muscles of larynx and pharynx, parasymp.	check for hoarseness, open wide and say "AH"
XI	trapezius and sternocleidomastoid	test shoulder raise or turning the head
XII	tongue muscles	stick out the tongue

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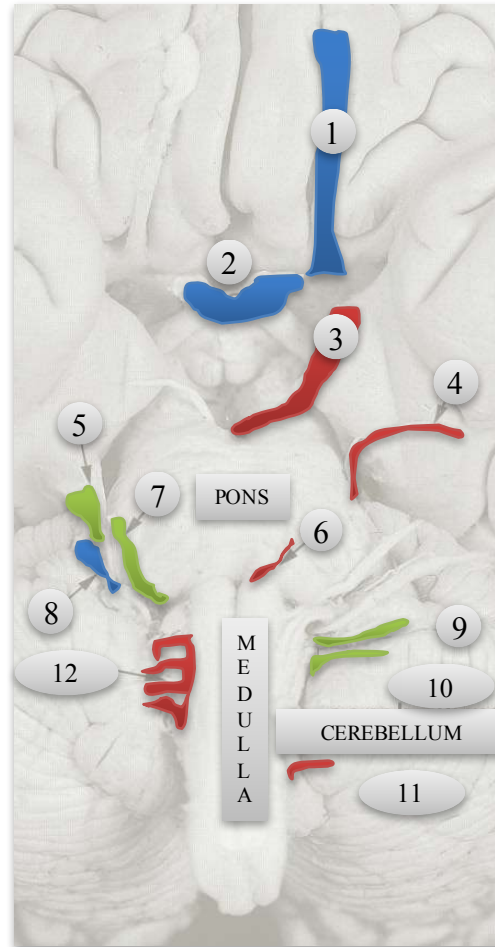
FUNCTIONAL CLASSIFICATION OF CRANIAL NERVES

SENSORY

1. Olfactory
2. Optic
8. Vestibulocochlear

MOTOR

3. Oculomotor
4. Trochlear
6. Abducens
11. Accessory
12. Hypoglossal



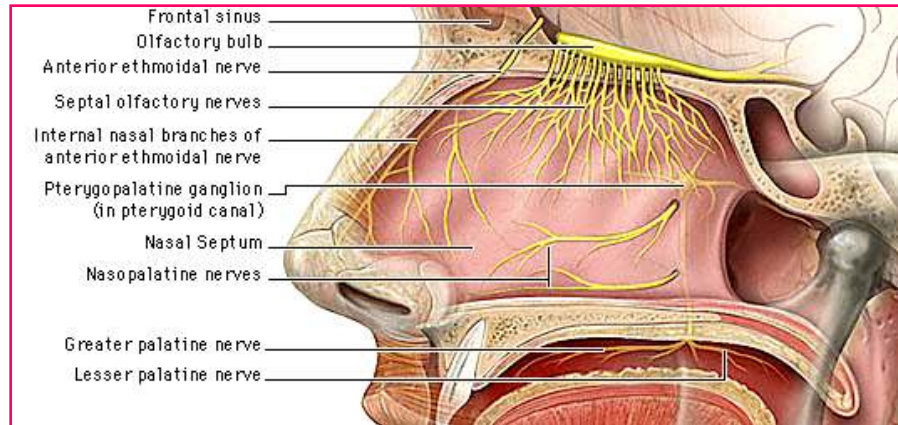
MIXED SENSORY AND MOTOR

5. Trigeminal
7. Facial
9. Glossopharyngeal
10. Vagus

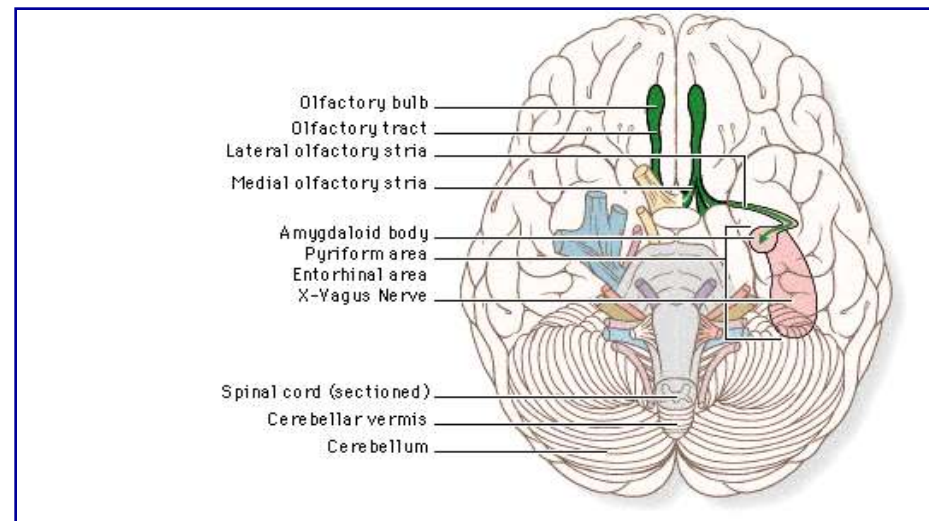
PARASYMPATHETIC

3. Oculomotor
7. Facial
9. Glossopharyngeal
10. Vagus

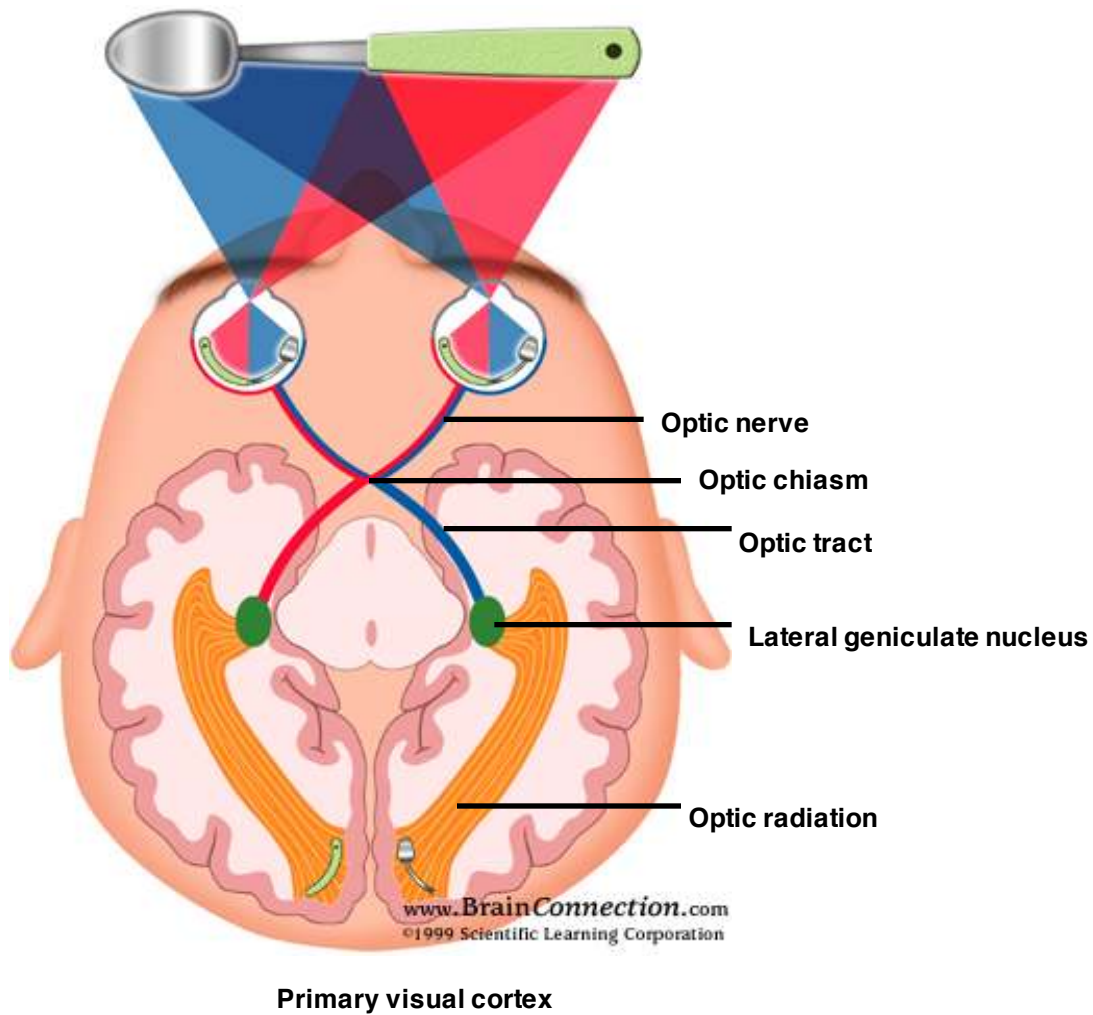
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I.



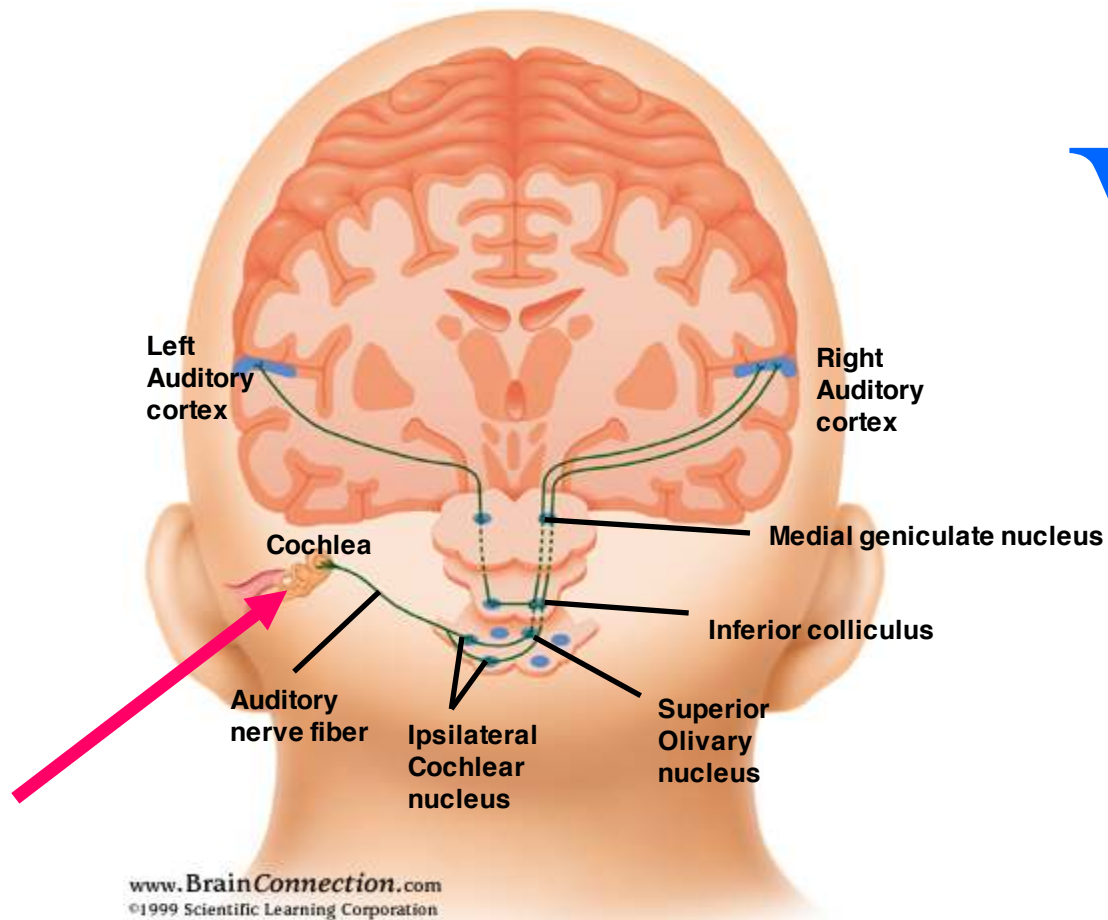
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II.

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VIII.



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SENSORY GANGLIA OF CRANIAL NERVES

GANGLION	CRANIAL NERVE
Trigeminal (Gasser)	Trigeminal (V)
Geniculate	Facial (VII)
Cochlear (spiral)	Cochlear (VIII)
Vestibular (Scarpa's)	Vestibular (VIII)
Sup.glossopharyngeal	Glossopharyngeal (IX)
Inf. glossopharyngeal	Glossopharyngeal (IX)
Superior vagal	Vagus (X)
Inferior vagal (nodose)	Vagus (X)

FIBERS CARRYING SENSORY INFORMATION TO THE BRAIN STEM ARISE FROM SENSORY GANGLIA. THE VESTIBULAR AND COCHLEAR GANGLIA ARE COMPOSED OF BIPOLAR NEURONS, THE REST OF THE GANGLIA CONTAINS PSEUDO-UNIPOLAR CELLS. THE DESIGN IS SIMILAR TO THAT OF THE SENSORY SYSTEM OF THE SPINAL CORD

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FUNCTIONS OF PARASYMPATHETIC GANGLIA BELONGING TO CRANIAL NERVES

AUTONOMIC GANGLIA OF CRANIAL NERVES III, VII, IX AND X

1. CILIARY
2. PTERYGOPALATINE
3. SUBMANDIBULAR
4. OTIC
5. INTRAMURAL

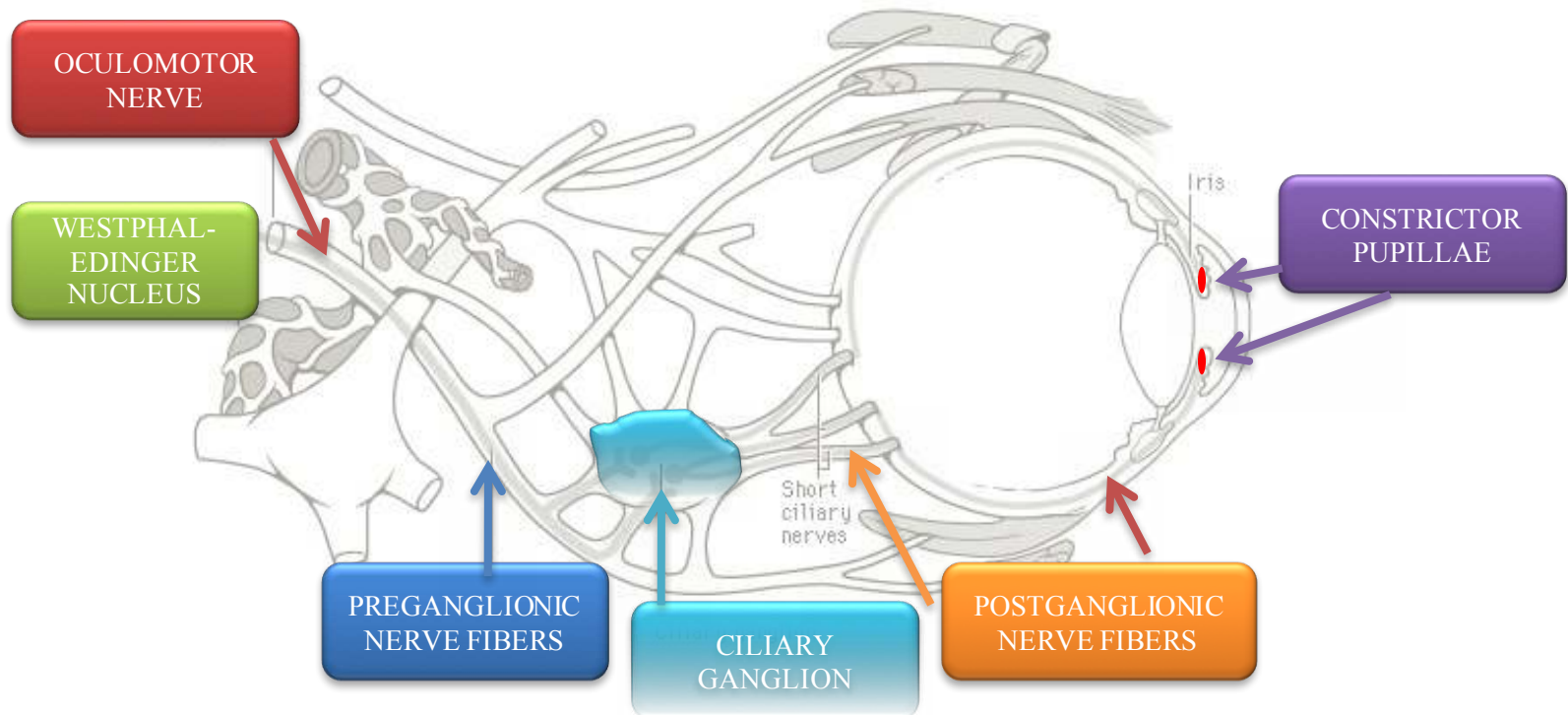
1. OCULOMOTOR (III)
2. FACIAL (VII)
3. FACIAL (VII)
4. GLOSSOPHARYNGEAL (IX)
5. VAGUS (X)

REGULATED FUNCTIONS

1. CONSTRICTS PUPIL, LENS ACCOMMODATION
2. LACRIMATION, NASAL GLAND SECRETION
3. SALIVATION OF SUBMANDIBULAR AND SUBLINGUAL GLANDS
4. SALIVATION OF PAROTID GLAND
5. GLAND SECRETION, PERISTALSIS

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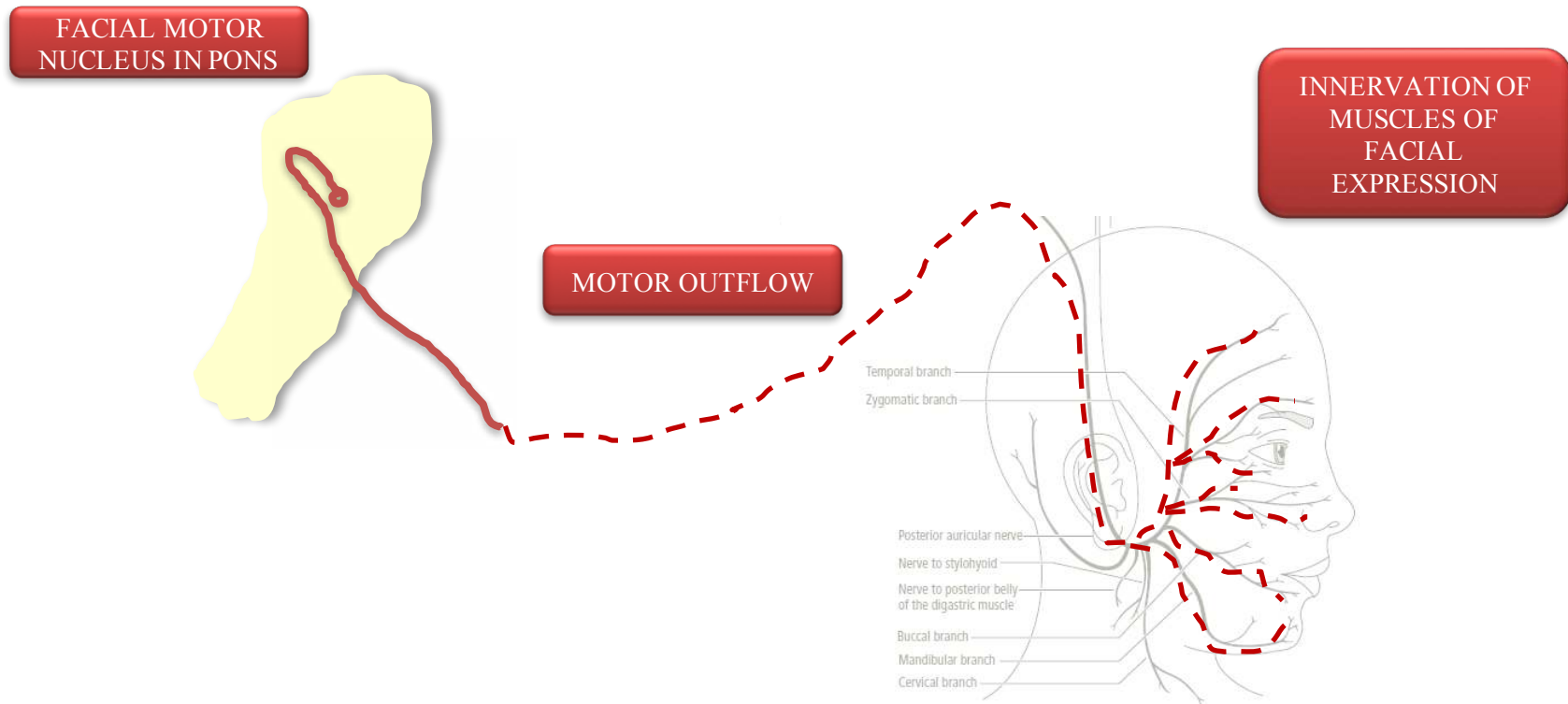
DEMONSTRATION OF THE AUTONOMIC FUNCTION OF THE OCULOMOTOR NERVE



THE OCULOMOTOR NERVE CONTRIBUTES TO THE EFFERENT WING OF THE PUPILLARY LIGHT REFLEX. IN RESPONSE TO INTENSE ILLUMINATION OF THE EYE THE PUPILS UNDERGO CONSTRICTION

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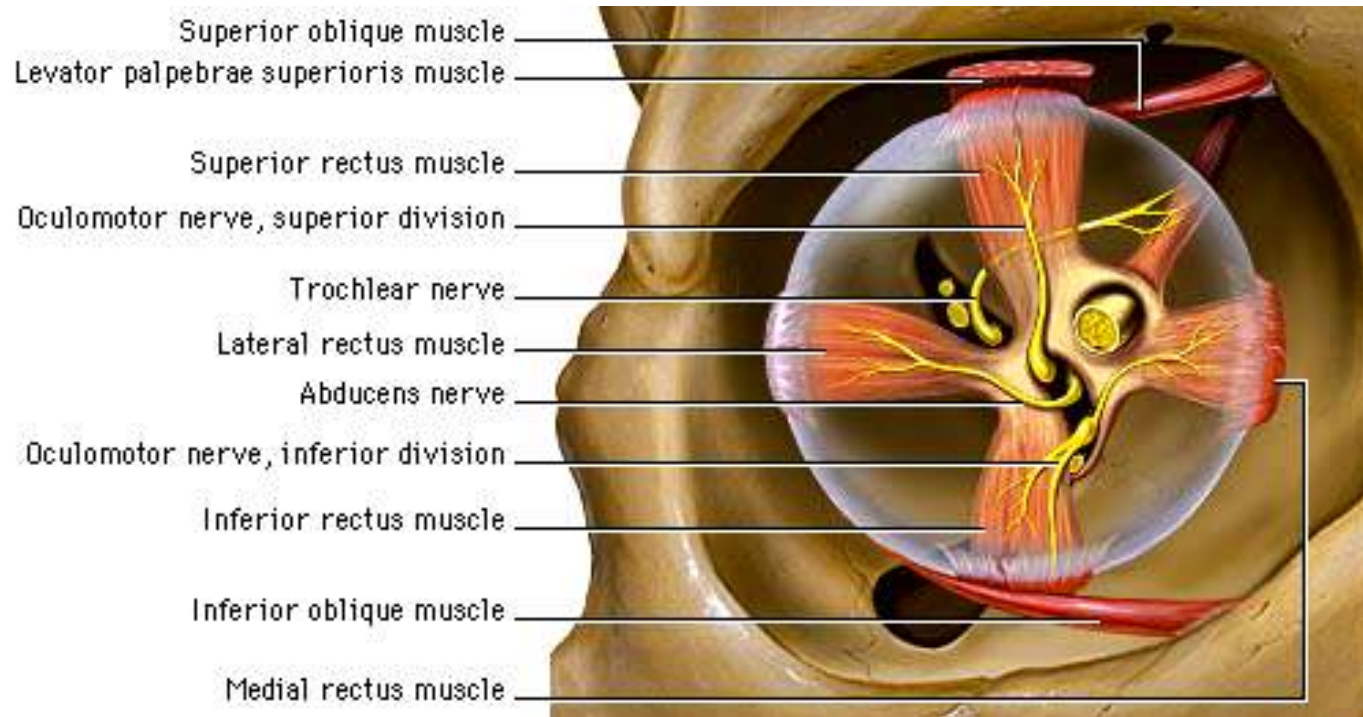
DEMONSTRATION OF THE SOMATOMOTOR FUNCTION OF THE FACIAL NERVE



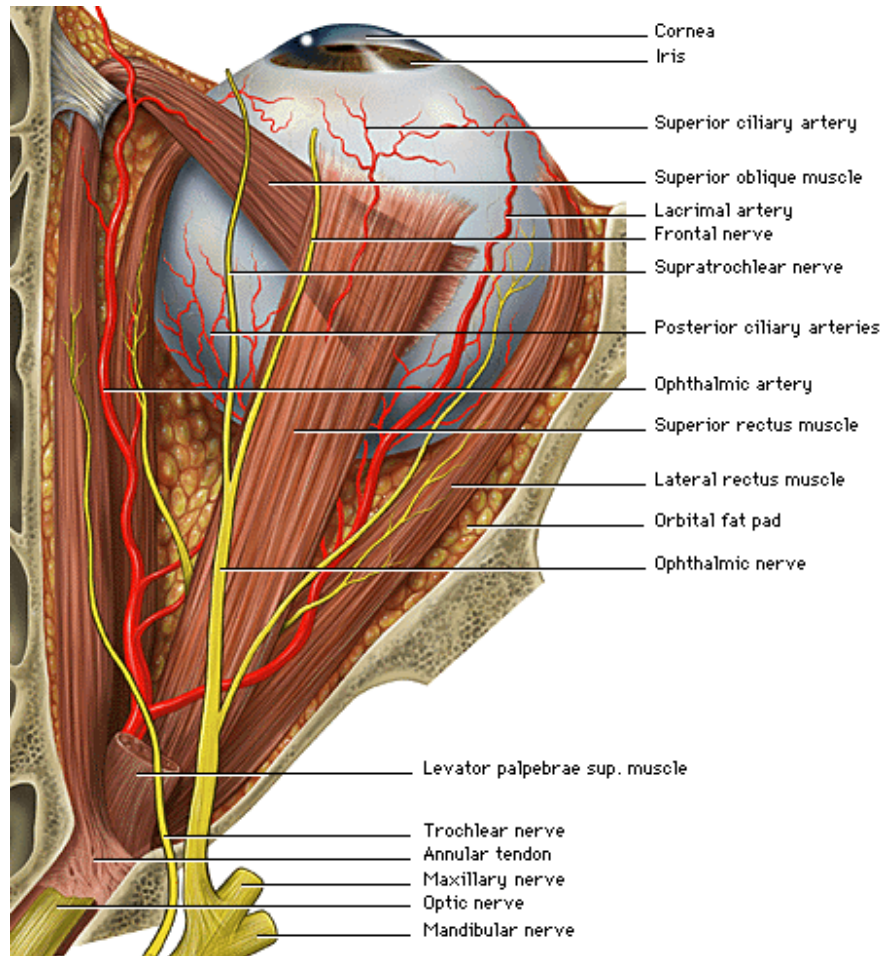
AFTER A LONG AND COMPLICATED COURSE, THE SOMATOMOTOR FACIAL FIBERS ARRIVE TO THE FACE REGION WHERE THEY INNERVATE THE MUSCLES OF FACIAL EXPRESSION. CENTRAL OR PERIPHERAL DAMAGES OF THE SYSTEM RESULT IN CHARACTERISTIC SYMPTOMS

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Nerve supply to external muscles of the eye



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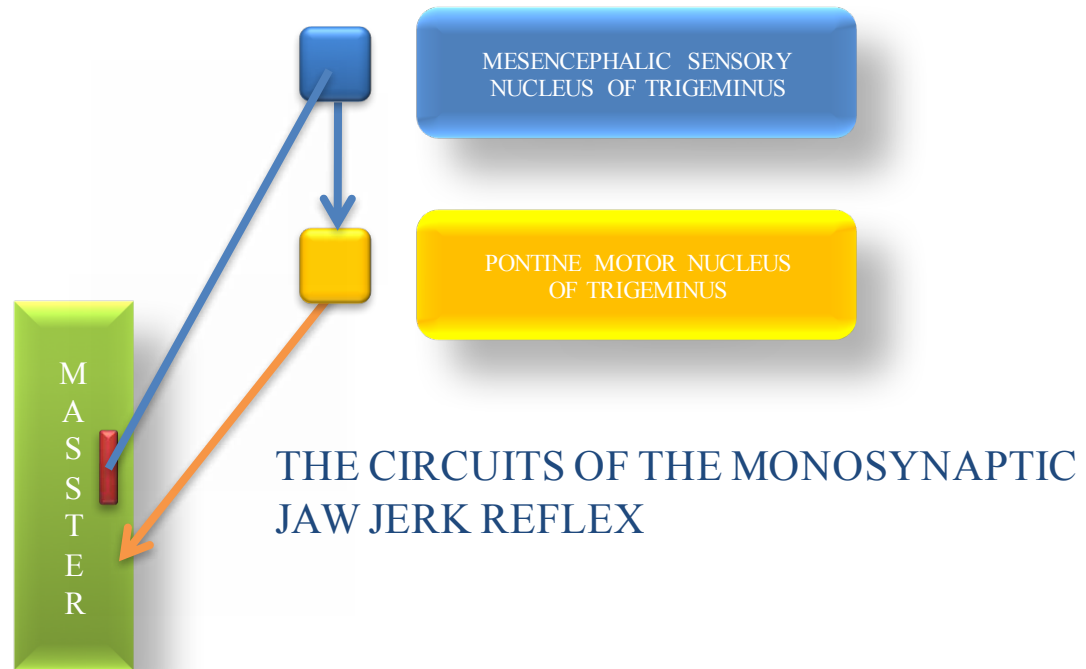
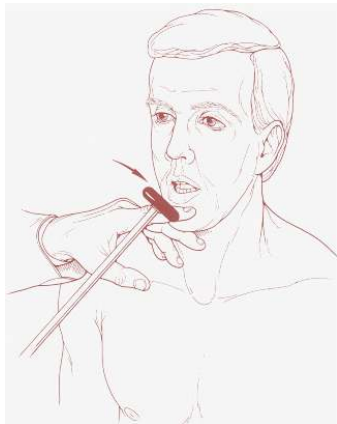


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Regional anatomy of the orbital cavity

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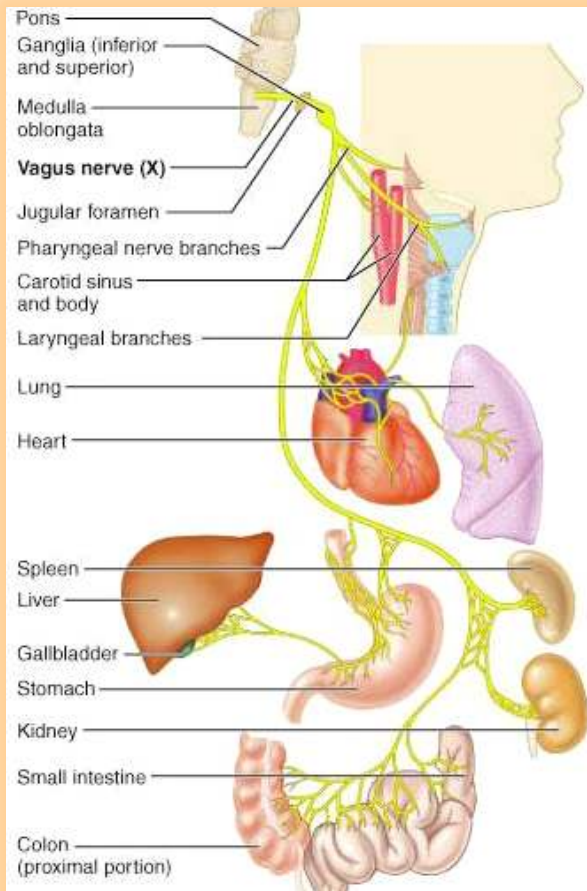
DEMONSTRATION OF THE SENSORY AND MOTOR FUNCTIONS OF THE TRIGEMINAL NERVE IN THE JAW JERK REFLEX



TAPPING ON THE MANDIBLE STRETCHES THE MASSETER MUSCLE WHICH IS SENSED BY ITS **MUSCLE SPINDLE RECEPTORS**. THE INFORMATION IS CONVEYED TO THE MIDBRAIN BY THE PERIPHERAL PROCESSES OF **TRIGEMINAL SENSORY NEURONS**. THE CENTRAL PROCESSES COMMUNICATE WITH **TRIGEMINAL MOTONEURONS** THAT INITIATE THE SHORTENING OF THE MUSCLE

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ILLUSTRATION OF THE SENSORY INNERVATION OF DIFFERENT VISCERA BY THE VAGUS NERVE



AS IT IS DEPICTED IN THE FIGURE, THE VAGUS NERVE LEAVES THE NECK REGION TRAVERSING DOWNWARD TO THE THORAX AND THE ABDOMINAL CAVITY. IT COMMUNICATES WITH ABDOMINAL ORGANS DOWN TO THE SPLENIC FLEXURE OF THE COLON. THE SENSORY NEURONS LOCATED IN THE SUPERIOR AND INFERIOR GANGLIA GATHER SENSORY INFORMATION FROM A WIDE SCALE OF ABDOMINAL ORGANS, THE LUNGS, THE HEART, THE PHARYNX AND THE LARYNX. THIS SENSORY INFORMATION IS PRIMARILY PROCESSED BY THE VISCERAL SENSORY NUCLEUS OF THE VAGUS, THE NUCLEUS OF THE SOLITARY TRACT. THIS PATHWAY IS CRUCIAL IN THE REGULATION OF FEEDING. THIS SYSTEM ALSO FORMS THE AFFERENT LIMB OF THE VISCERAL REFLEX OPERATING AT THE LEVEL OF THORACIC AND ABDOMINAL ORGANS