

BASICS OF NEUROBIOLOGY

SENSORY SYSTEMS

ZSOLT LIPOSITS

Basics of Neurobiology: Sensory systems

FEATURES OF THE GENERAL SENSORY SYSTEM

TOUCH, PAIN, TEMPERATURE AND CONSCIOUS PROPRIOCEPTIVE STIMULI PROVIDE USEFUL INFORMATION ABOUT OBJECTS IN THE ENVIRONMENT AND THE ACTUAL STATE OF BODY PARTS

FROM MOST PARTS OF THE BODY, TWO GENERAL SENSORY SYSTEMS CARRY THE INFORMATION FROM RECEPTORS TO HIGHER PROCESSING CENTERS, THE SPINO-THALAMIC SYSTEM AND THE MEDIAL LEMNISCUS SYSTEM. FROM THE HEAD REGION, THE TRIGEMINAL AND DORSAL TRIGEMINAL TRACTS FORWARD THE SENSORY INFORMATION TO THE THALAMUS

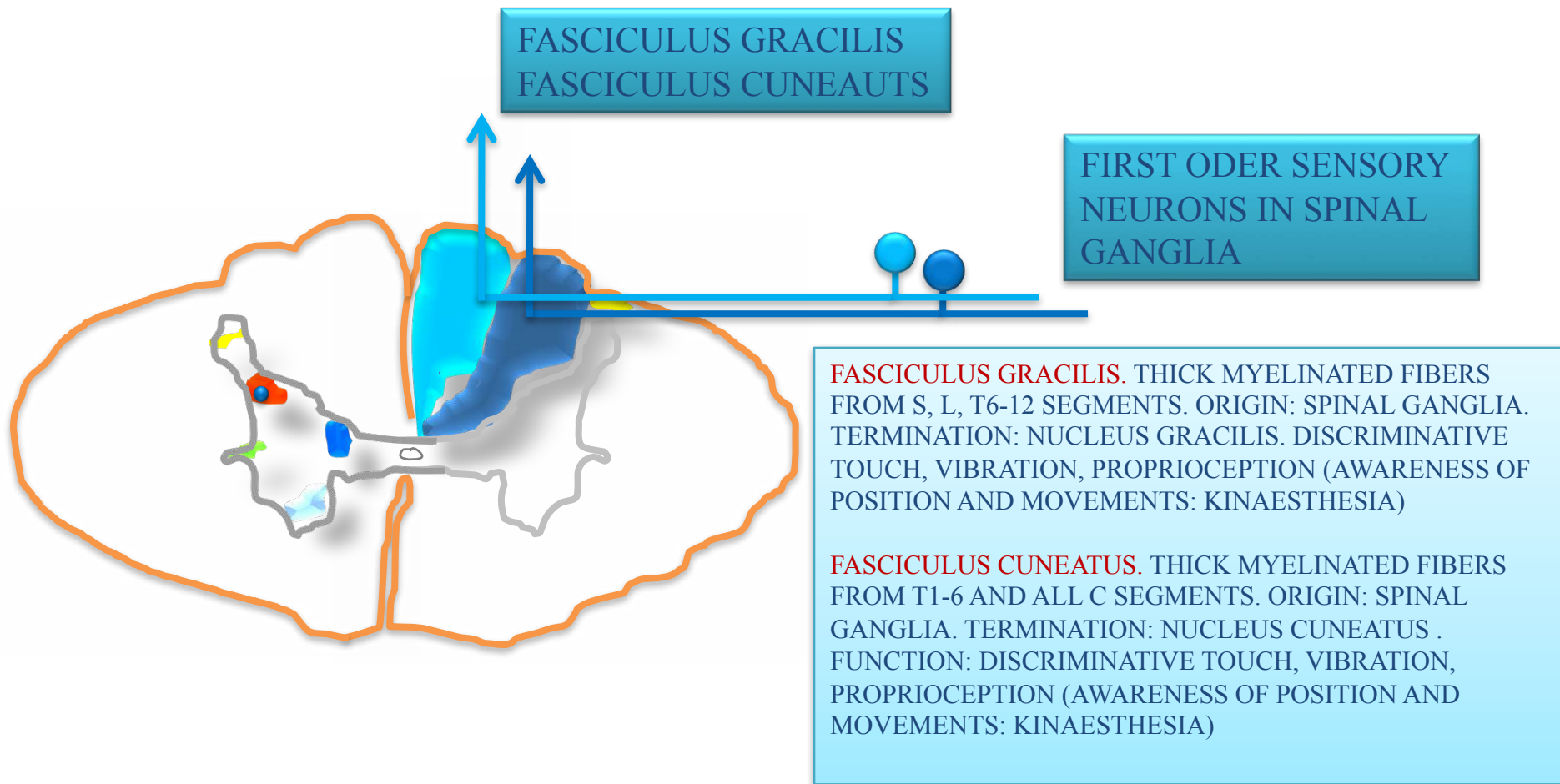
THE SYSTEMS ARE CROSSED AND MULTISYNAPTIC IN NATURE

THEY ARE LINKED TO THE SENSORY NUCLEI OF THE THALAMUS, ESPECIALLY THE VENTRAL POSTERO-MEDIAL AND VENTRAL POSTERO-LATERAL NUCLEI

THE MAJOR PROCESSING SITE OF GENERAL SENSORY INFORMATION IS IN THE PRIMARY SOMATOSENSORY CORTEX LOCATED IN THE POSTCENTRAL GYRUS OF THE PARIETAL LOBE (BRODMANN AREAS 3, 2, 1)

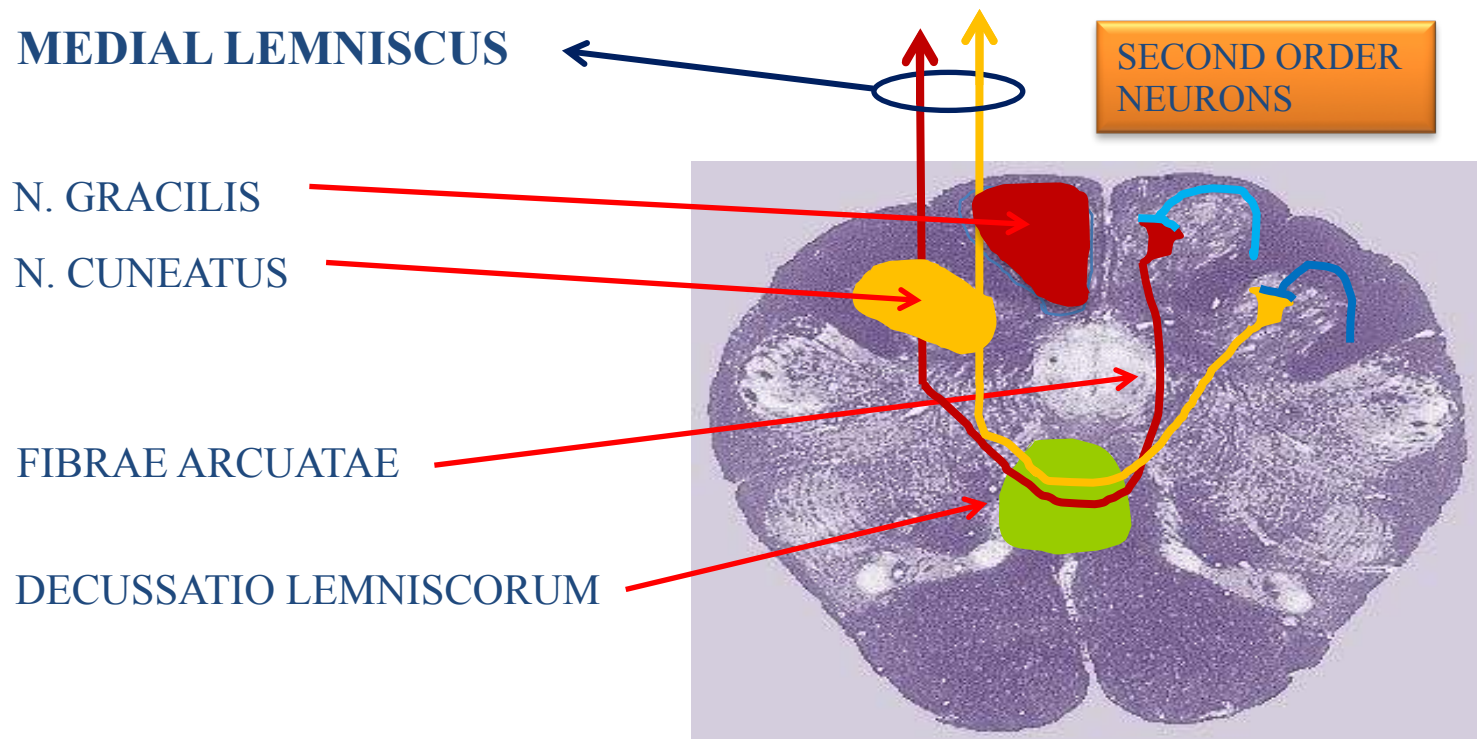
Basics of Neurobiology: Tracts of spinal cord

ORIGIN AND INITIAL COURSE OF THE MEDIAL LEMNISCUS SYSTEM



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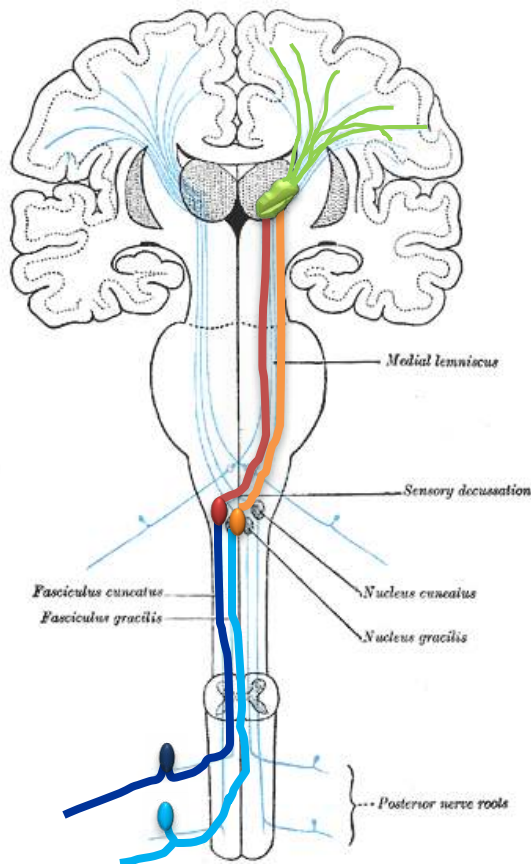
THE MEDIAL LEMNISCUS SYSTEM AT THE LEVEL OF ITS DECUSSATION



THE AXONS OF FIRST ORDER NEURONS TERMINATE ON SECOND ORDER NEURONS RESIDING IN N. GRACILIS AND N. CUNEATUS. THE ASCENDING, CROSSED TRACT ORIGINATING FROM THEM IS THE MEDIAL LEMNISCUS, PROJECTING TO THE THALAMUS

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PROJECTIONS OF THE MEDIAL LEMNISCUS SYSTEM TO THE THALAMUS AND THE SOMATOSENSORY CORTEX



THIRD ORDER
NEURONS

SECOND ORDER
NEURONS

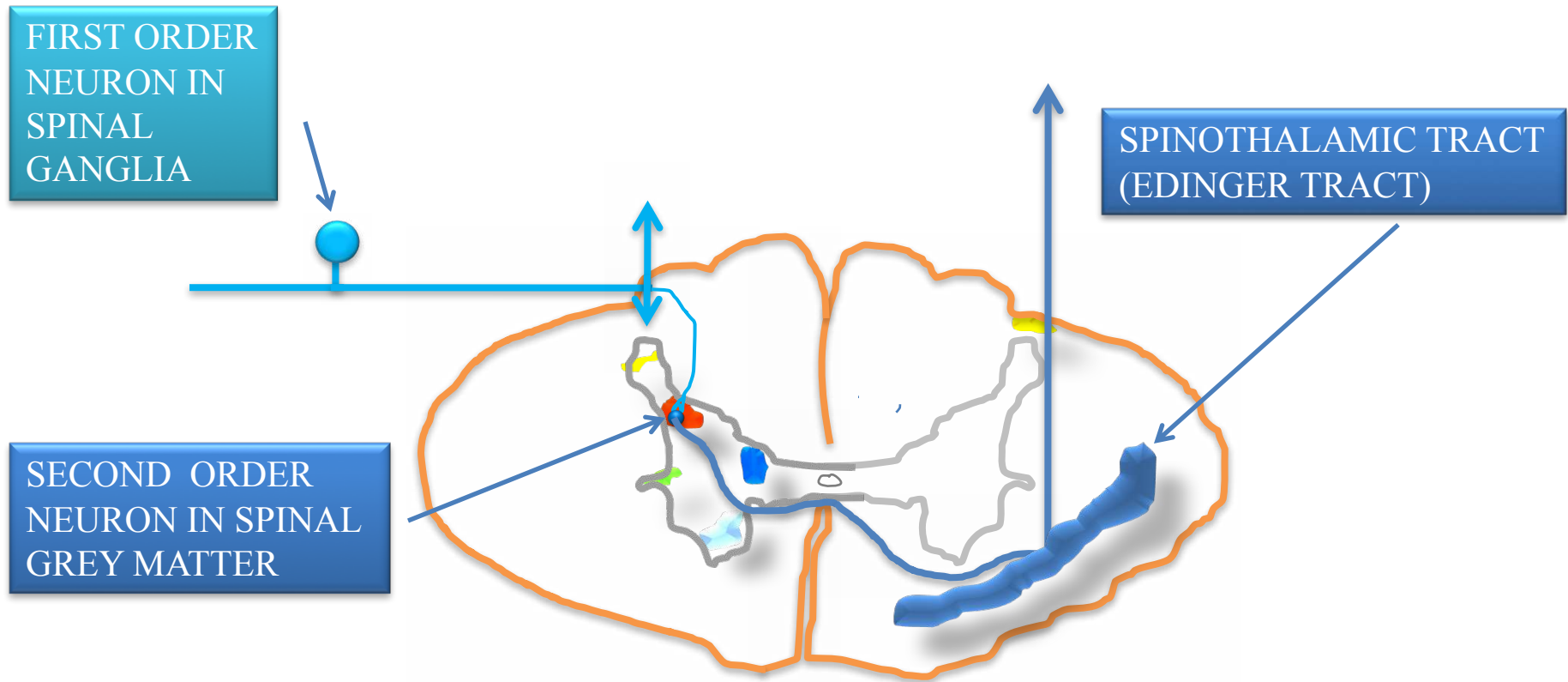
FIRST ORDER
NEURONS

THE ASCENDING MEDIAL LEMNISCUS TERMINATES IN THE VENTRAL POSTERO-LATERAL NUCLEUS OF THE THALAMUS. CELLS OF THIS NUCLEUS SERVE AS THIRD ORDER NEURONS AND PROJECT TO THE PRIMARY SOMATOSENSORY CORTEX IN THE PARIETAL LOBE

FROM THE HEAD REGION, VIBRATION, DISCRIMINATIVE TOUCH ARE PROCESSED BY THE PRINCIPLE SENSORY NUCLEUS OF THE TRIGEMINAL NERVE LOCATED IN THE PONS. THE PROJECTION FROM THIS NUCLEUS TERMINATES IN THE VENTRAL POSTERO-MEDIAL NUCLEUS OF THE THALAMUS. PROPRIOCEPTION IS COUPLED TO THE MESENCEPHALIC TRIGEMINAL NUCLEUS

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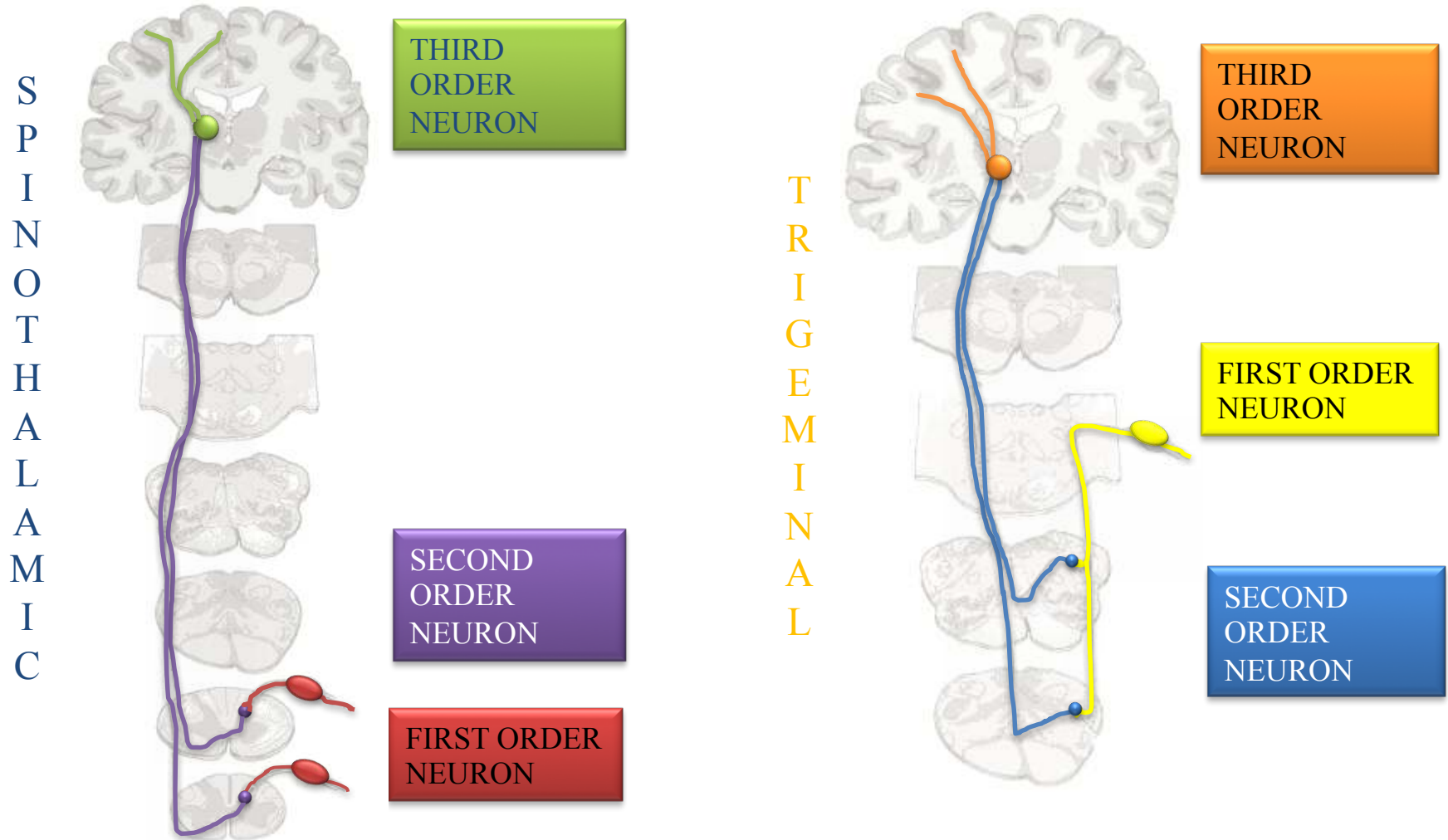
ORIGIN AND INITIAL COURSE OF THE SPINOTHALAMIC TRACT



SPINOTHALAMIC TRACT. ORIGIN: CONTRALATERAL GREY MATTER, LAMINAE I, IV AND V. TERMINATION: THALAMUS. FUNCTION: SENSORY. NOXIOUS PAIN AND THERMAL STIMULI, LESS DISCRIMINATIVE (CRUDE) TOUCH

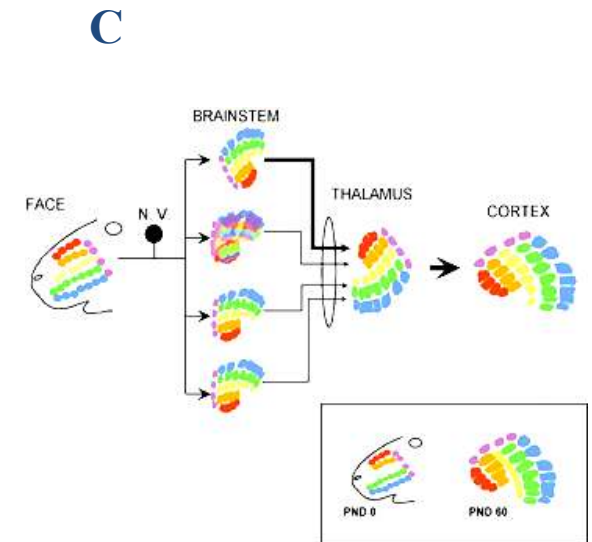
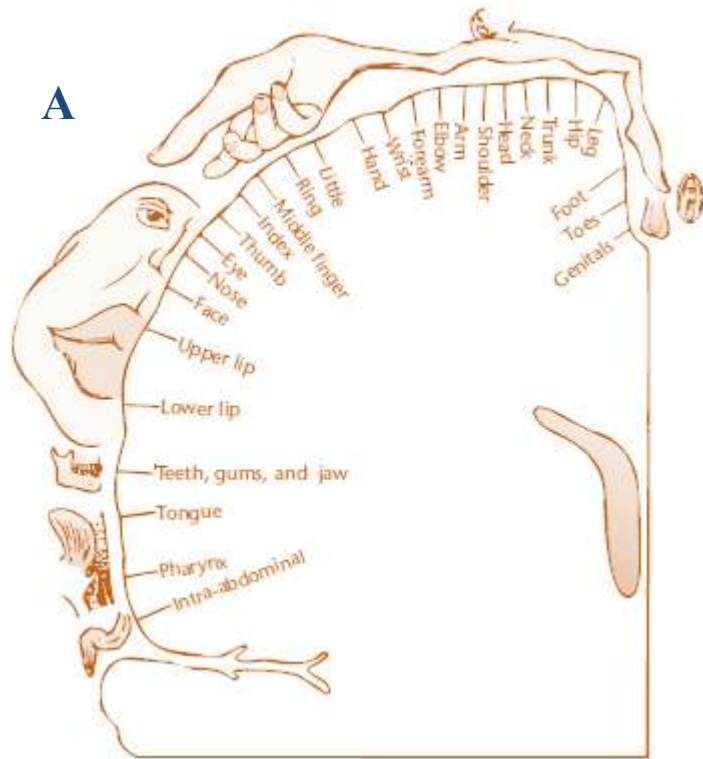
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COURSE OF THE SPINOTHALAMIC AND TRIGEMINAL TRACTS



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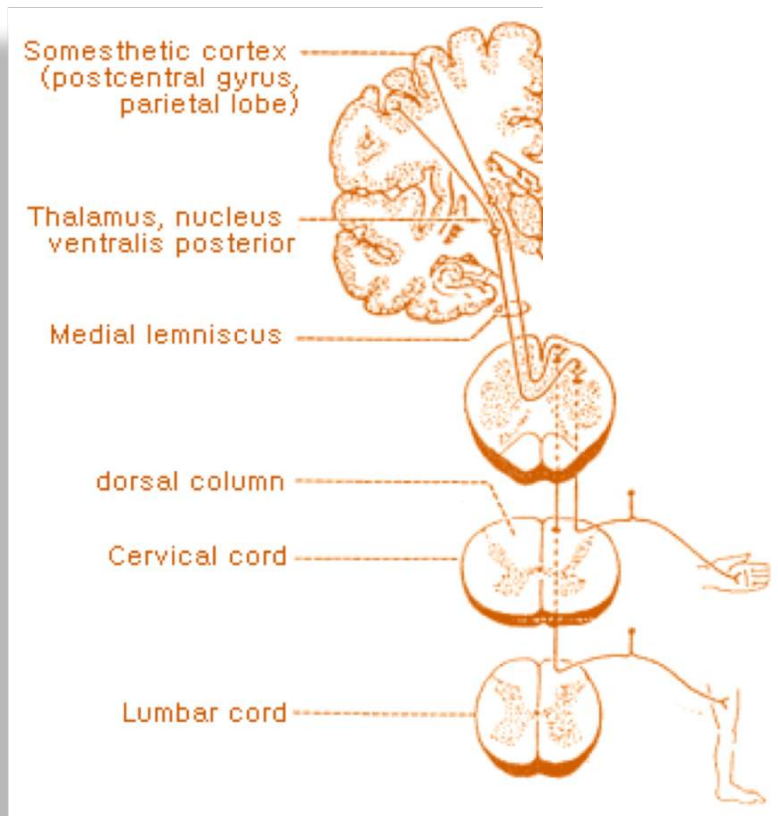
SOMATOTOPIC ORGANIZATION IN THE PRIMARY SENSORY CORTEX



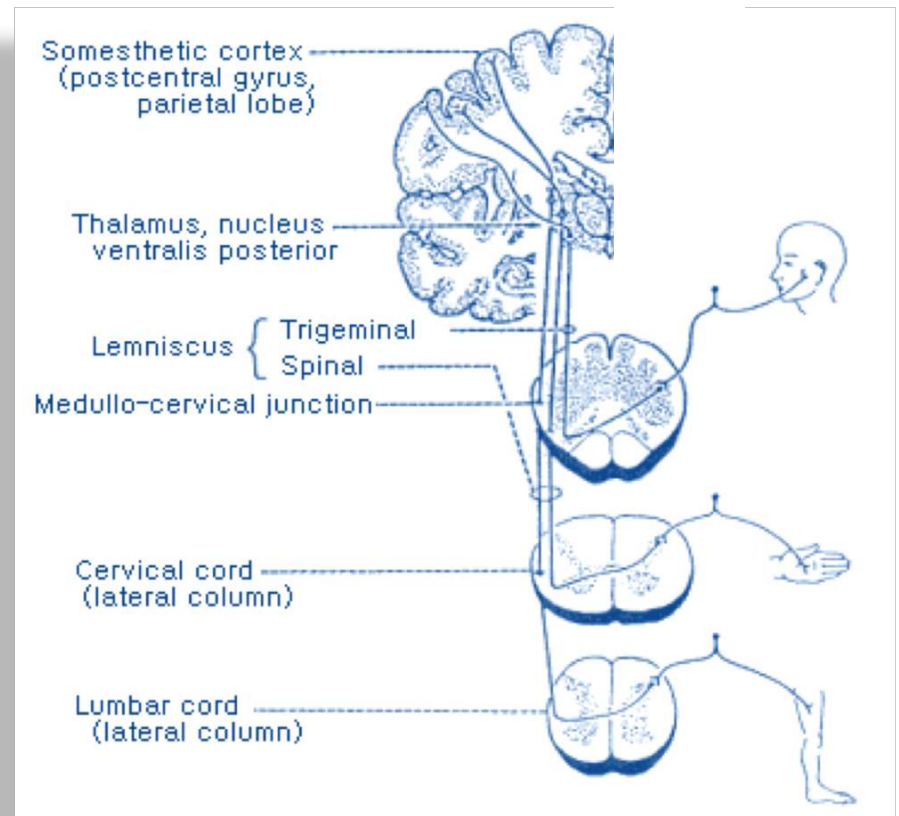
A. REPRESENTATION OF DIFFERENT BODY PARTS IN THE SOMATOSENSORY CORTEX. THE FACE AND HANDS ARE OVERREPRESENTED. B. THE SENSORY HOMUNCULUS. C. ILLUSTRATION OF THE WHISKER BARREL FIELDS OF THE RODENT BRAIN

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COMPARISON OF THE TWO SENSORY SYSTEMS



THE MEDIAL LEMNISCUS SYSTEM



THE SPINOTHALAMIC SYSTEM

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SOMATIC SENSATIONS TRANSMITTED BY THE TWO SENSORY SYSTEMS

MEDIAL LEMNISCUS	SPINOTHALAMIC
TOUCH SENSATIONS WITH HIGH DEGREE OF LOCALIZATION OF THE STIMULUS	PAIN
TOUCH SENSATIONS REQUIRING TRANSMISSION OF FINE GRADIENTS OF INTENSITY	CRUDE TOUCH AND PRESSURE SENSATIONS
SENSATIONS THAT SIGNAL MOVEMENT OCCURS AGAINST THE SKIN	THERMAL SENSATIONS (COLD, WARM)
PHASIC SENSATION (VIBRATION)	SEXUAL SENSATIONS
POSITION SENSATIONS (KINAESTHESIA)	TICKLE SENSATION
PRESSURE SENSATIONS, FINE DEGREES OF JUDGMENT OF PRESSURE INTENSITY	ITCH SENSATION

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PAIN SENSATION



THE PAIN PATHWAY OF DESCARTES

TISSUE DAMAGE EVOKES ACUTE OR CHRONIC PAIN WHICH IS AN UNPLEASANT SENSORY AND EMOTIONAL EXPERIENCE. IT NEGATIVELY INFLUENCES THE QUALITY OF LIFE. PAIN KILLING IS A PRIMARY OBLIGATION OF MEDICAL PRACTICE. PAINFUL EVENTS ARE CATEGORIZED ACCORDING TO DURATION, SEVERITY, ANATOMICAL LOCATION, BODY SYSTEM INVOLVED, CAUSE, TEMPORAL FEATURES AND THE NEUROCHEMICAL MECHANISMS INVOLVED

IN 1962, MELZACK AND WALL INTRODUCED THE PAIN GATE THEORY. ACCORDING TO THAT THE PROJECTING NEURONS CARRYING TISSUE DAMAGE/PAIN-RELATED INFORMATION TO HIGHER PROCESSING SENSORY CENTERS ARE CONTROLLED LOCALLY IN THE GREY MATTER BY INCOMING INFORMATION OF NON-NOXIOUS STIMULI, THESE ARRIVE FROM THE SEGMENTAL LEVEL VIA THICK, MYELINATED FIBERS OF MECHANORECEPTORS AND ALSO TRACTS DESCENDING FROM THE BRAIN STEM. OPENING OF THE PAIN GATE AND PAIN THRESHOLD LEVEL SEEM TO DEPEND ON THE ACTUAL BALANCE OF INFORMATION SUPPLIED BY THESE, MULTIPLE SYSTEMS

