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

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

BASICS OF NEUROBIOLOGY

Neurobiológia alapjai

THE NEURON

(IDEGSEJT)

ZSOLT LIPOSITS

STRUCTURE AND FUNCTION OF THE CELL BODY

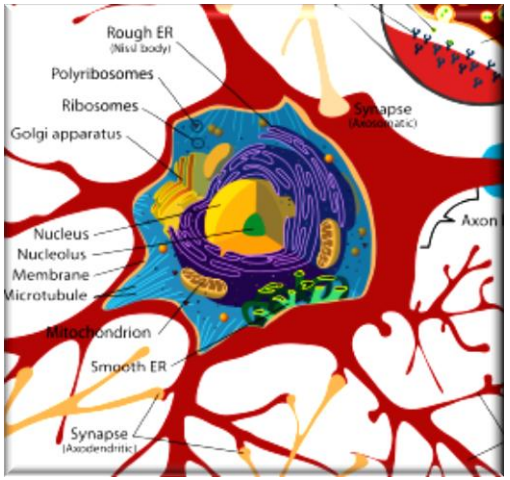
PERIKARYA ARE 10-100 MICROMETER WIDE IN DIAMETER

THE NUCLEUS HAS A CENTRAL LOCATION AND CONTAINS 1-2 PROMINENT NUCLEOLI

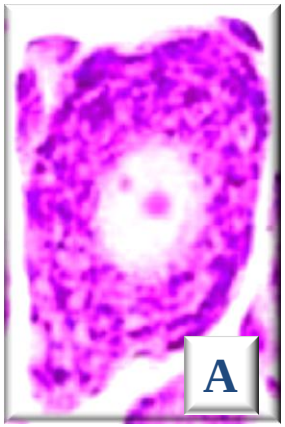
IN LIGHT MICROSCOPIC (LM) PREPARATIONS, THE NUCLEUS HAS A PALE STAINING IN COMPARISON WITH THE CYTOPLASM. THE NUCLEOLUS SHOWS A STRONG BASOPHILIC STAINING

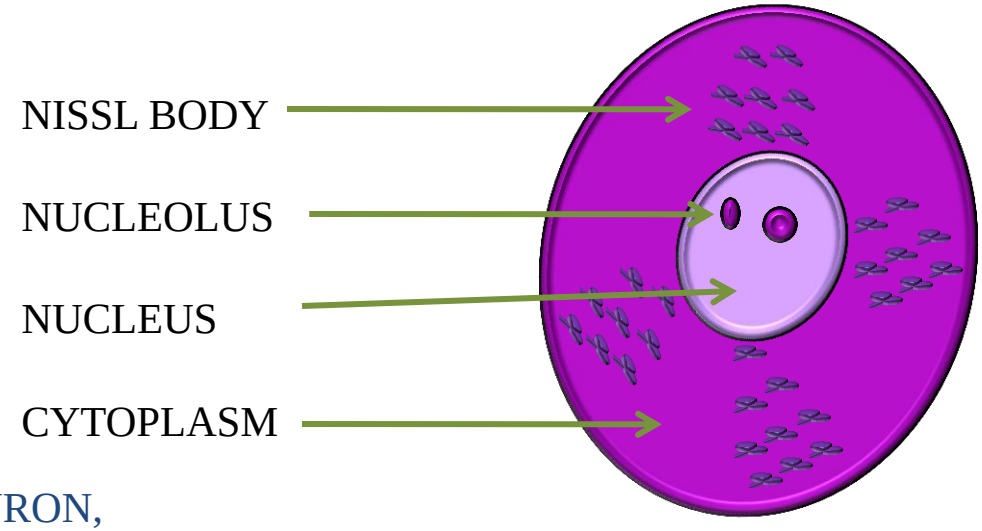
THE CYTOPLASM AROUND THE NUCLEUS CONTAINS WELL-DEVELOPED ROUGH ENDOPLASMIC RETICULUM SYSTEM UNITS CALLED NISSL BODIES. THE STRONG BASOPHILIA OF THE CYTOPLASM IS DUE TO ITS HIGH RIBONUCLEIC ACID CONTENT

FREE RIBOSOMES, RER AND GOLGI COMPLEXES TAKE PART IN THE PRODUCTION AND SORTING OF PROTEINS

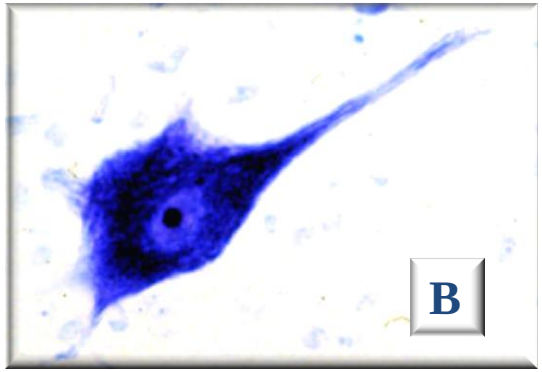


LIGHT MICROSCOPIC FEATURES OF THE PERIKARYON



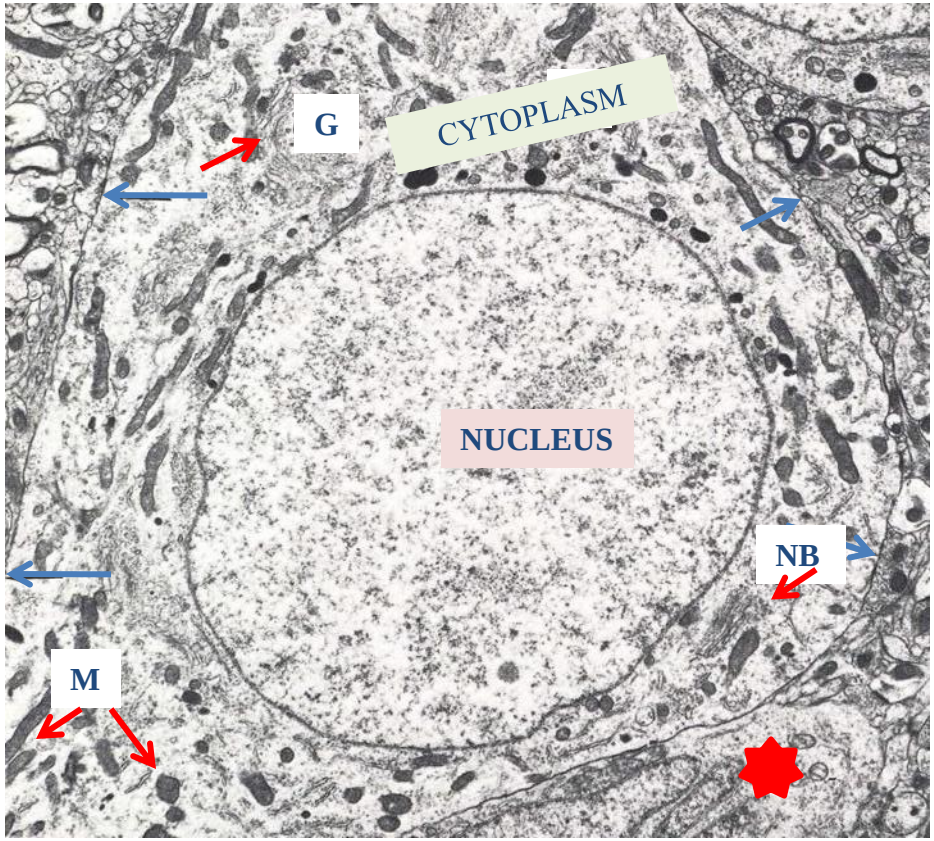


A. SPINAL GANGION NEURON, HEMATOXYLIN-EOSIN STAINING



B. SPINAL MOTONEURON, TOLUIDINE BLUE STAINING. NOTE, THE PRESENCE OF THE STAIN IN THE PROXIMAL DENDRITES INDICATING RIBOSOMES AND PROTEIN SYNTHESIS

ULTRASTRUCTURE OF THE NEURONAL CELL BODY



NUCLEUS DISPLAYS HETERO- AND EUCHROMATIN. PROMINENT NUCLEAR MEMBRANE.

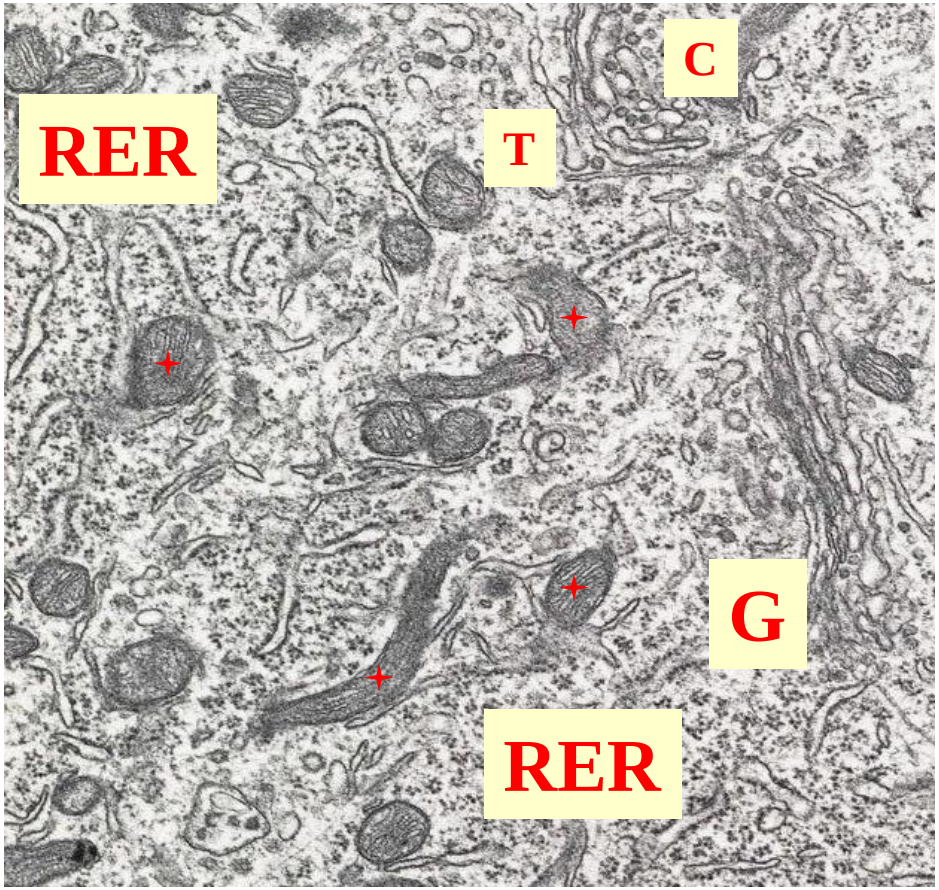
CYTOPLASM CONTAINS GOLGI COMPLEX (G), MANY MITOCHONDRIA AND NISSL BODIES (NB).

CELL MEMBRANE IS INDICATED BY BLUE ARROWS

A NEIGHBORING CELL IS SHOWN BY A STAR

BUNDLES OF DENDRITES, AXONS AND GLIAL PROCESSES ARE PRESENT IN THE VICINITY OF THE CELLS

HIGH POWER DETAIL OF NEURONAL ORGANELLES



CLUSTERING MITOCHONDRIA (STAR) PROVIDE ENERGY FOR CELLULAR ACTIONS

WITHIN THE ROUGH ENDOPLASMIC RETICULUM (RER), BOTH THE FLATTENED CISTERNAE AND THE RIBOSOMES ARE VISIBLE

THE GOLGI COMPLEX (G) IS ACTIVE. THE TRANS (T) AND CIS (C) FACES ARE DISTINGUISHABLE

THE CRISTAE ARE OBVIOUS IN MOST MITOCHONDRIA

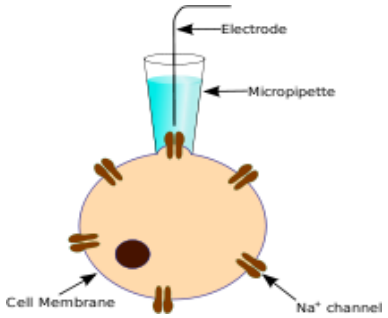
STUDYING THE ION CHANNELS OF THE NEURAL MEMBRANE *IN VITRO* BY PATCH CLAMP ELECTROPHYSIOLOGY

GLASS ELECTRODE WITH A TIP OF 1 MICROMETER IS FILLED WITH SPECIAL ELECTROLYTE SOLUTION

THE SMOOTH ELECTRODE TIP IS PLACED ON THE CELL MEMBRANE UNDER MICROSCOPIC CONTROL AND A SEAL IS MADE

CHLORIDED SILVER ELECTRODE PICKS UP THE CURRENTS AND SENDS THEM TO THE AMPLIFIER

ERWIN NEHER AND BERT SAKMANN DEVELOPED THE TECHNIQUE, THEY RECEIVED NOBEL PRIZE IN 1991.



TYPES OF APPLICATION

CELL ATTACHED
WHOLE-CELL
INSIDE-OUT
OUTSIDE-OUT
PERFORATED
LOOSE

DENDRITES

MOST NEURONS HAVE MULTIPLE DENDRITES THAT ARE CONTINUOUS WITH THE CYTOPLASM

DENDRITES BRANCH NEAR THE PERIKARYON RESULTING IN PRIMARY, SECONDARY AND TERTIARY UNITS

DENDRITES ESTABLISH THIN CYTOPLASMIC PROTRUSIONS CALLED DENDRITIC SPINES

DENDRITIC SHAFTS AND SPINES RECEIVE MOST OF THE INCOMING INFORMATION, THEREFORE SYNAPSING AXON TERMINALS CAN BE FOUND ON THEIR SURFACES

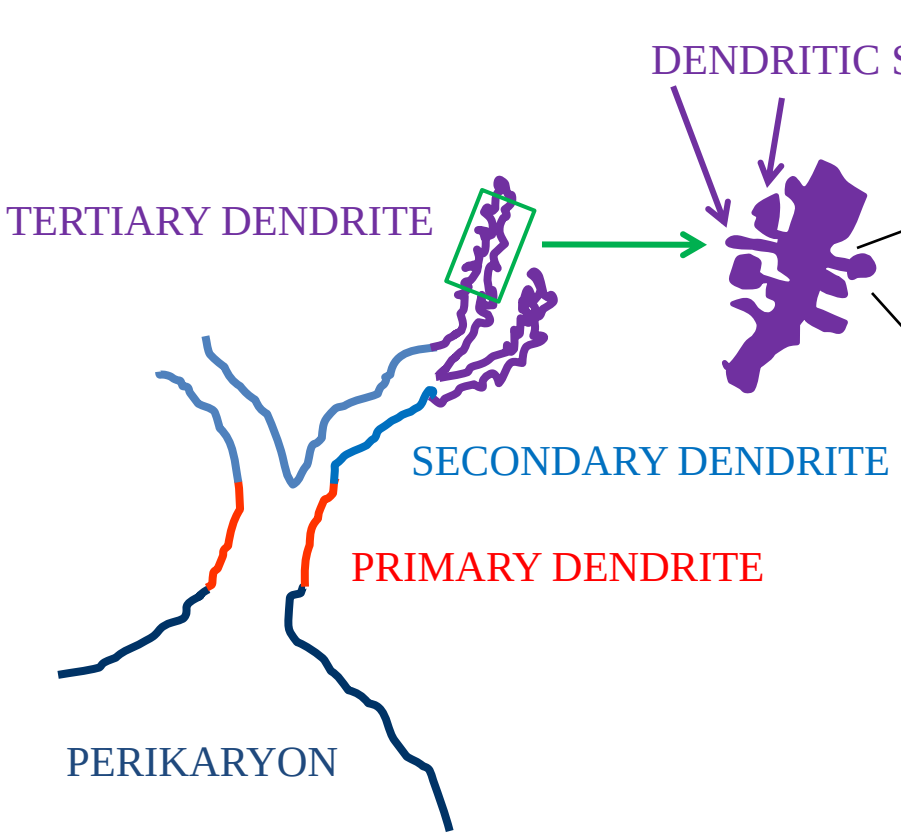
THE DENDRITIC TREE TAKES PART IN NEURONAL PLASTICITY AND REMODELING

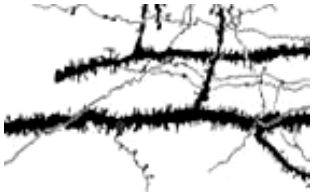
THEY CONTAIN MICROTUBULES, RER, POLYSOMES AND SPECIFIC mRNAs

THEY ARE ENRICHED IN SPECIFIC PEPTIDE AND TRANSMITTER RECEPTORS

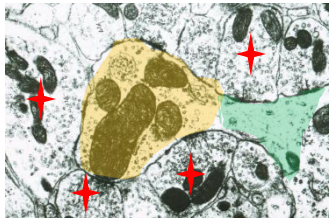
THEIR PRIMARY ROLE IS TO INTEGRATE THE INCOMING INFORMATION FROM THOUSANDS OF AXONS

BRANCHING OF DENDRITES, DENDRITIC SPINES





LIGHT MICROSCOPIC IMAGE OF SILVER IMPREGNATED DENDRITES OF PYRAMIDAL NEURONS. NOTE THE ABUNDANCE OF SPINES



ELECTRON MICROGRAPH ILLUSTRATES THE NECK AND HEAD OF A DENDRITIC SPINE. THE STRUCTURE IS COVERED BY AXON BOUTONS (ASTERISKS)

ULTRASTRUCTURE OF DENDRITIES

THE PICTURE DEPICTS A CELLBODY-FREE REGION OF THE NEURAL TISSUE CALLED NEUROPIL

IN THE NEUROPIL, LONGITUDINALLY- AND CROSS-SECTIONED DENDRITES OF DIFFERENT CALIBERS CAN BE REVEALED

AT THIS POWER, MICROTUBULES AND MITOCHONDRIA ARE RECOGNIZABLE

DENDRITIC PROCESSES ARE LESS ELECTRON DENSE THAN AXONS (ARROWHEADS)

DENSE, BAR LIKE THICKENINGS (ARROWS) INDICATE SYNAPTIC COMMUNICATION SITES

PROPERTIES OF AXONS

THE AXONIC PROCESS APPEARS FIRST DURING DIFFERENTIATION OF NEURONS

ITS INITIAL SEGMENT, THE AXON HILLOCK, HAS A HIGH DENSITY OF ION CHANNELS

THE GENERATION OF ACTION POTENTIAL BEGINS AT THE AXON HILLOCK

MICROTUBULES DISPLAY A UNIFORM POLARITY, THE PLUS ENDS OCCUR DISTALLY

AXON COLLATERALS ARISE IN AN OBTUSE ANGEL, SIMILAR THICKNESS

AXONS CARRY SPECIALIZED PRE-SYNAPTIC MACHINERIES FOR COMMUNICATION

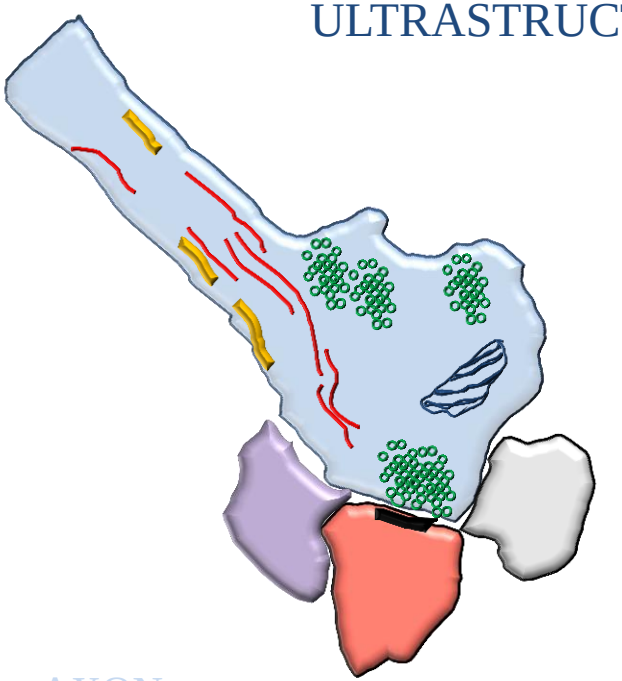
THEIR LENGTH DEPENDS ON THE SPECIES AND THE DISTANCE OF THE SERVICE SITE

NEUROFILAMENT CONTENT ALLOWS THEIR DETECTION BY SILVER IMPREGNATION

SEVERAL AXONS SHOW VARICOSITIES ALONG THEIR COURSE

THEY BRANCH AT THEIR FINAL DESTINATION, PRE-TERMINAL ARBORIZATION

ULTRASTRUCTURAL FEATURES OF THE AXON TERMINAL



AXON
MICROTUBULE
NEUROFILAMENT
MITOCHONDRION
SYNAPTIC VESICLE
POST-SYNAPTIC DENSITY
DENDRITE

THE AXON TERMINAL CONTAINS MICROTUBULES, NEUROFILAMENT BUNDLES, MITOCHONDRIA AND POOLS OF SYNAPTIC VESICLES

ITS TERMINAL ENLARGEMENT IS CALLED BOUTON

AGGREGATION OF SYNAPTIC VESICLES AT THE PRE-SYNAPTIC MEMBRANE IS INDICATIVE OF COMMUNICATION

THE SYNAPTIC ENGAGEMENTS CAN BE REVEALED BY ELECTRON MICROSCOPY

GROWING AXONS EXHIBIT CHARACTERISTIC GROWTH CONES