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

Consortium leader

PETER PAZMANY CATHOLIC UNIVERSITY

Consortium members

SEMMELWEIS UNIVERSITY, DIALOG CAMPUS PUBLISHER

The Project has been realised with the support of the European Union and has been co-financed by the European Social Fund ***

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

***A projekt az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósul meg.

BASICS OF NEUROBIOLOGY

Neurobiológia alapjai

STRETCH REFLEX

(Nyújtási reflex)

ZSOLT LIPOSITS

FEATURES OF REFLEXES

THE REFLEX IS A RAPID, INVOLUNTARY NEURONAL REGULATORY ACTION EXECUTED IN RESPONSE TO SENSORY STIMULI

IT IS ASSOCIATED WITH NEURONAL ASSEMBLIES OF SPINAL SEGMENTS AND CRANIAL NERVE NUCLEI

IT ENSURES THE ADAPTATION OF THE BODY TO EXTERNAL AND INTERNAL ENVIRONMENTS AND THE CONTINUOUSLY CHANGING CHALLENGES

REFLEXES ARE USED IN THE REGULATION OF BOTH SOMATIC AND VISCERAL FUNCTIONS

SOME REFLEXES ARE INNATE, OTHERS ARE LEARNED ONES

THE REFLEX MECHANISM STRUCTURALLY IS ORGANIZED IN THE REFLEX ARC

THE EXAMINATION OF THE DIFFERENT REFLEXES GIVES PLENTY OF INFORMATION TO THE PHYSICIAN ABOUT THE OPERATION OF THE SENSORY, SOMATO-MOTOR AND VISCERO-MOTOR SYSTEMS

THE REFLEX ARC

REFLEXES ARE EXECUTED VIA REFLEX ARCS

EACH REFLEX ARC HAS FIVE MAIN STRUCTURAL CONSTITUENTS:

1. RECEPTOR. IT PICKS UP THE INFORMATION FROM THE INTERNAL AND EXTERNAL ENVIRONMENTS IN FORMS OF PHYSICAL AND CHEMICAL STIMULI

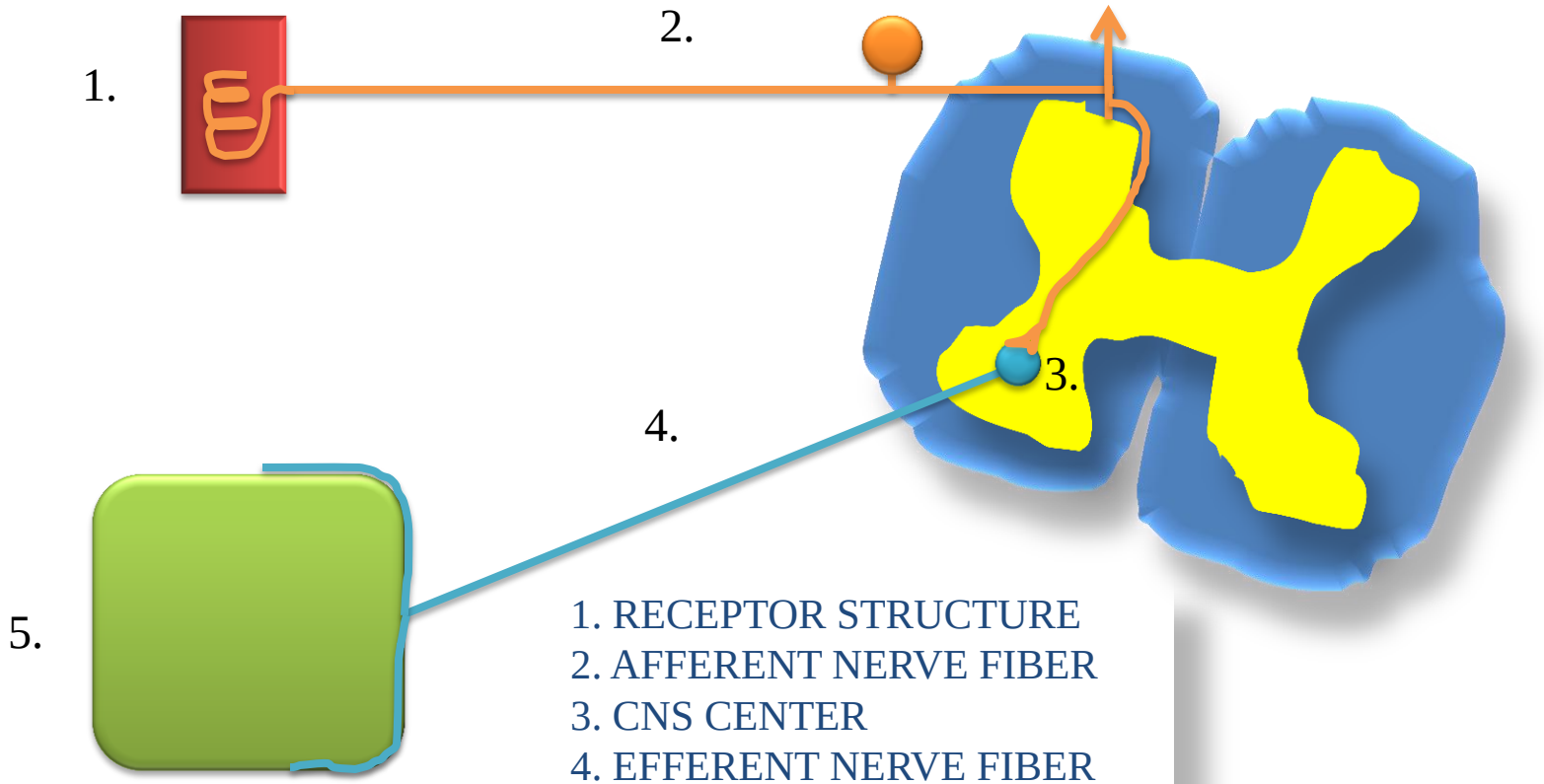
2. AFFERENTS. THESE ARE SENSORY NERVES THAT ARE LINKED WITH THE RECEPTORS AND CARRY THE STIMULUS-EVOKED INFORMATION TO THE PROCESSING CENTER. IN CASE OF SPINAL REFLEXES, NEURONS OF THE DORSAL ROOT GANGLIA SERVE THE ROLE OF AFFERENTS BY THEIR PROCESSES INTERCONNECTING THE RECEPTORS WITH THE GREY MATTER OF THE SPINAL CORD

3. CENTER. PART OF THE SPINAL CORD OR BRAINSTEM THAT HANDLES, PROCESSES THE INCOMING SENSORY INFORMATION

4. EFFERENTS. SOMATOMOTOR OR VISCEROMOTOR NERVES THAT CONVEY THE GENERATED ADAPTIVE RESPONSE TO THE SITE OF THE COMPENSATORY ACTION

5. EFFECTOR. THESE UNITS EXECUTE THE REGULATORY COMMANDS

SCHEMATIC ILLUSTRATION OF THE REFLEX ARC



1. RECEPTOR STRUCTURE
2. AFFERENT NERVE FIBER
3. CNS CENTER
4. EFFERENT NERVE FIBER
5. EFFECTOR STRUCTURE

THE STRETCH REFLEX

MUSCLE LENGTH AND MUSCLE TONE ARE IMPORTANT FEATURES OF MUSCLE FUNCTION AND THEIR REGULATION IS A KEY FACTOR IN MOVEMENTS

THEY ARE CONTROLLED BY THE STRETCH REFLEX

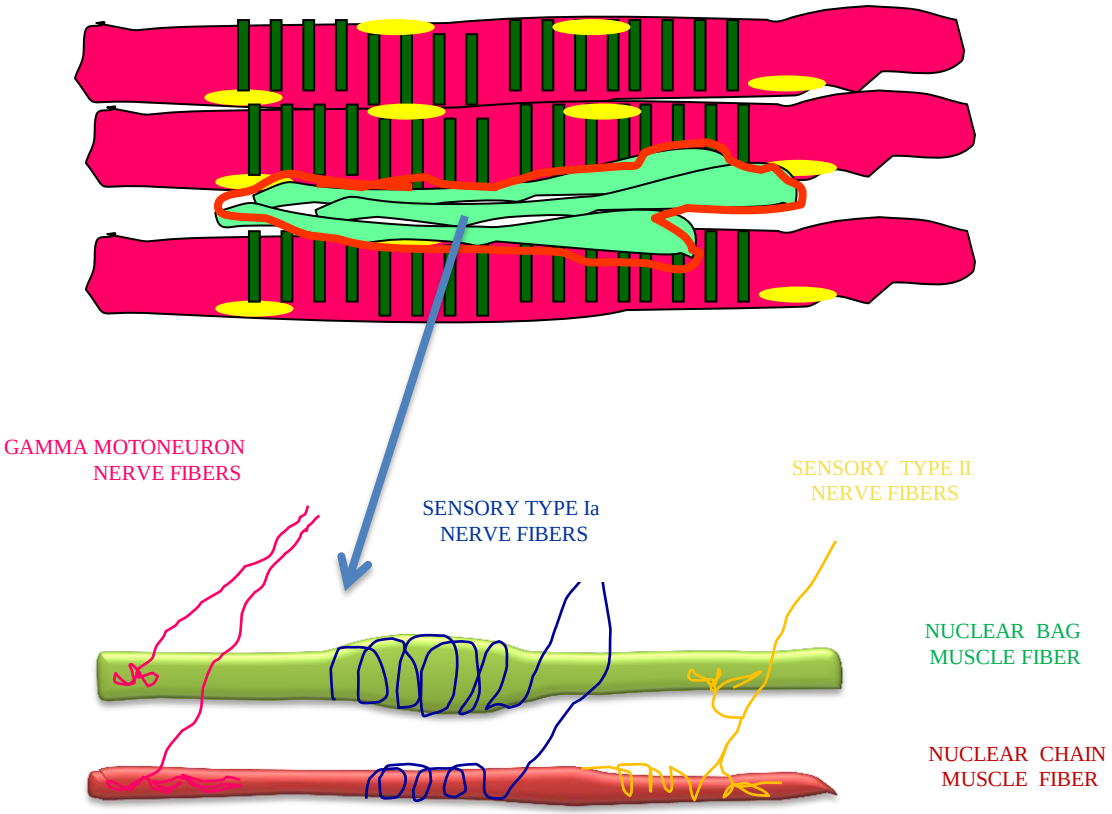
SYNONYMS FOR STRETCH REFLEX ARE MYOTATIC REFLEX OR PROPRIOCEPTIVE REFLEX

IT IS A MONOSYNAPTIC, POSTURAL REFLEX THAT AMONG OTHERS WORKS AGAINST THE GRAVITY FORCE

CHARACTERISTICS OF THE REFLEX INCLUDE:

1. STIMULUS: STRETCHING OF THE MUSCLE
2. RECEPTOR: MUSCLE SPINDLE, INTRAFUSAL MUSCLE FIBERS, NUCLEAR BAG AND NUCLEAR CHAIN RECEPTORS
3. AFFERENT PATH: Ia AND II TYPE NERVE FIBERS OF SENSORY GANGLION CELLS
4. CENTER. SPINAL CORD, VENTRAL HORN, SOMATOMOTOR NEURONS (ALPHA TYPE)
5. EFFERENT PATH: AXONS OF ALPHA MOTONEURONS
6. EFFECTOR STRUCTURE: EXTRAFUSAL MUSCLE FIBERS OF THE MUSCLE
7. COMPENSATORY ACTION: SHORTENING OF THE MUSCLE

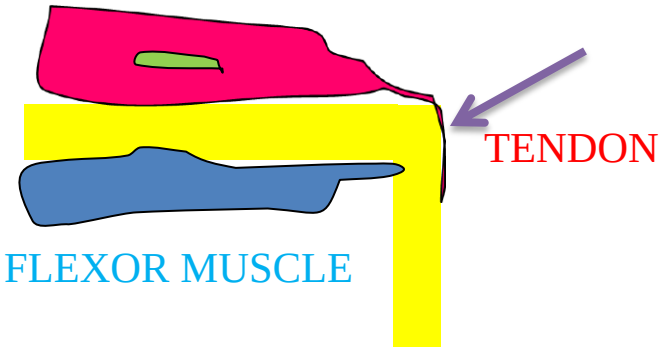
THE RECEPTOR STRUCTURE OF THE STRETCH REFLEX

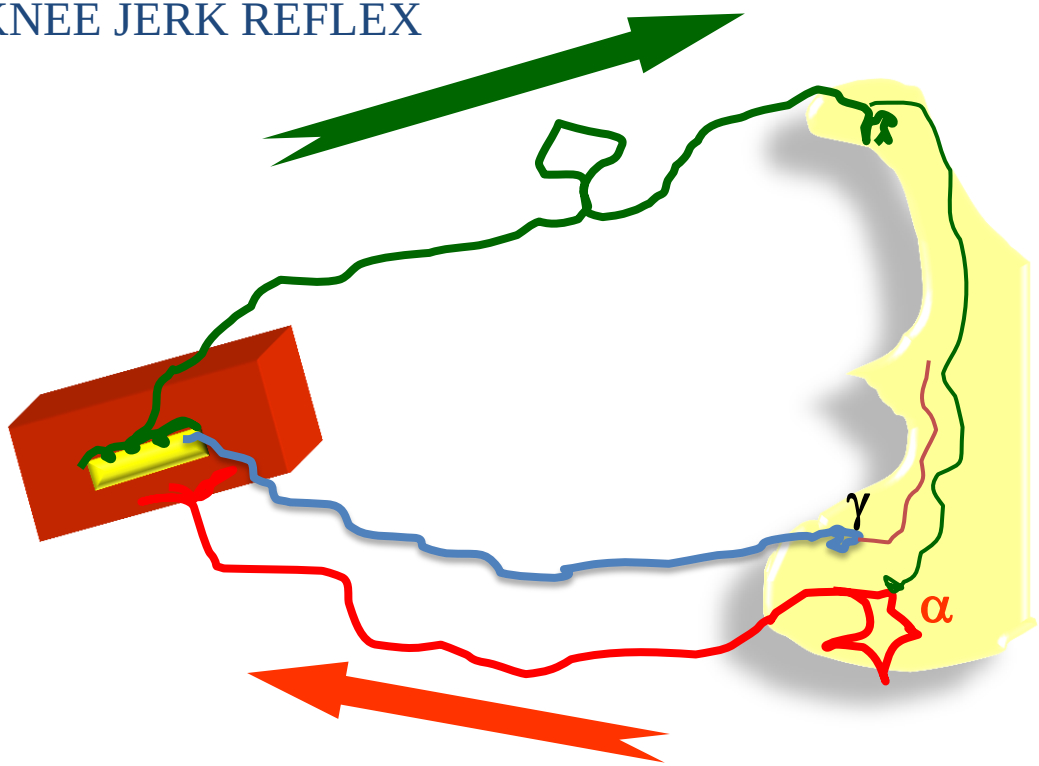


INNERVATION OF THE MUSCLE SPINDLE, THE RECEPTOR STRUCTURE OF THE MYOTATIC REFLEX. STATIC AND DYNAMIC RESPONSES

EXTENSOR MUSCLE

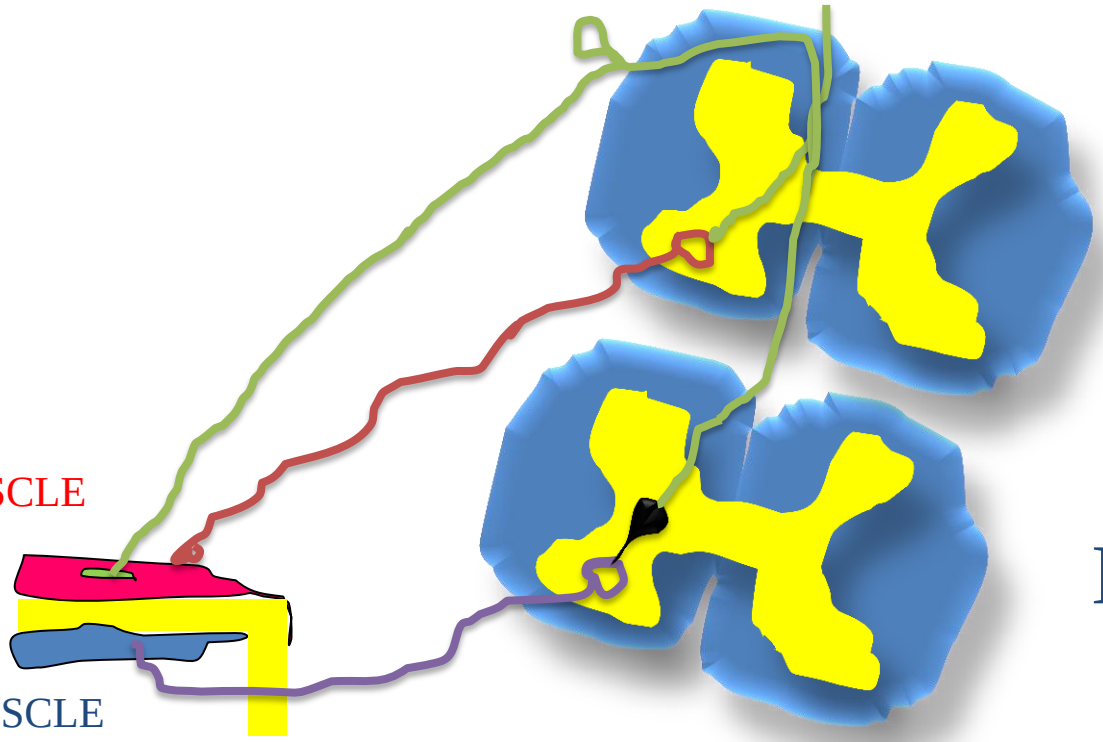
THE KNEE JERK REFLEX





A SHARP TAP ON THE TENDON OF THE EXTENSOR MUSCLE STRETCHES IT, EVOKING THUS THE ACTIVATION OF THE MUSCLE SPINDLE. THIS INFORMATION IS RELAYED VIA A MONOSYNAPTIC CONNECTION TO ALPHA MOTONEURONS IN THE SPINAL CORD. THE EFFERENT FIBERS FORCE THE EXTENSOR FOR CONTRACTION. THE REFLEX MAINTAINS THE PROPER CONSTANT LENGTH OF THE MUSCLE

INHIBITION OF THE ANTAGONIST MUSCLES



AS A RESULT OF THE KNEE JERK REFLEX, THE QUADRICEPS FEMORIS EXTENSOR MUSCLE UNDERGOES CONTRACTION. SIMULTANEOUSLY, THE DESCENDING AFFE-RENTS INHIBIT - VIA INTERNEURONS- THE ALPHA MOTONEURONS THAT SUPPLY THE ANTAGONIST FLEXOR MUSCULATURE

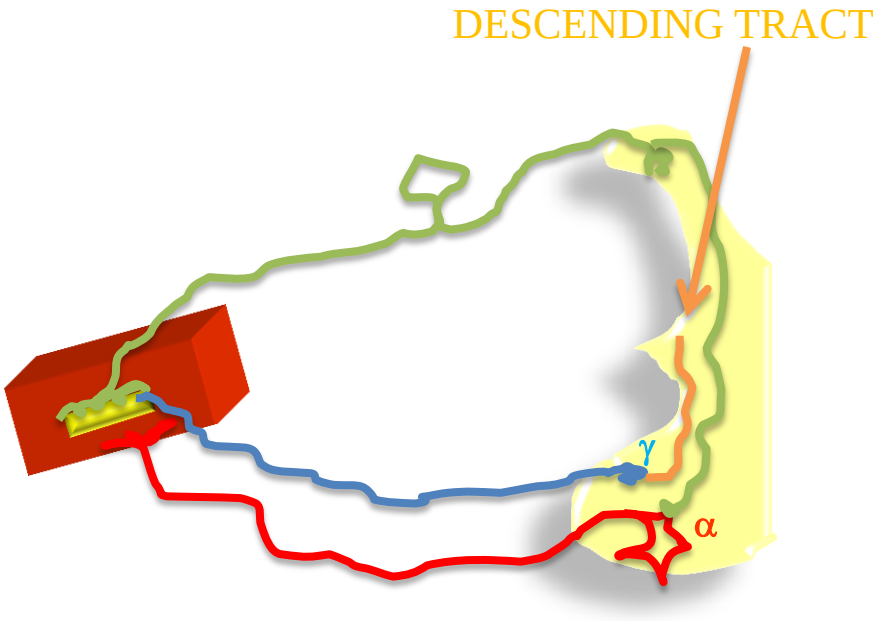
THE GAMMA REFLEX LOOP

THE ANTERIOR HORN IN ADDITION TO ALPHA MOTONEURONS ALSO CONTAINS SMALLER-SIZED CELLS, THE GAMMA MOTONEURONS

GAMMA MOTONEURONS INNERVATE THE INTRAFUSAL MUSCLE FIBERS OF THE MUSCLE SPINDLE RECEPTOR

DESCENDING TRACTS (CORTICOSPINAL, RUBROSPINAL, RETICULOSPINAL) EXCITE GAMMA MOTONEURONS CAUSING CONTRACTION OF THE INTRAFUSAL FIBERS

AS A RESULT, THE INCREASED FIRING FROM SENSORY ENDINGS INFORMS THE ALPHA MOTONEURONS THAT WILL MAKE AN ADJUSTMENT OF THE MUSCLE LENGTH



GAMMA MOTONEURONS CAN ADJUST THE LEVEL OF SENSITIVITY OF MUSCLE SPINDLE RECEPTOR FIBERS, INITIATE CONTRACTION ACCORDING TO HIGHER MOTONEURON COMMANDS AND SET THE MUSCLE TONE