Development of Complex Curricula for Molecular Bionics and Infobionics Programs within a consortial* framework**

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**Molekuláris bionika és Infobionika Szakok tananyagának komplex fejlesztése konzorciumi keretben

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BASICS OF NEUROBIOLOGY

Neurobiológia alapjai

FLEXOR AND AUTONOMIC REFLEXES

(Flexor és vegetatív reflexek)

ZSOLT LIPOSITS

THE FLEXOR REFLEX

THE REFLEX IS ASSOCIATED WITH THE OPERATION OF THE LIMBS

IT IS A PROTECTIVE REFLEX. IN RESPONSE TO PAINFUL STIMULI THE LIMB IS WITHDRAWN

ANATOMICALLY THE WITHDRAWAL MEANS THE FLEXURE OF THE LIMB, IN OTHER WORDS SHORTENING

THE SHORTENING OF THE LIMB ON ONE SIDE GENERALLY EVOKES A COMPENSATORY MECHANISM THAT EXTENDS THE LIMB ON THE OTHER SIDE, THEREFORE, THE REFLEX IS ALSO REFERRED TO AS FLEXOR-CROSSED EXTENSOR REFLEX

A FREQUENTLY USED SYNONYM IS THE NOCICEPTIVE REFLEX. THE TERM EXPRESSES THE NOXIOUS NATURE OF THE STIMULUS

IT IS A POLYSYNAPTIC REFLEX ARC THAT MODIFIES BOTH THE IPSI- AND THE CONTRALATERAL LIMBS

SPECIFIC FEATURES OF THE FLEXOR CROSSED EXTENSOR REFLEX

STIMULUS. CRUDE AND DANGEROUS STIMULI THAT CAN DESTROY THE INTEGRITY OF THE AFFECTED TISSUES OF THE LIMB. NOXIOUS PAIN AND THERMAL STIMULI ARE THE TRIGGERS

RECEPTOR. HEAT AND PAIN RECEPTORS IN THE SKIN

AFFERENT PATH. THIN, MYELINATED AND UNMYELEINATED AXONS OF PSEUDO-UNIPOLAR CELLS OF SPINAL GANGLIA

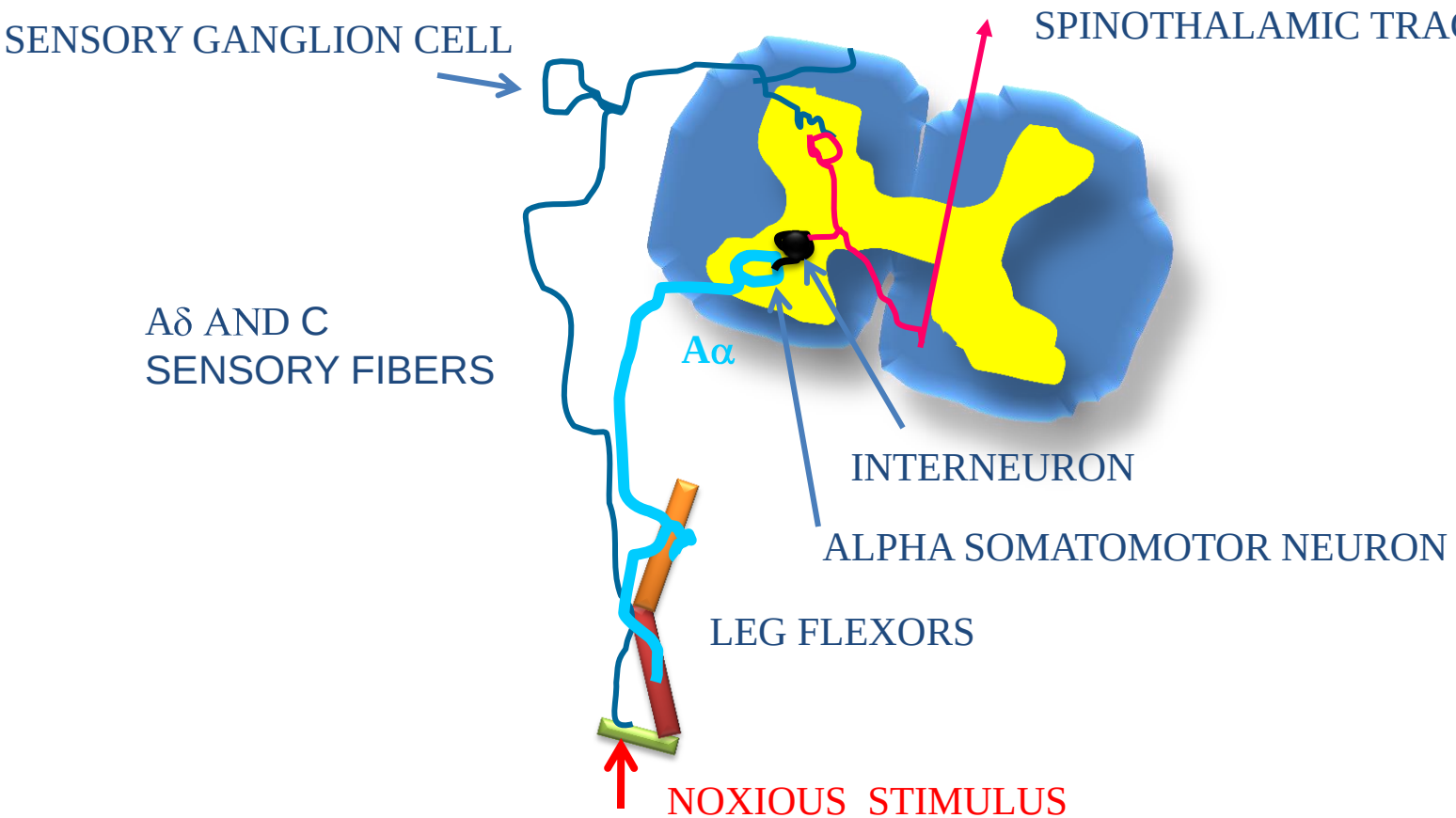
CENTER. SPINAL CORD, DORSAL AND VENTRAL HORNS, INVOLVEMENT OF INTERNEURONS

EFFERENT PATH. AXONS OF ALPHA MOTONEURONS INNERVATING FLEXOR MUSCLES OF THE LIMB IPSILATERALLY AND AXON PROJECTIONS FROM CONTRALATERALLY LOCATED MOTONEURONS INNERVATING EXTENSORS OF THE LIMB ON THE OPPOSITE SIDE TO THE STIMULUS

EFFECTOR STRUCTURE. EXTRAFUSAL MUSCLE FIBERS OF THE INVOLVED MUSCLES

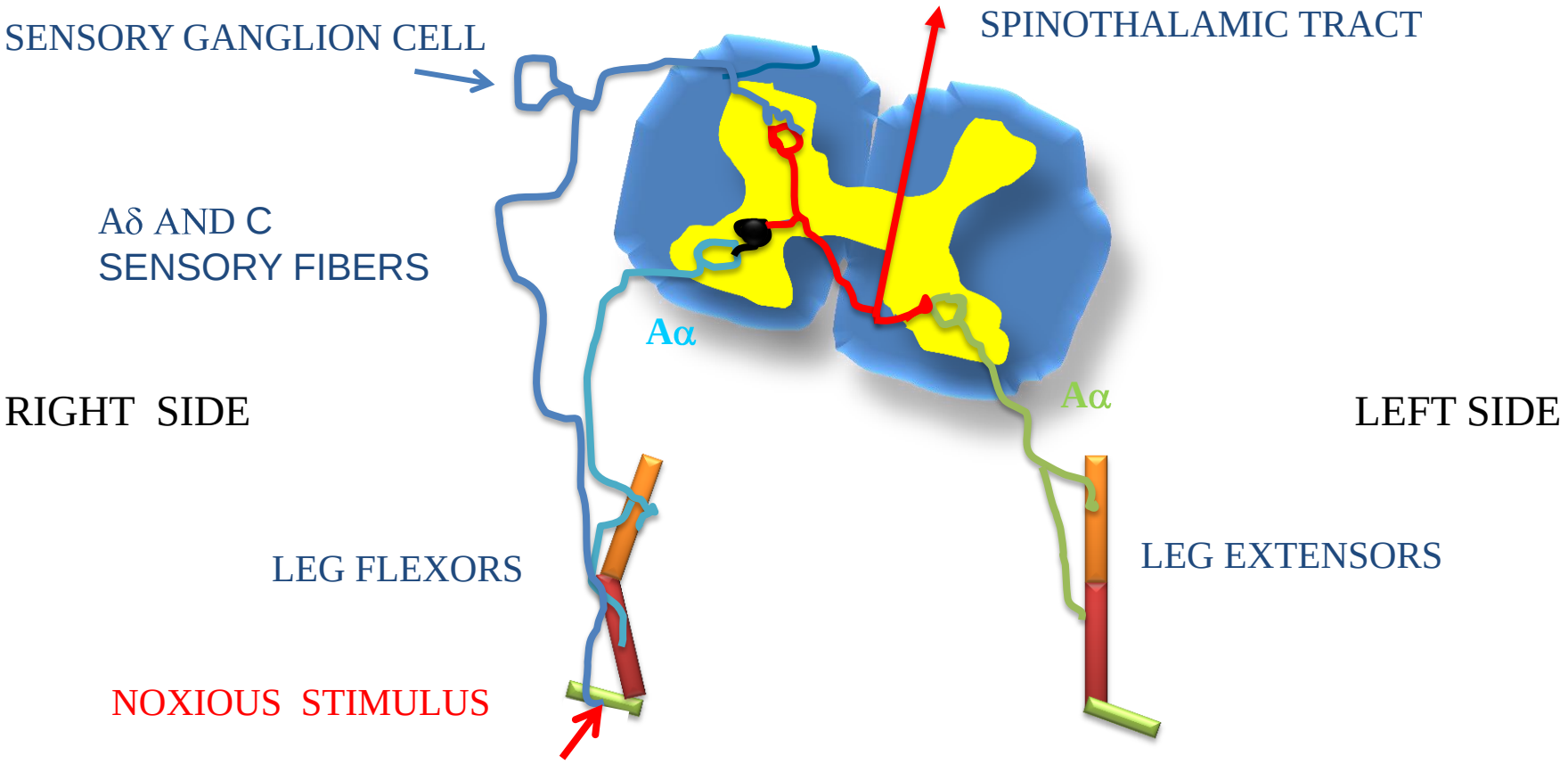
ACTIONS. IPSILATERAL FLEXION AND CONTRALATERAL EXTENSION

SCHEMATIC ILLUSTRATION OF THE WITHDRAWAL REFLEX



A PAINFUL STIMULUS CAUSES THE FLEXION OF THE LIMB, IT IS AN ESCAPE MECHANISM FROM THE TISSUE DAMAGING STIMULUS (HEAT, PAIN). NOTE THE POLYSYNAPTIC CHARACTER

DEMONSTRATION OF THE FLEXOR AND CROSSED EXTENSOR REFLEX



APPROXIMATELY 0.2-0.5 SECOND AFTER THE ACTION OF THE NOXIOUS STIMULUS, THE OPPOSITE LIMB EXTENDS. THIS EXTENSOR MECHANISMS PUSHES AWAY THE BODY FROM THE DANGEROUS OBJECT CAUSING THE STIMULUS

THE AUTONOMIC REFLEX

THE OPERATION OF THE VISCERAL ORGANS IS MODULATED BY THE AUTONOMIC NERVOUS SYSTEM

ACCORDINGLY, SENSORY VISCERAL AFFERENTS CONVEY INFORMATION TO THE CENTERS OF THE CNS FROM RECEPTORS DISTRIBUTED IN THE ORGANS

THE BRAIN STEM AND THE SPINAL CORD REGULATE THE MOTOR ACTIVITY (SMOOTH OR CARDIAC MUSCLE CONTRACTION) OF THE ORGANS VIA VISCERO-MOTOR EFFERENTS

THE VISCEROMOTOR INNERVATION IS INDIRECT AND CONSISTS OF TWO UNITS:
1. PREGANGLIONIC MOTOR NEURONS RESIDING IN THE CNS
2. GANGLIONIC MOTOR NEURONS DISTRIBUTED AT THE PERIPHERY. THEY TRANSMIT CENTRAL INFORMATION TO TARGET ORGANS

THE ORGANS RECEIVE A DUAL VISCEROMOTOR INNERVATION BY GETTING SUPPLY FROM BOTH SYMPATHETIC AND PARASYMPATHETIC SOURCES

THE CENTRAL NERVOUS SYSTEM UTILIZES THE AUTONOMIC REFLEX ARC FOR EXECUTING MODULATORY ACTIONS IN RESPONSE TO INCOMING VISCERAL STIMULI (PAIN, HEAT, PRESSURE)

SPECIFIC FEATURES OF THE AUTONOMIC REFLEX

STIMULUS. CHANGE IN PRESSURE, ALTERATION OF CHEMICAL MILIEU, INFLAMMATION RELATED PAIN AND HEAT, DISTENSION OF LUMINAL VISCERA

RECEPTOR. BARORECEPTOR, CHEMORECEPTOR, MECHANORECEPTOR, HEAT RECEPTOR

AFFERENT PATH. PROCESSES OF PSEUDOUNIPOLAR CELLS OF SPINAL GANGLIA

CENTER. SPINAL CORD AND BRAIN STEM

EFFERENT PATH. 1. PREGANGLIONIC NEURONS PROJECTING FROM THE INTERMEDIOLATERAL NUCLEUS TO THE PERIPHERAL AUTONOMIC GANGLIA. 2. PROCESSES OF VISCERAL GANGLION CELLS PROJECTING TO THE ORGANS

EFFECTOR STRUCTURE. CARDIAC MUSCLE (FOR HEART) AND SMOOTH MUSCLE (FOR OTHER ORGANS)

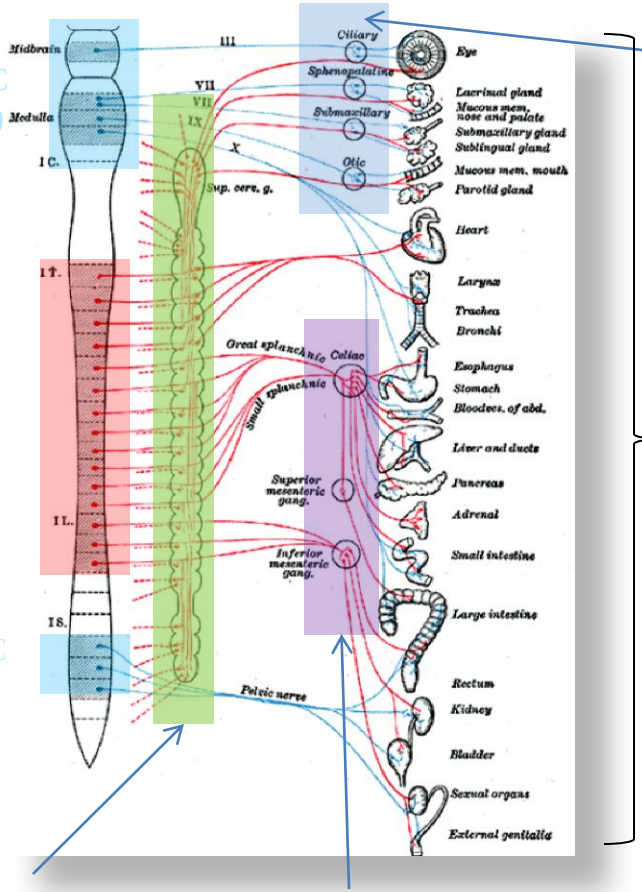
ACTIONS. MODULATION OF VISCERAL FUNCTIONS (PACEMAKER ACTIVITY IN HEART, LUMEN OF BLOOD VESSELS, SMOOTH MUSCLES OF BRONCHI, THE SECRETION OF GLANDS, PERISTALTIC MOVEMENT OF THE GI TRACT)

STRUCTURAL ORGANIZATION OF THE AUTONOMIC NERVOUS SYSTEM

PARASYMPATHETIC CENTER (CRANIAL)

SYMPATHETIC CENTER

PARASYMPATHETIC CENTER (SACRAL)



PARASYMPATHETIC GANGLIA (FOR ORGANS OF HEAD)

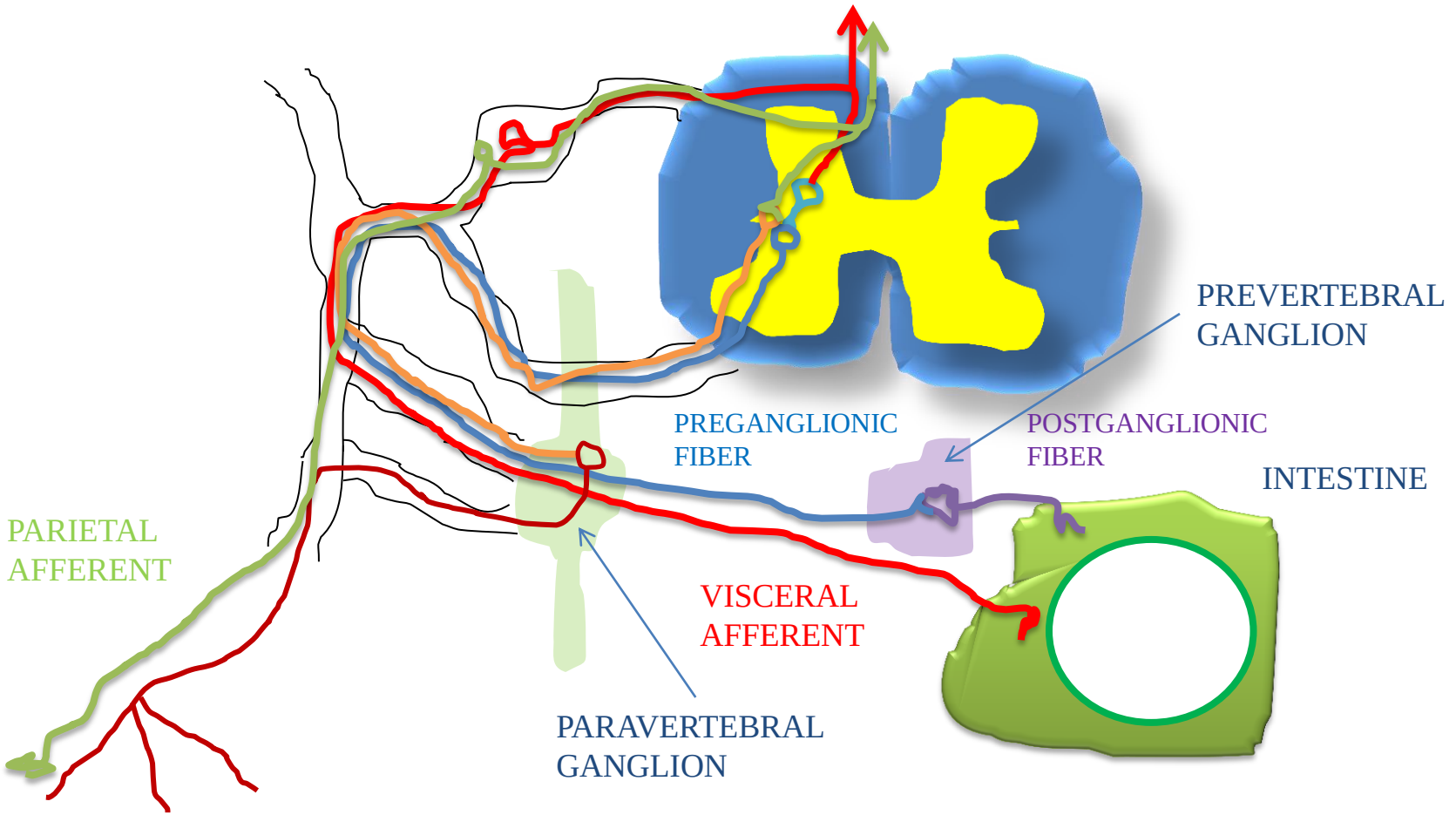
VISCERAL ORGANS

NOTE, THAT PARASYMPATHETIC GANGLIA OF THORACIC AND ABDOMINAL ORGANS ARE EMBEDDED INTO THE WALL OF THE VISCERA

PARAVERTEBRAL GANGLIA (SYMPATHETIC)

PREVERTEBRAL GANGLIA (SYMPATHETIC)

THE SCHEME OF VISCERAL AND PARIETAL SYMPATHETIC INNERVATION



SUDOMOTOR, PILOARRECTOR, VASOMOTOR

INFORMATION FLOW IN VISCERAL AND PARIETAL SYMPATHETIC REFLEX ARCS

VISCERAL

SENSORY STIMULUS GENERATED IN THE ORGAN --- PRIMARY VISCERAL AFFERENTS CARRY THE INFORMATION TO THE DORSAL HORN --- TRANSFER OF INFORMATION TO INTERNEURONS --- TRANSFER OF INPUT TO VISCERAL SOMATOMOTOR NEURONS --- PREGANGLIONIC EFFERENT PROJECTION TO THE PREVERTEBRAL GANGLION --- INNERVATION OF GANGLIONIC CELLS --- PROJECTION OF GANGLION NEURONS TO EXECUTIVE STRUCTURE (SMOOTH MUSCLE) --- CHANGE IN CONTRACTION STATE OF SMOOTH MUSCLE

PARIETAL

SENSORY STIMULUS TO THE SKIN --- PRIMARY PARIETAL AFFERENTS OF DORSAL ROOT GANGLION CELLS CONVEY INFORMATION TO THE POSTERIOR HORN --- INFORMATION TRANSFER TO INTERNEURONS --- TRANSFER OF INPUT TO PREGANGLIONIC NEURONS OF THE LATERAL HORN --- PREGANGLIONIC EFFERENTS TO CELLS OF THE PARAVERTEBRAL GANGLION --- INFORMATION TRANSFER TO PARAVERTEBRAL NEURONS --- POSTGANGLIONIC AFFERENTS TO BLOODS VESSELS, HAIR AND SWEAT (SUDOR) GLANDS OF THE SKIN