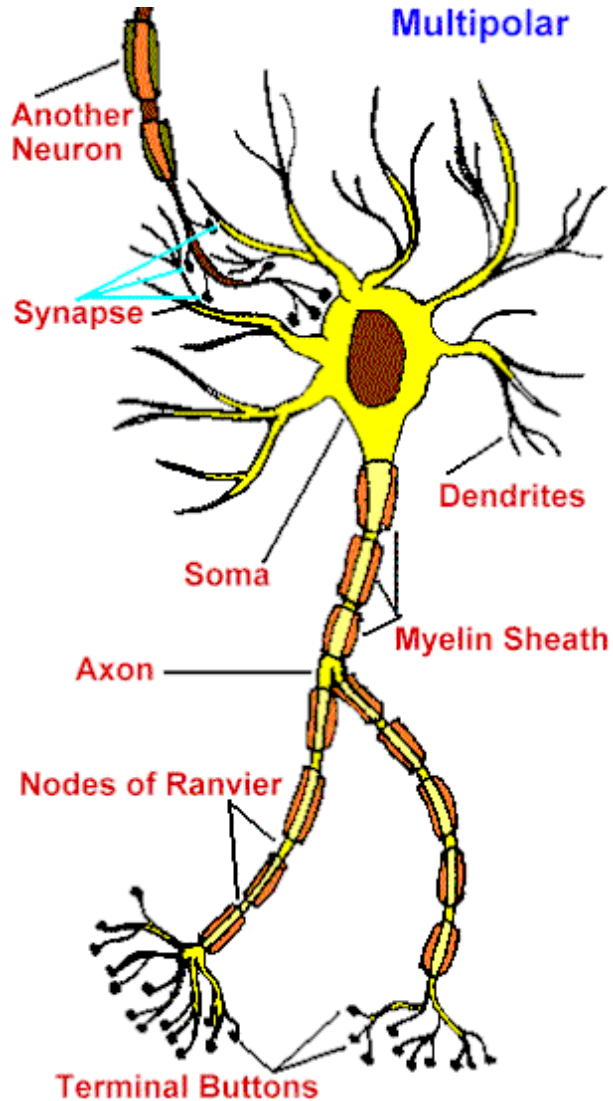


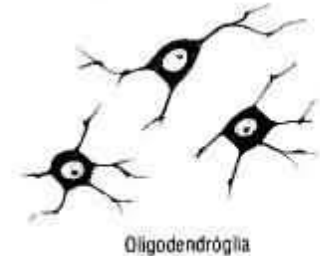
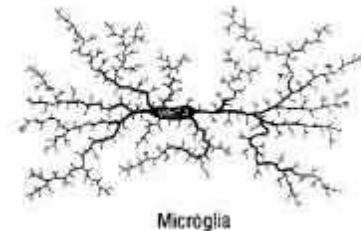
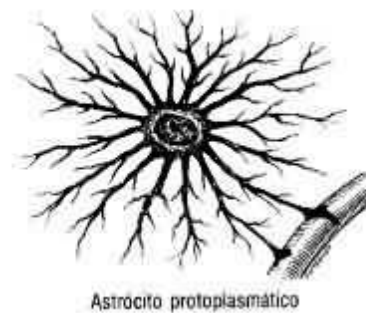
Nervová tkáň a nervový systém

• neurony



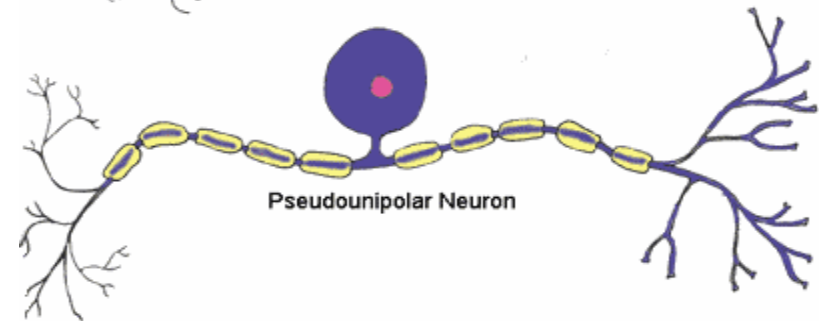
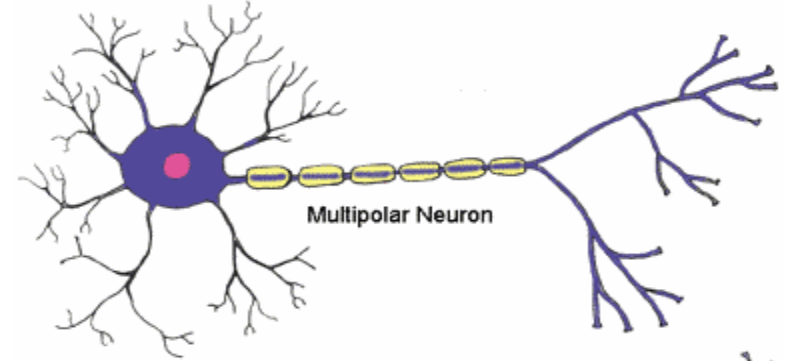
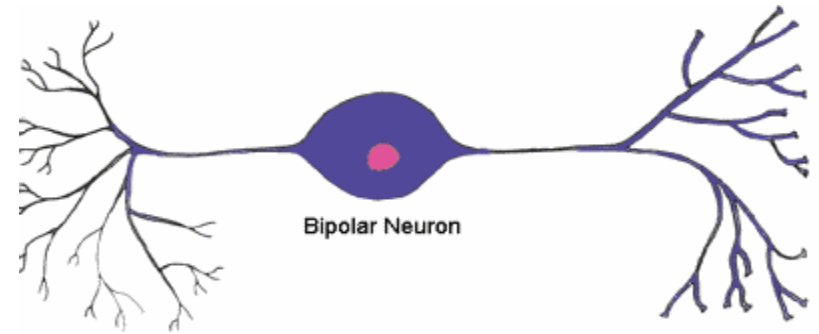
• neuroglie

- centrální
 - astrocyty
 - oligodendrocyty
 - mikroglie
 - ependym
- periferní
 - Schwannovy buňky
 - satelitní buňky



Neuron - klasifikace

- podle **počtu výběžků**
 - apolární
 - unipolární
 - pseudounipolární
 - bipolární
 - multipolární
 - anaxonální
- podle **délky axonu**
 - Golgi typ I /axon až 1 m/
 - Golgi typ II - s krátkým axonem
- podle **typu neurotransmiteru**
 - ACh, aminokyseliny (glutamát, GABA, glycin), monoaminy (serotonin, katecholaminy – dopamin, noradrenalin, adrenalin), neuropeptidy (somatostatin, enkefalin, endorfin, CCK), NO, adenosin



NEUROTRANSMITTERY

ADRENALINE fight or flight

produced in stressful situations. Increases heart rate and blood flow, leading to physical boost and heightened awareness.

GABA calming

Calms firing nerves in the central nervous system. High levels improve focus, low levels cause anxiety. Also contributes to motor control and vision.

NORADRENALINE concentration

affects attention and responding actions in the brain. Contracts blood vessels, increasing blood flow.

ACETYLCHOLINE learning

Involved in thought, learning and memory. Activates muscle action in the body. Also associated with attention and awakening.

DOPAMINE pleasure

feelings of pleasure, also addiction, movement and motivation. People repeat behaviors that lead to dopamine release.

GLUTAMATE memory

Most common neurotransmitter. Involved in learning and memory, regulates development and creation of nerve contacts.

SEROTONIN mood

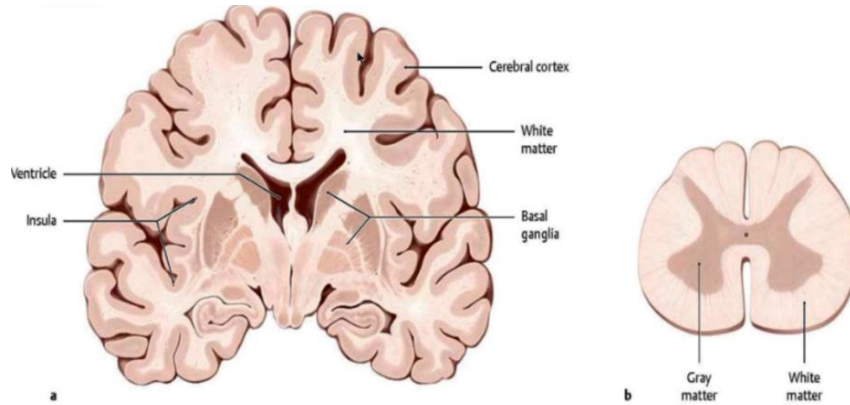
contributes to well-being and happiness. Helps sleep cycle and digestive system regulation. Affected by exercise and light exposure.

ENDORPHINS euphoria

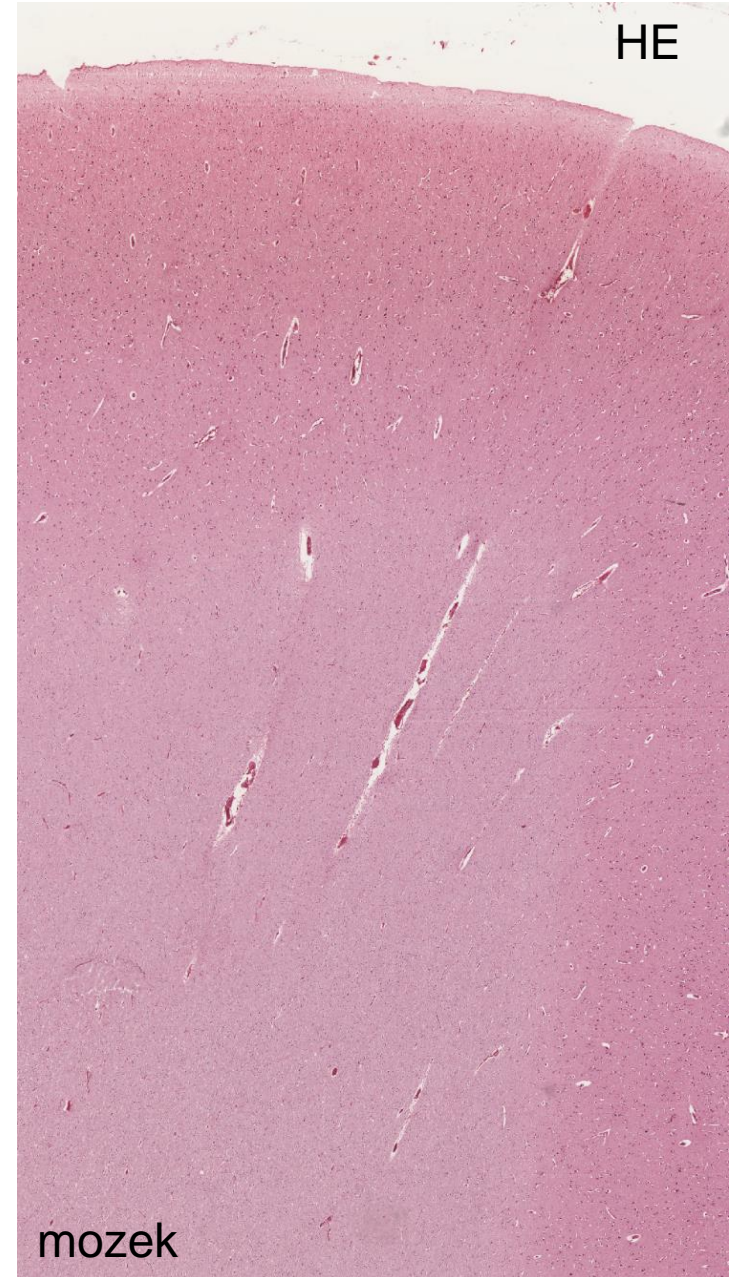
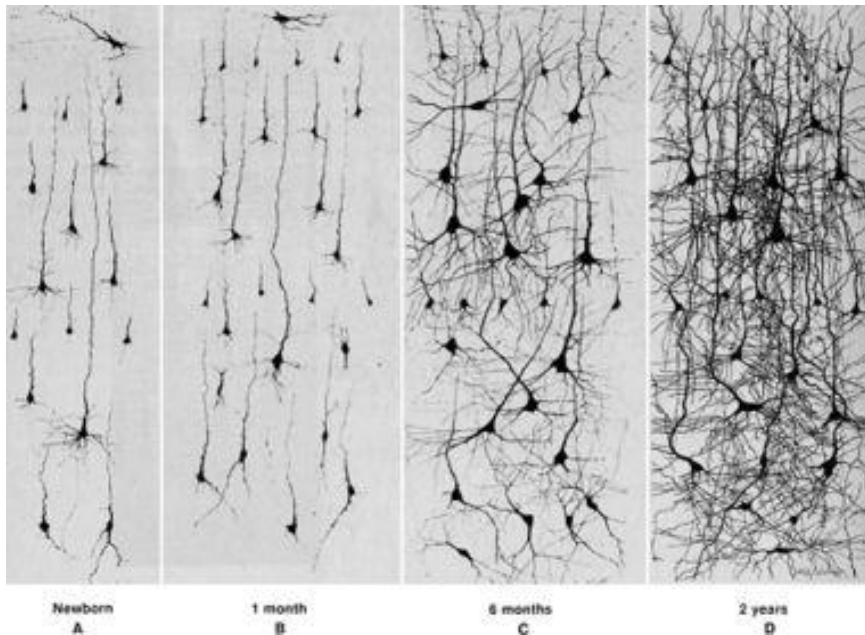
Released during exercise, excitement and sex, producing well-being and euphoria, reducing pain

Nervový systém - CNS a PNS

CNS – mozek, mozkový kmen, mozeček, mícha
PNS – hlavové a míšní nervy, ganglia



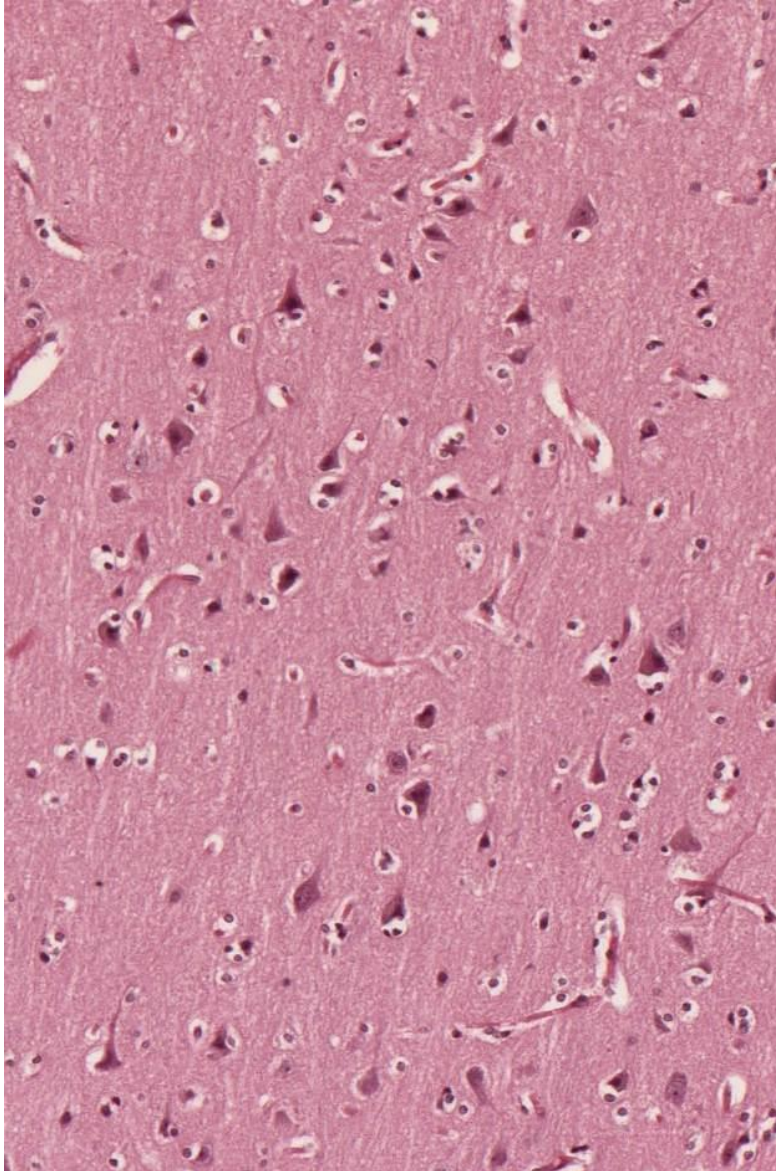
Distribution of gray and white matter in the CNS



CNS – mozek

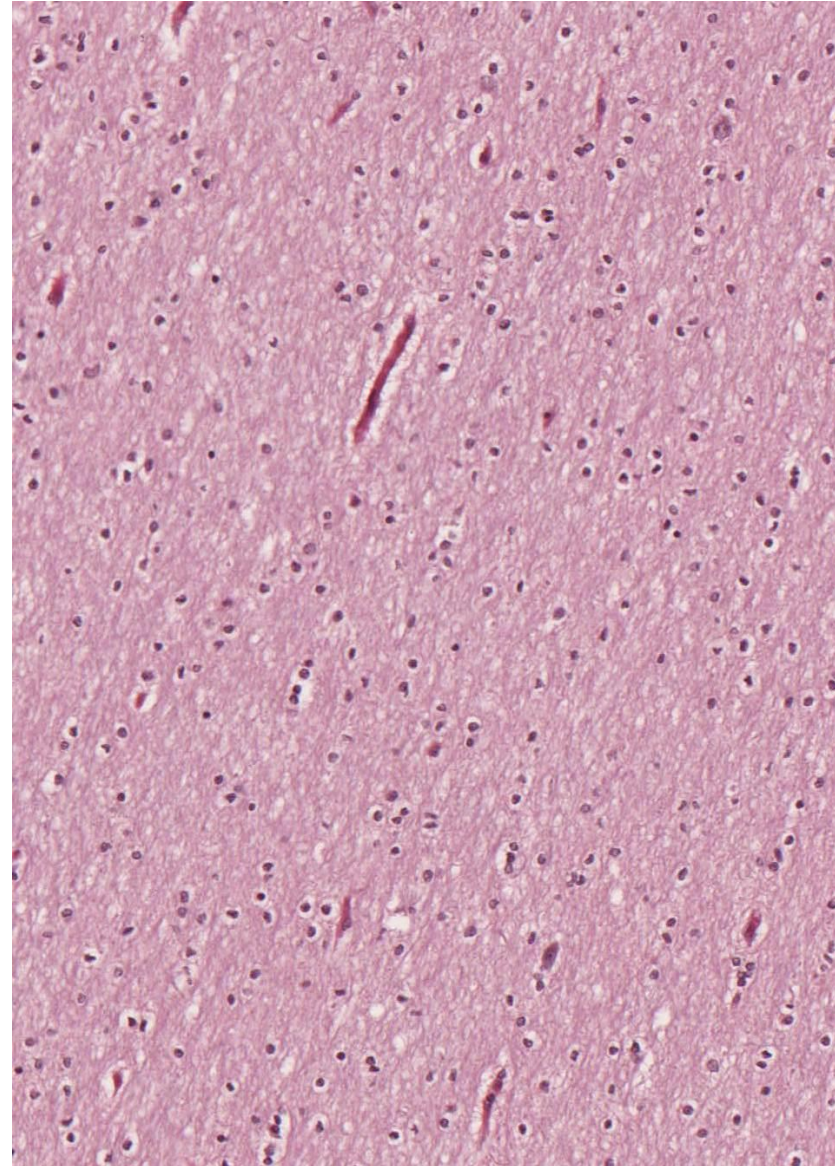
- **šedá hmota**

perikarya neuronů, nerv. výběžky, glie (plazmatické astrocyty, mikroglie), cévy



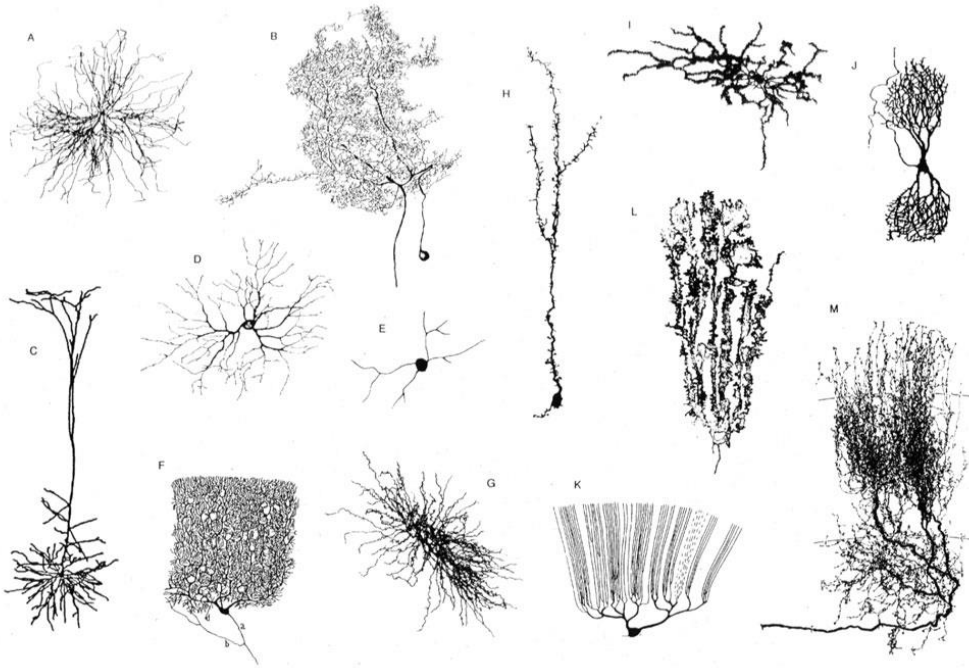
- **bílá hmota**

myelinizované axony, glie (oligodendrocyty, fibrilární astrocyty, mikroglie), cévy

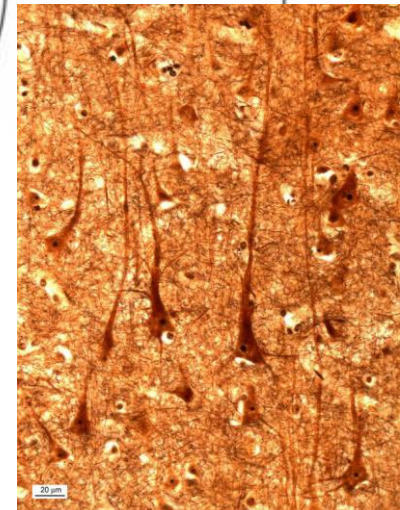
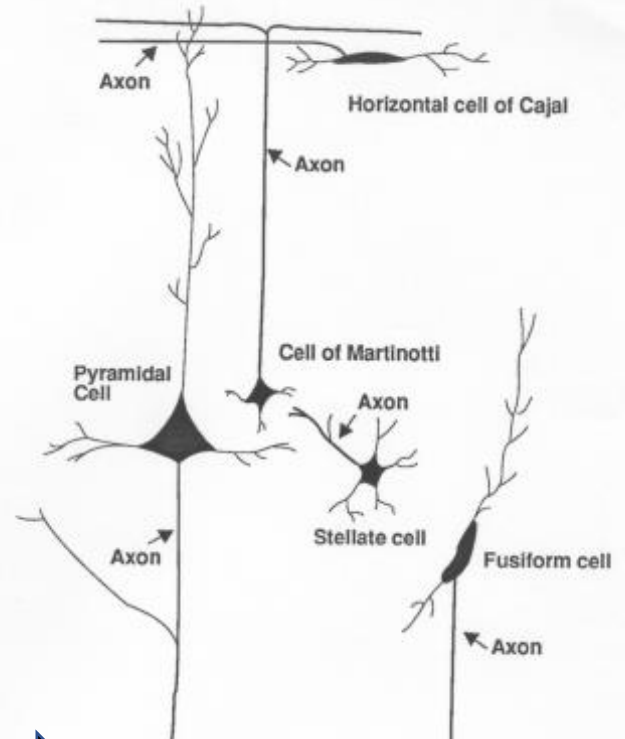


HE

CNS - *cortex cerebri* – typy neuronů



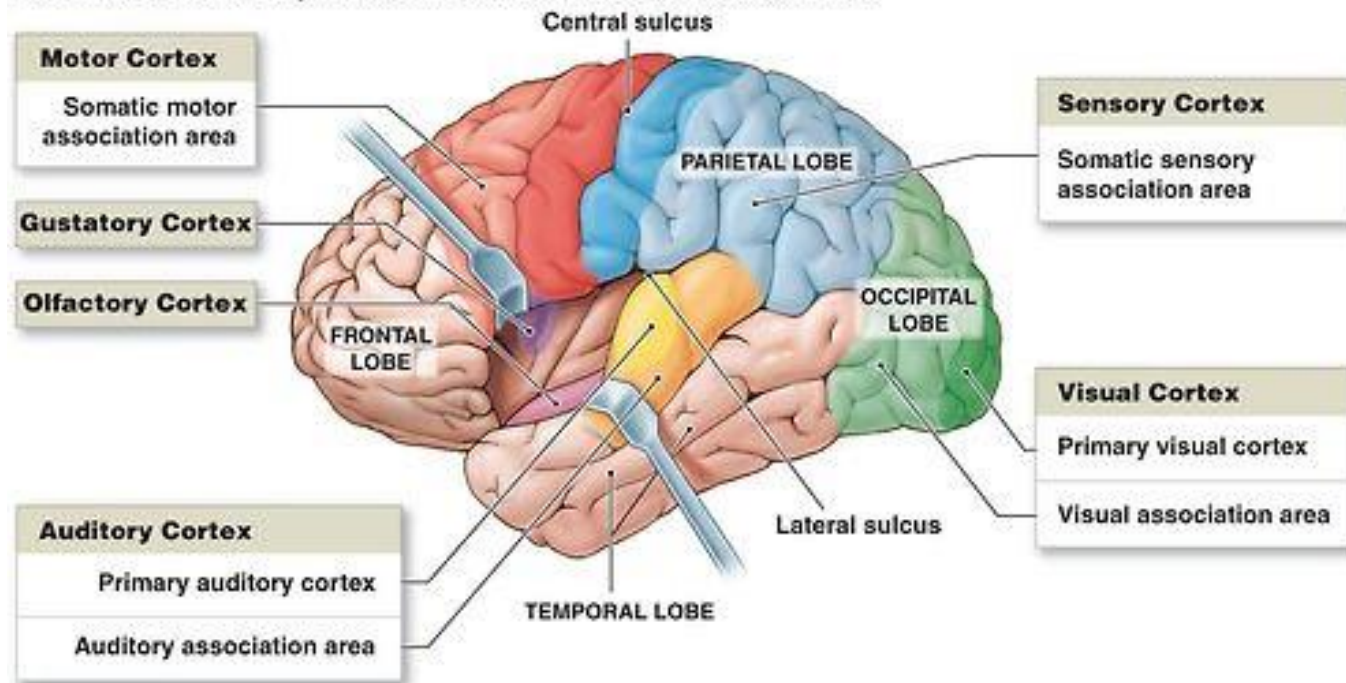
<https://www.janelia.org/lab/spruston-lab/research/cellular-diversity-hippocampus>



- pyramidové buňky
- zrnité (granulární) buňky
- vřetenovité buňky
- horizontální (Cajal) buňky
- vertikální (Martinotti) buňky

CNS - cortex cerebri

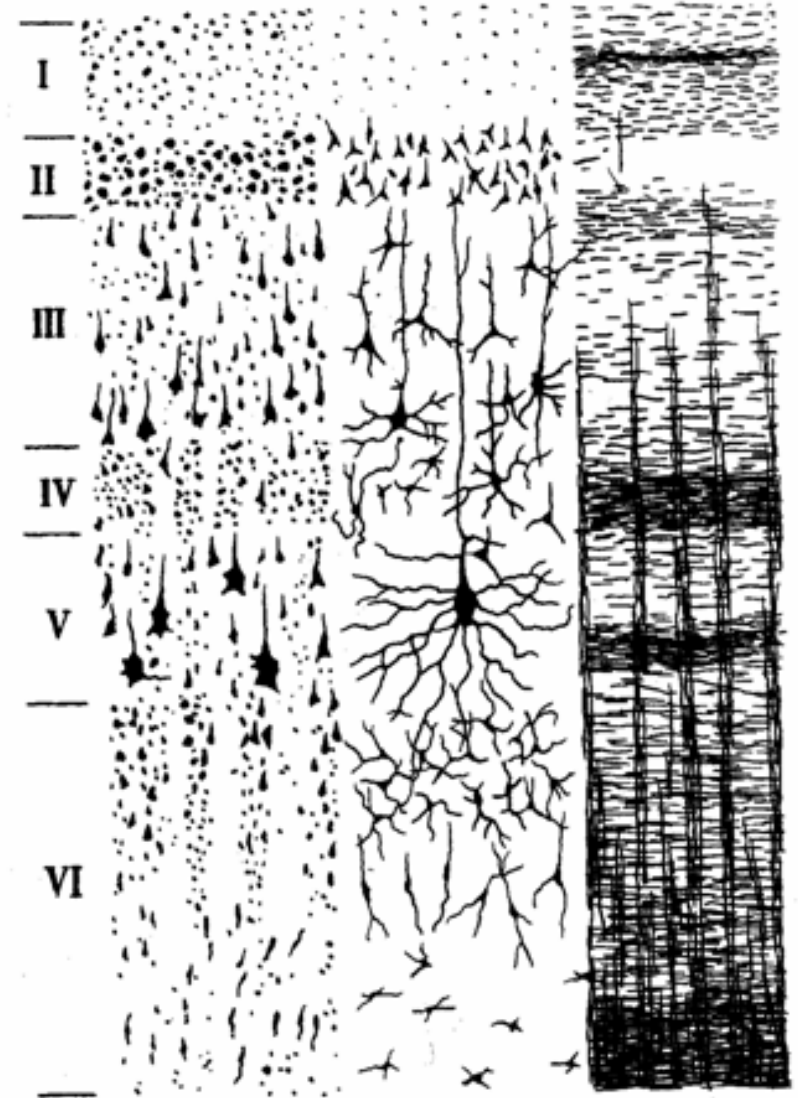
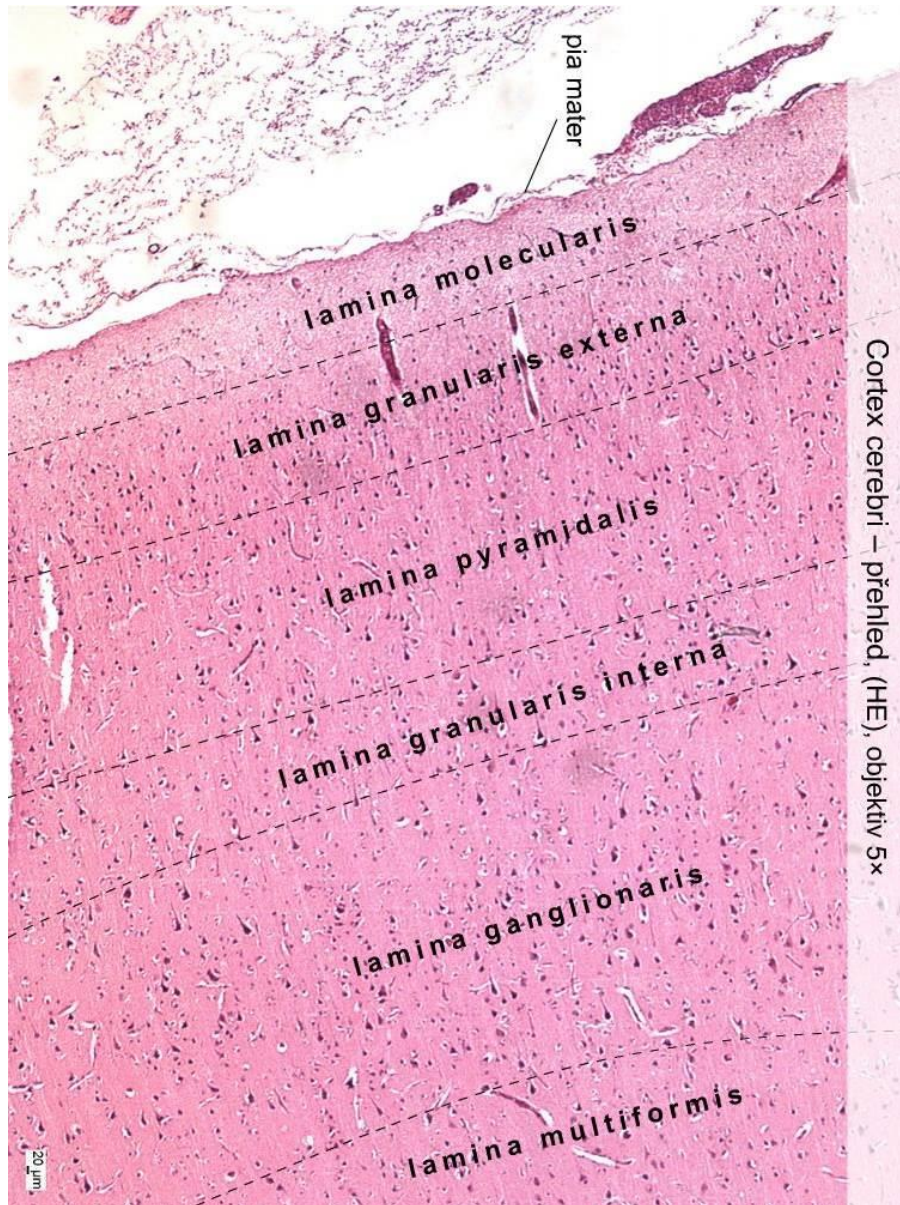
The motor and sensory cortices and the association areas for each



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- **isocortex** - 11/12 povrchu, vývojově mladší, typických 6 vrstev
 - homotypický cortex
 - heterotypický cortex
- **allocortex** – 1/12, vývojově starší, stavebně jednodušší

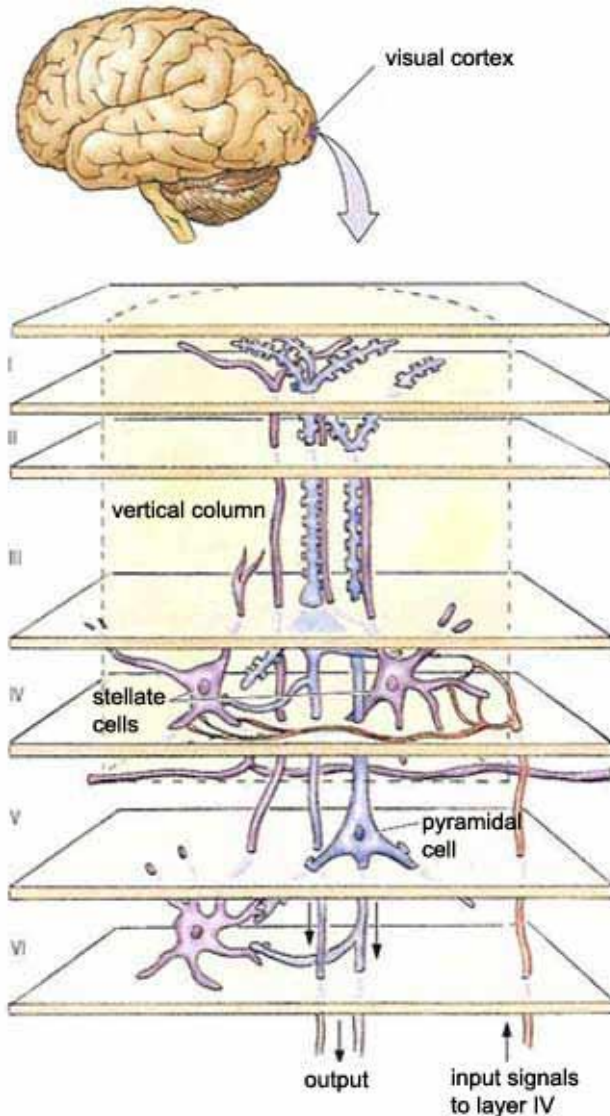
CNS - *isocortex cerebri*



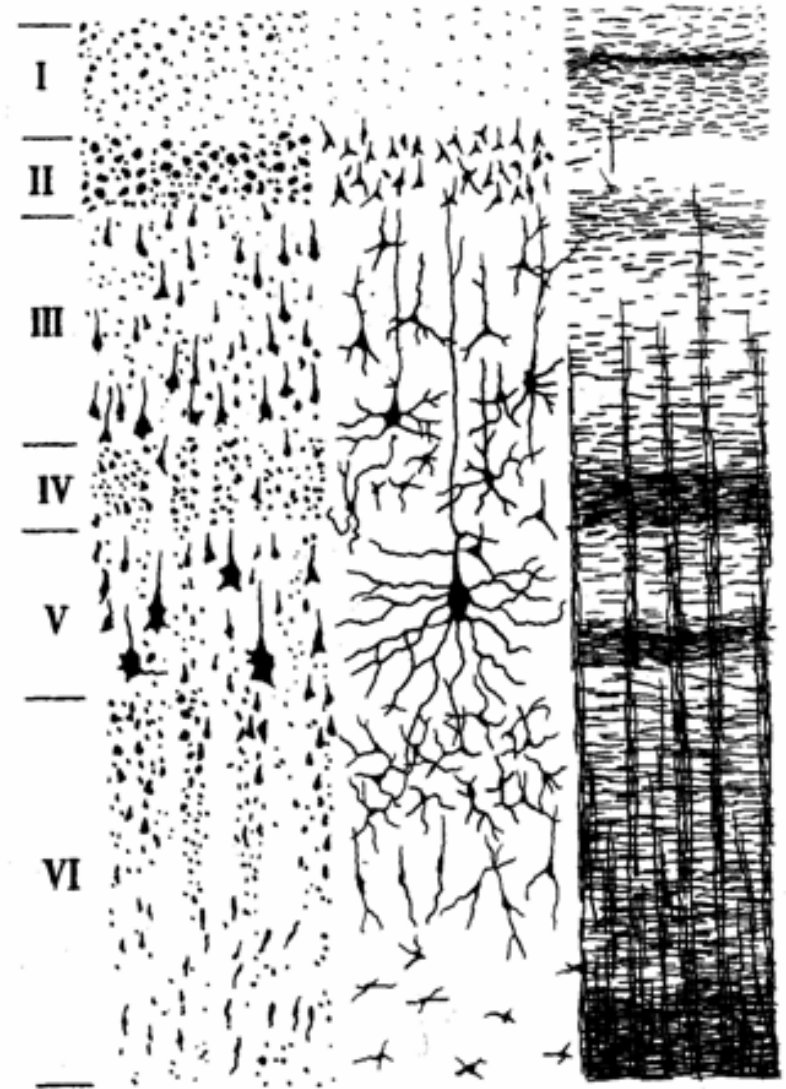
tloušťka: 1.5-5 mm, plocha: 0.20-0.25 m²

CNS - cortex cerebri - isocortex

sensorická

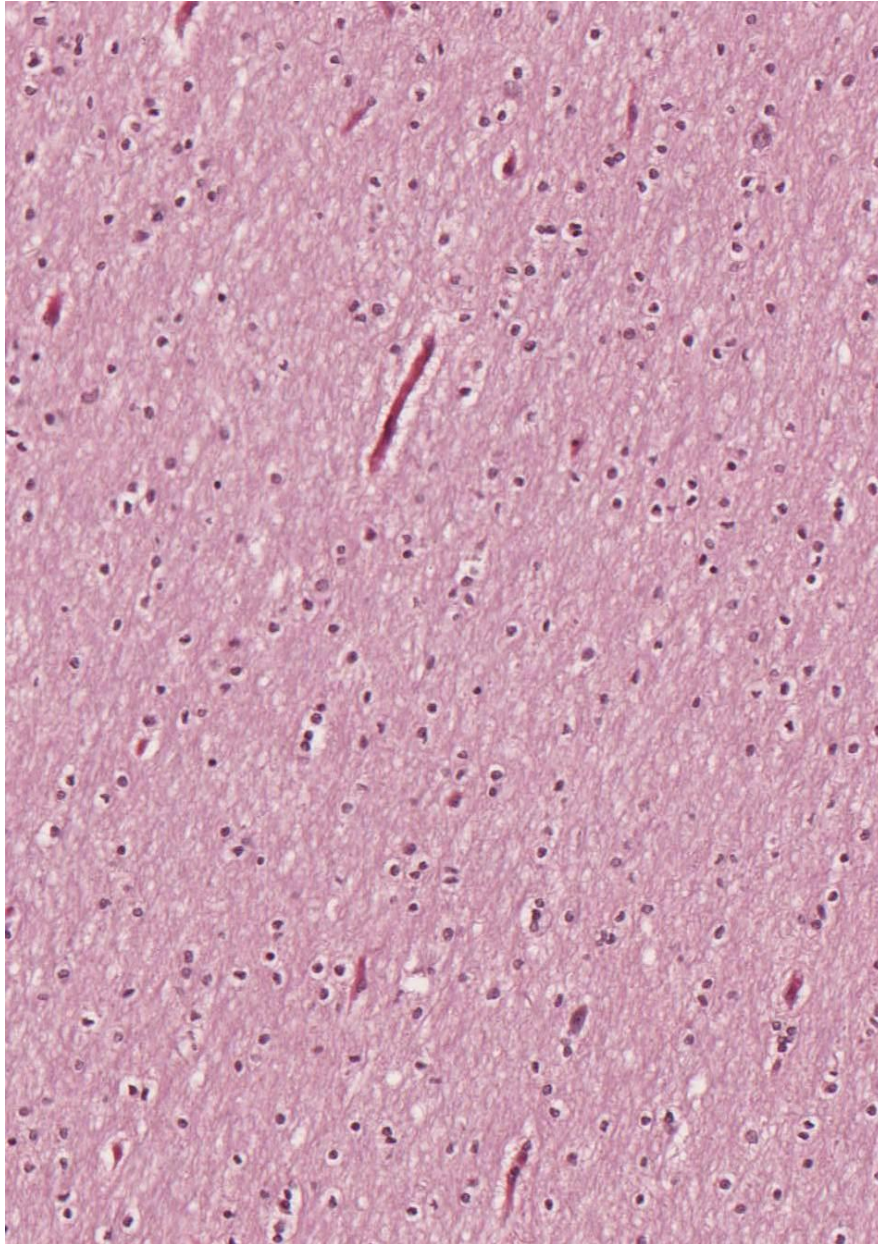


motorická



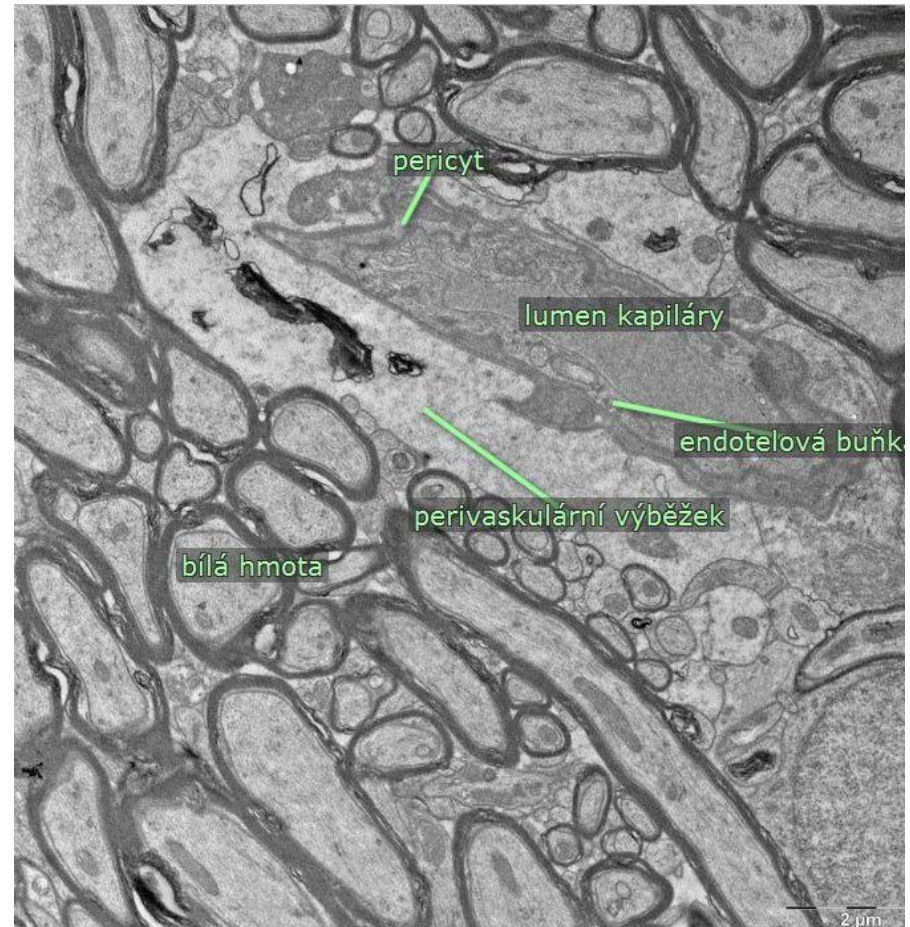
cytoarchitektonika, myeloarchitektonika

CNS – bílá hmota



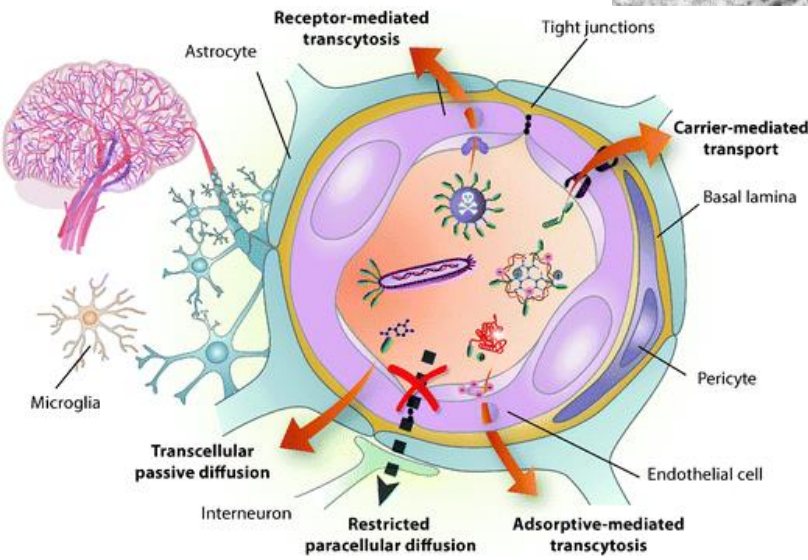
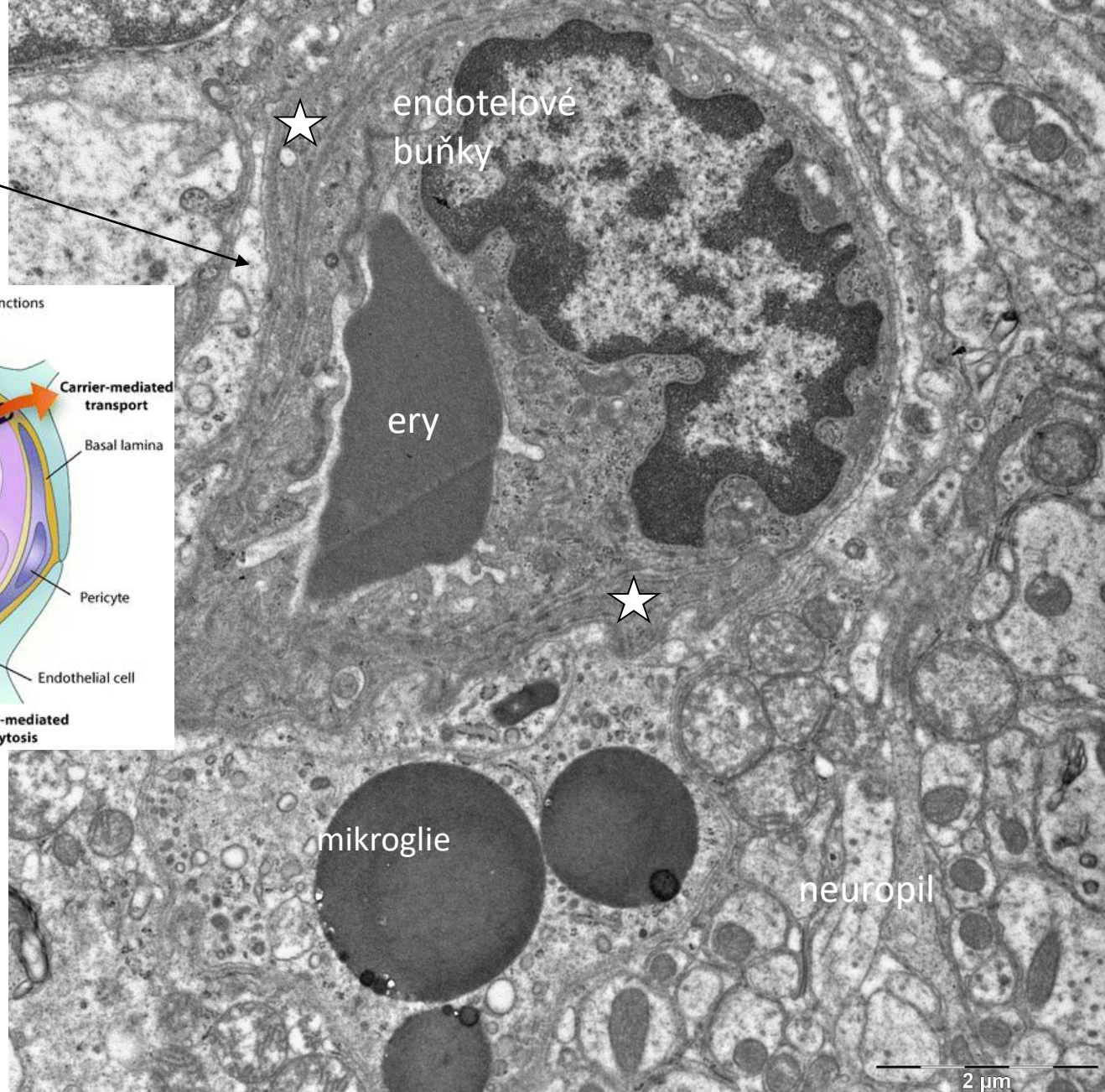
výběžky neuronů, neuroglie, cévy

bílá hmota (TEM) - HEB v šedé i v bílé hmotě



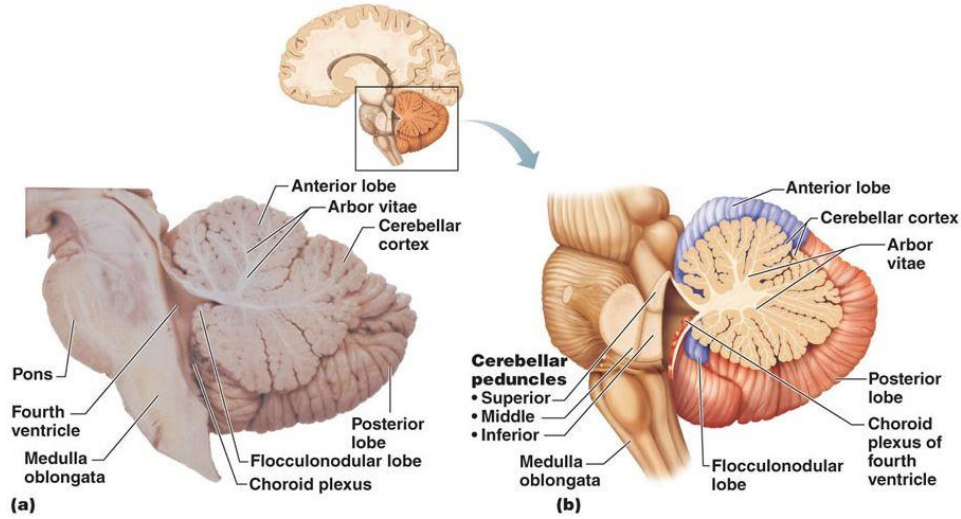
Hemato-encephalická bariéra (HEB)

perivaskulární nožky astrocytů

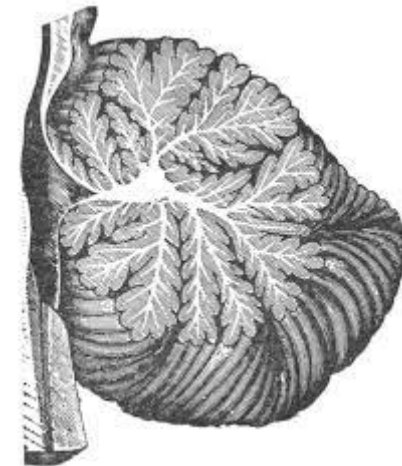
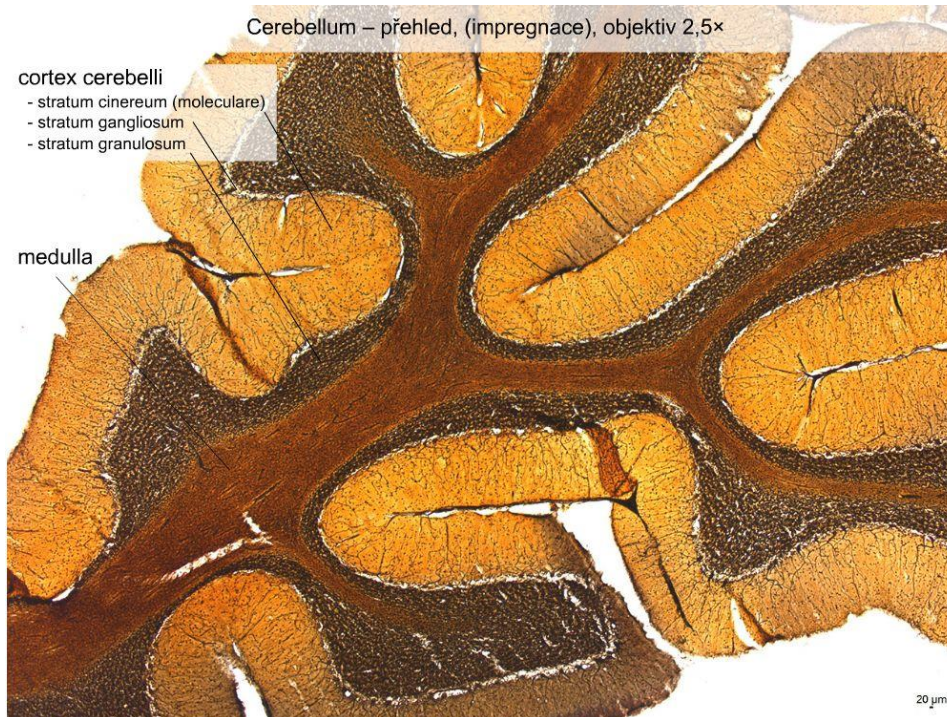


☆ pericyt

CNS - mozeček (*cerebellum*)



2 hemisféry
vermis - nepárové



arbor vitae

Mozeček (*cerebellum*)

Kůra mozečku (*cortex cerebelli*)

Stratum moleculare - košíčkové a hvězdicovité buňky

Stratum gangliosum - Purkyňovy buňky

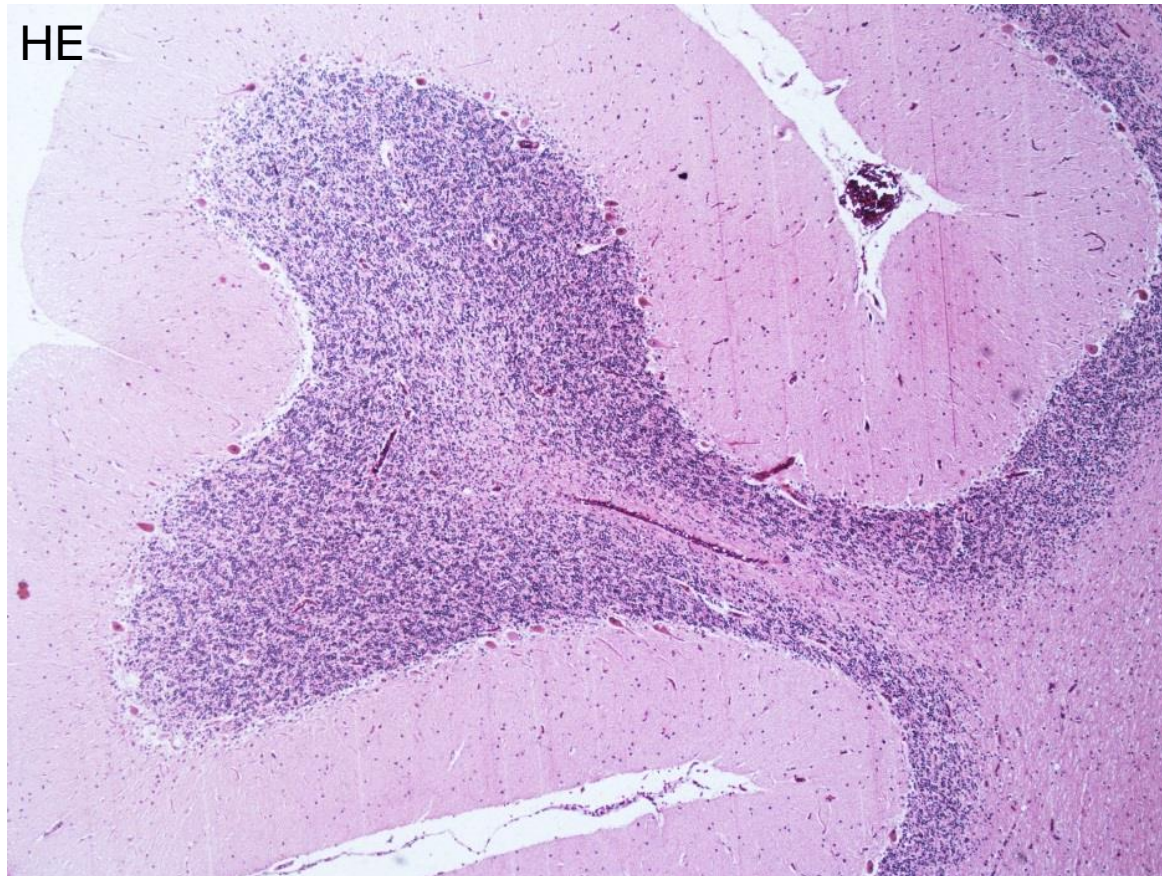
Stratum granulosum - malé a větší zrnité multipolární neurony

Bílá hmota mozečku

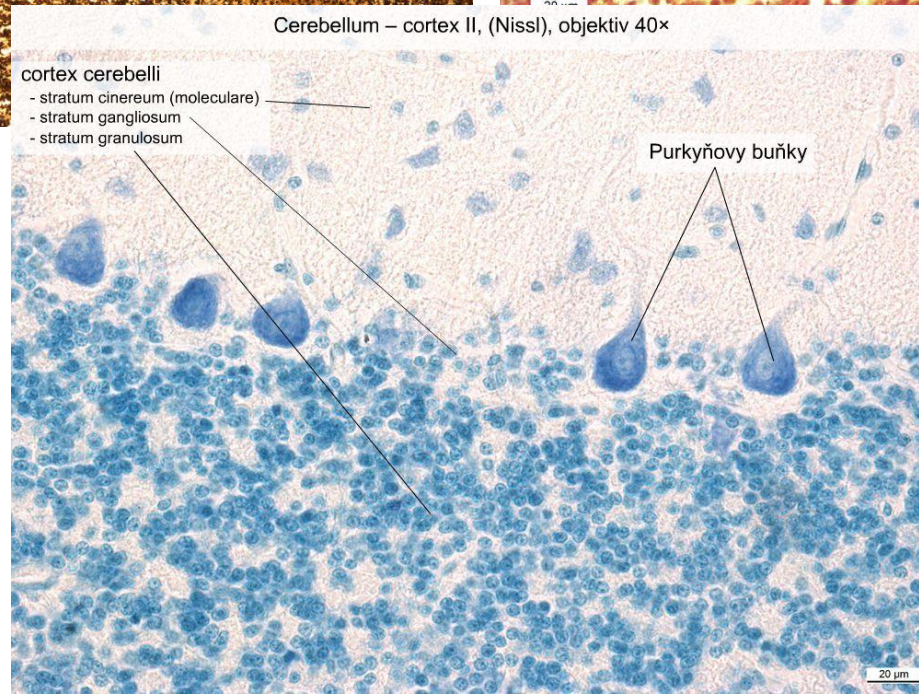
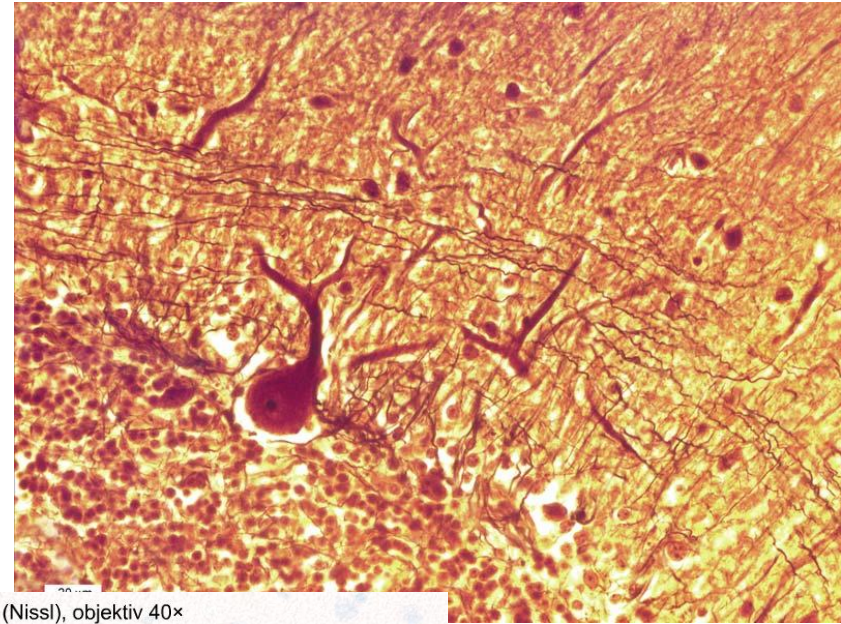
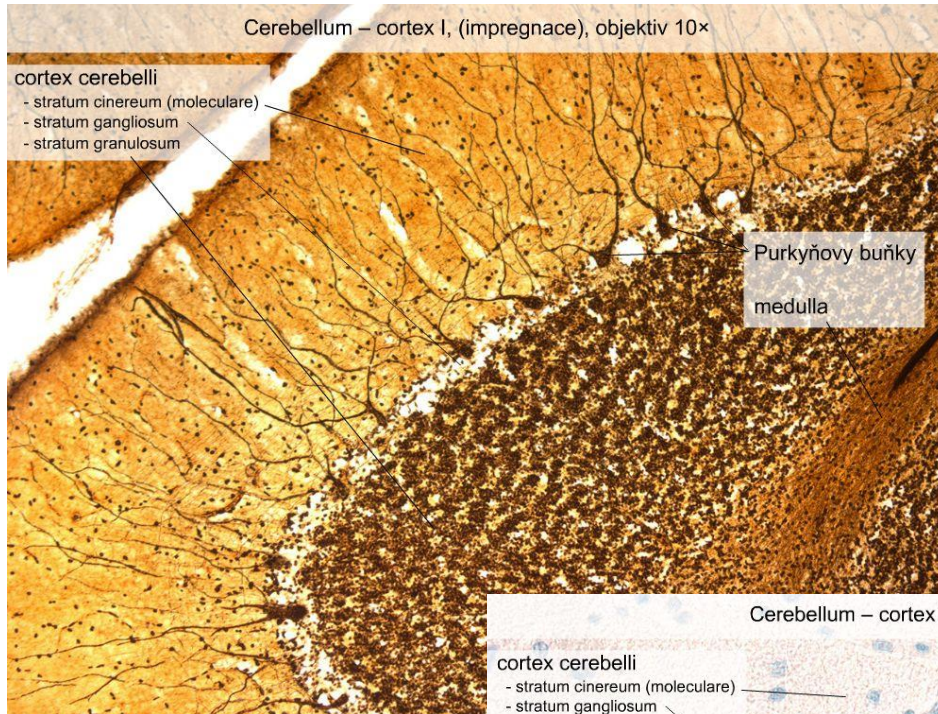
Eferentní vlákna – neurity Purkyňových buněk

Aferentní - mechová (synapse: *glomeruli cerebellares*) a šplhavá

Jádra mozečku

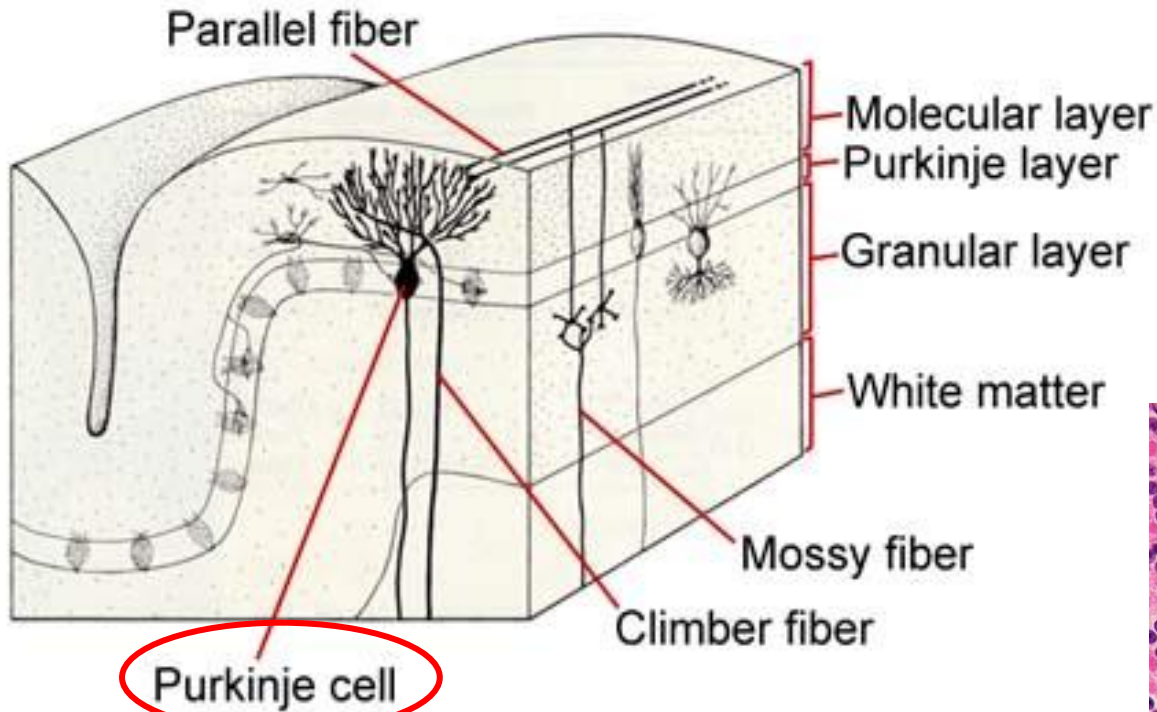


Mozeček (*cerebellum*)



50% všech neuronů
CNS

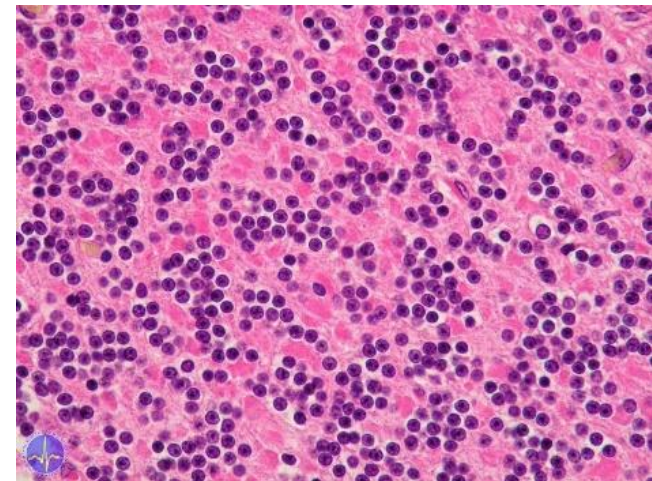
Mozeček - zapojení neuronů



Purkinje cell

- jediná eferentní vlákna

stratum granulosum -
glomeruli cerebellares



košičkové buňky

malé zrnité (granulární) neurony

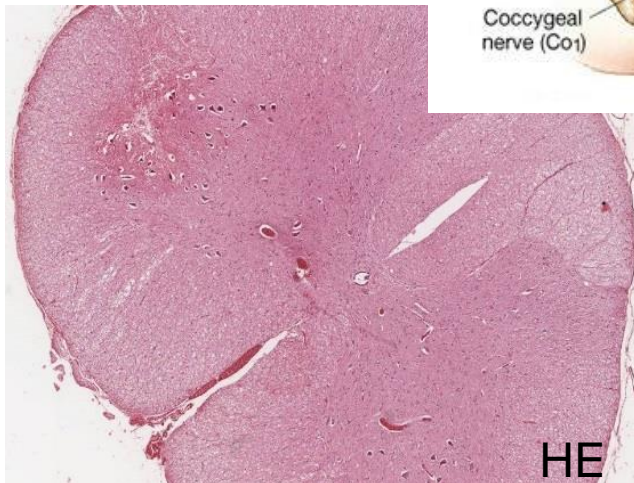
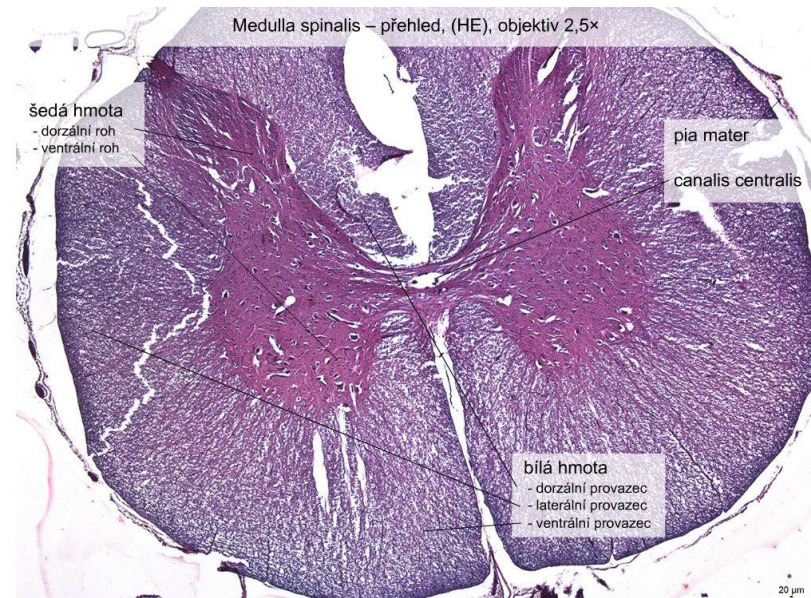
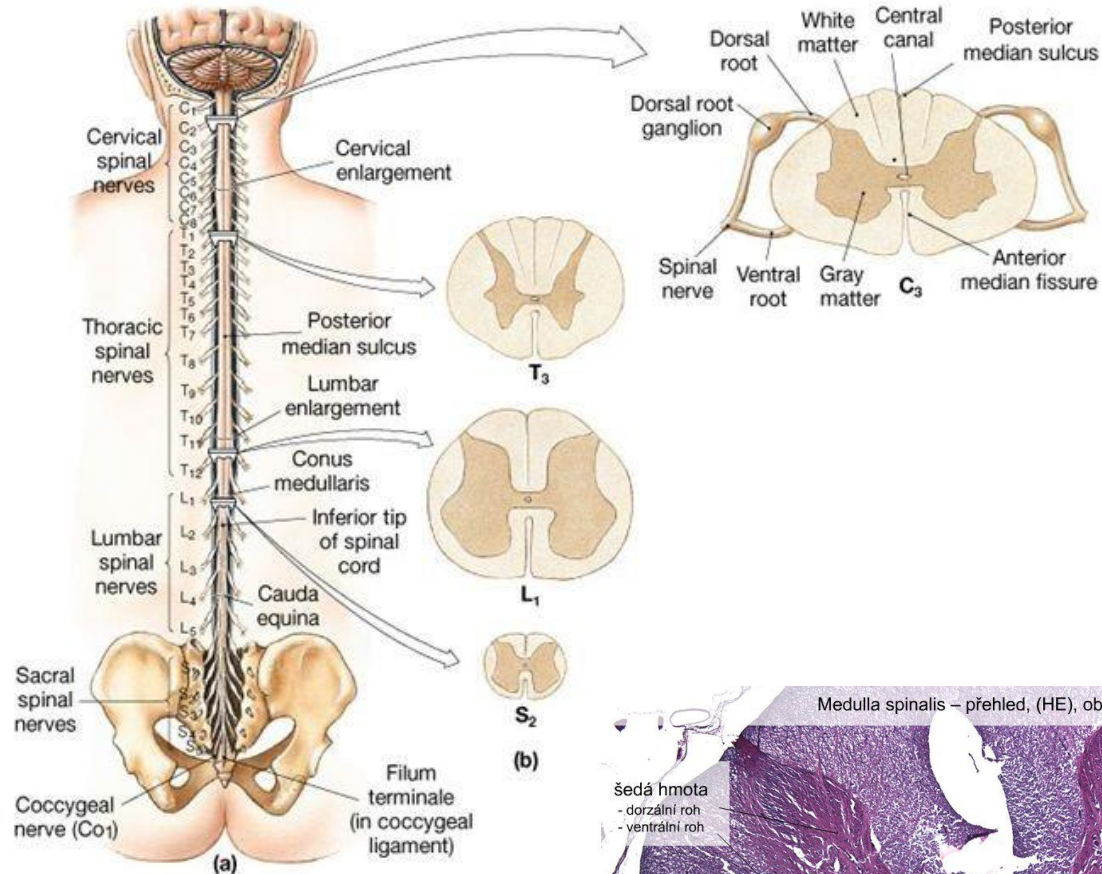
interneurony



kooperace Purkyňových buněk (inhibiční neurony
- koordinace pohybů, udržování rovnováhy,
jemná motorika)

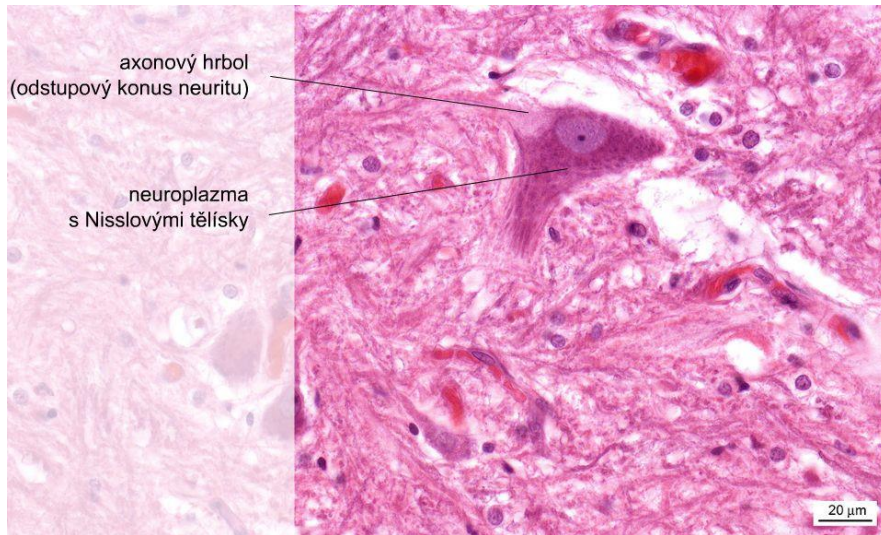
CNS – mícha (*medulla spinalis*)

- C1-L2
- 40-45 cm
- průměr se snižuje směrem dolů: 13 mm - 6,4 mm
- *intumescentia cervicalis*
- *intumescentia lumbalis*
- míšní segmenty (8C, 12Th, 5L, 5S, 1-3Co)



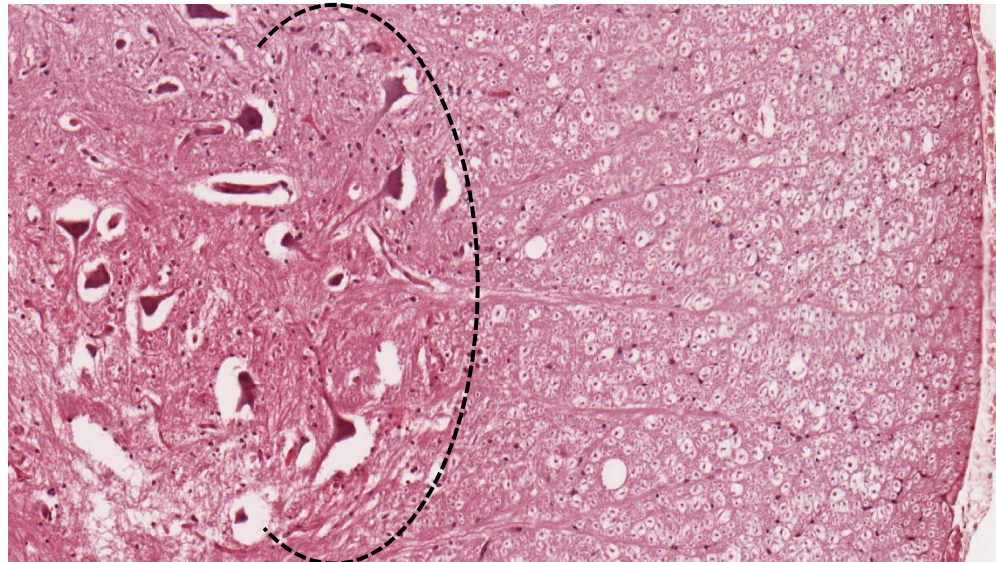
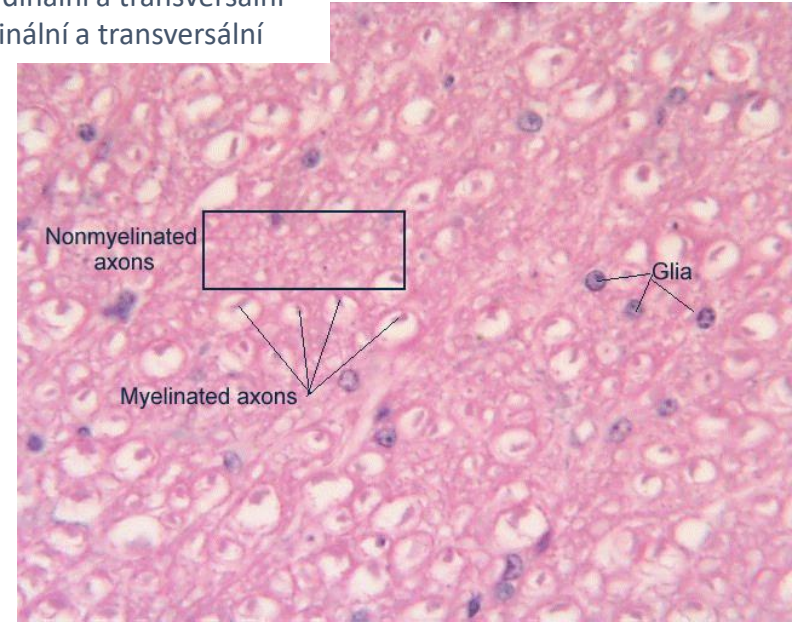
Medulla spinalis

- Šedá hmota míšňí
 - *Cellulae radicales* (kořenové buňky)
 - somatomotorické a visceromotorické
 - *Interneurony*
 - vsunuté, komisurální, asociační
 - *Cellulae funiculares* (buňky provazců)
 - v ncl. proprius a ncl. thoracicus

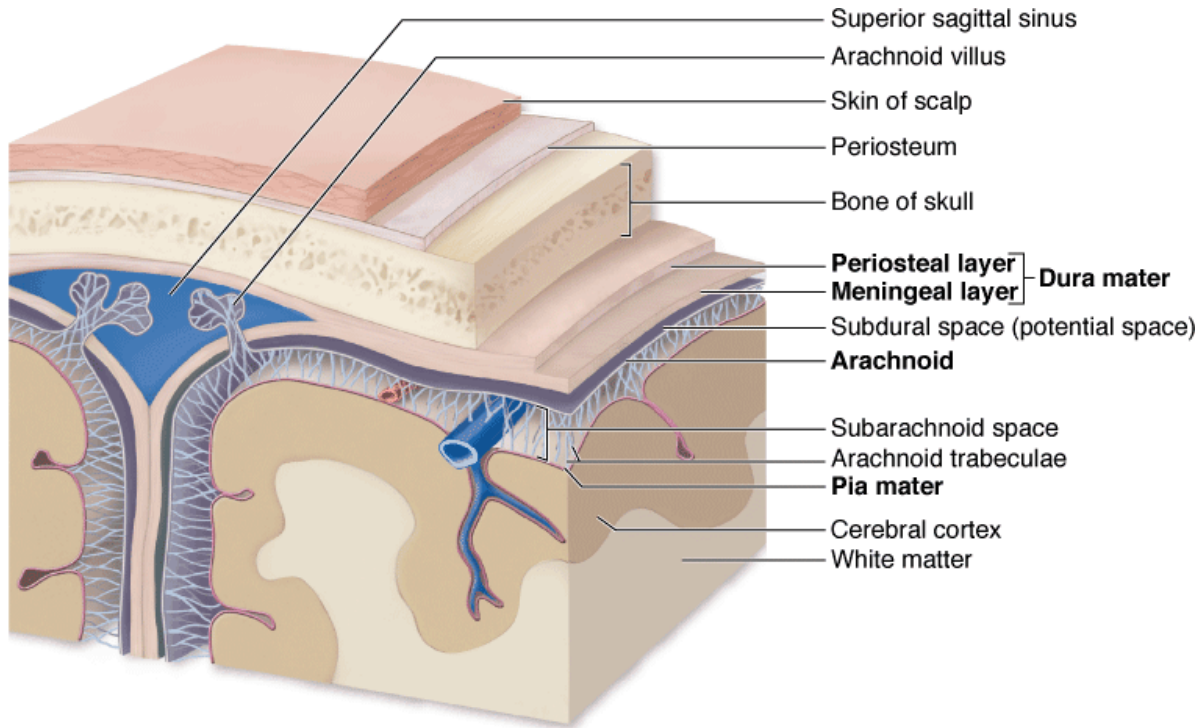


Medulla spinalis – bílá hmota

endogenní vlákna – longitudinální a transversální
exogenní vlákna – longitudinální a transversální



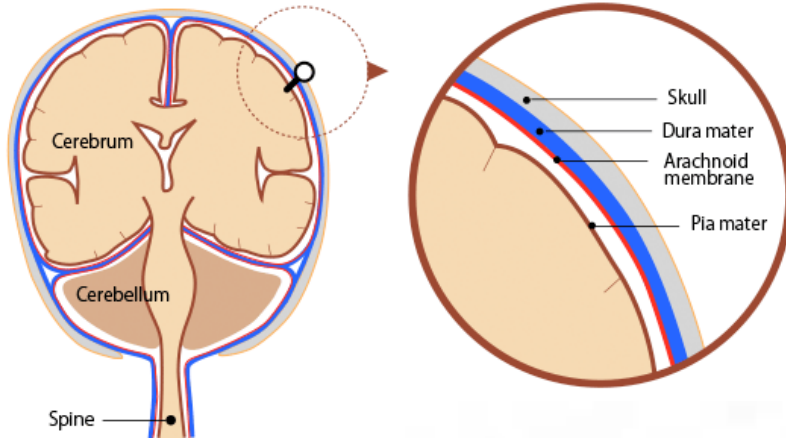
Mozkomíšní obaly - meningy



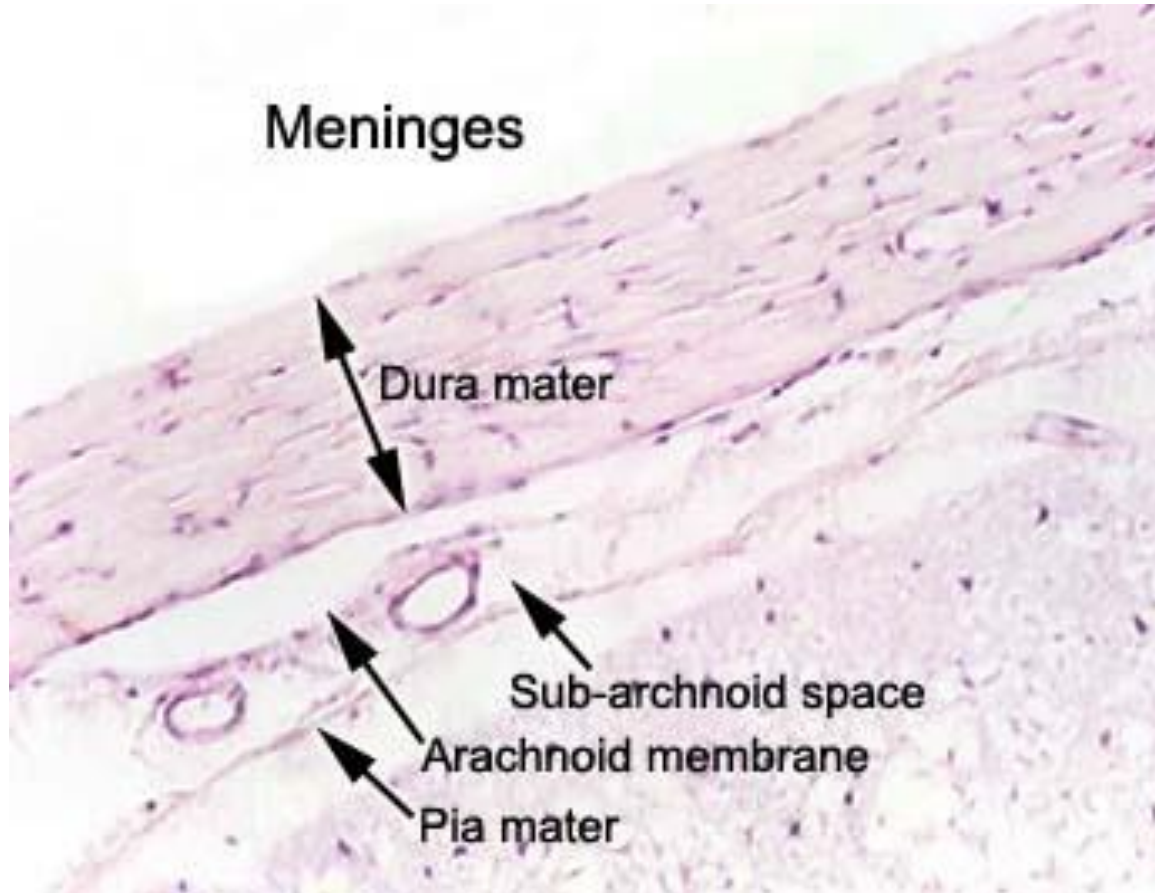
Source: Mescher AL: *Junqueira's Basic Histology: Text and Atlas, 12th Edition*: <http://www.accessmedicine.com>
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- **Dura mater**
 - endosteální vrstva (periostální)
 - meningeální vrstvav určitých místech obě vrstvy odděleny – venózní sinusy
- **Arachnoidea** – jemná, bez cév
 - vazivo
 - síť jemných trabekulv subarachnoidálním prostoru jsou četné cévy, prostor je vyplněn mozkomíšním mokem
- **Pia mater** – velmi vaskularizovaná jemná blána

Mozkomíšní obaly - meningy

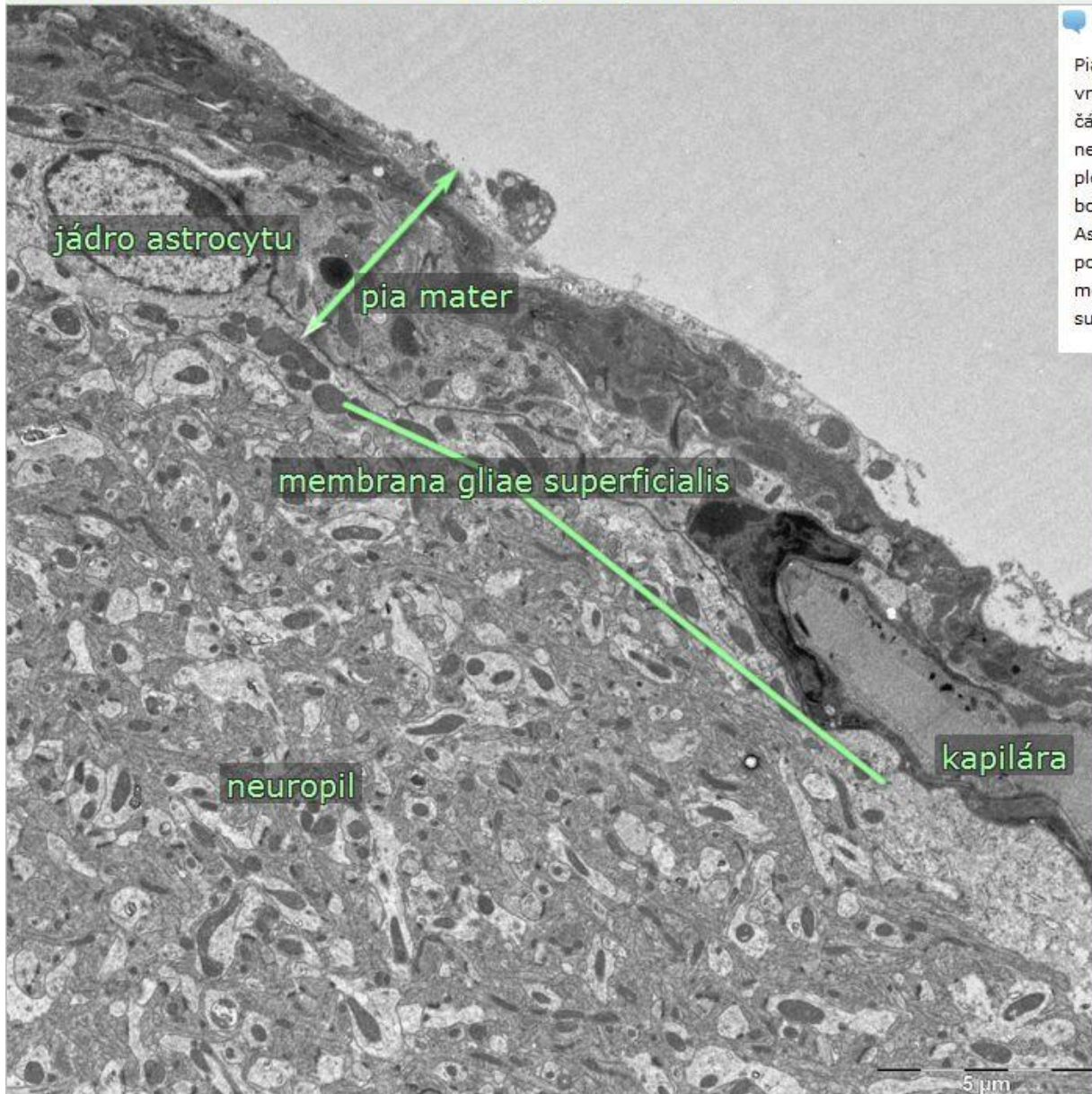


Meninges



Mozkomíšní obaly – meningy, *membrana gliae superficialis*

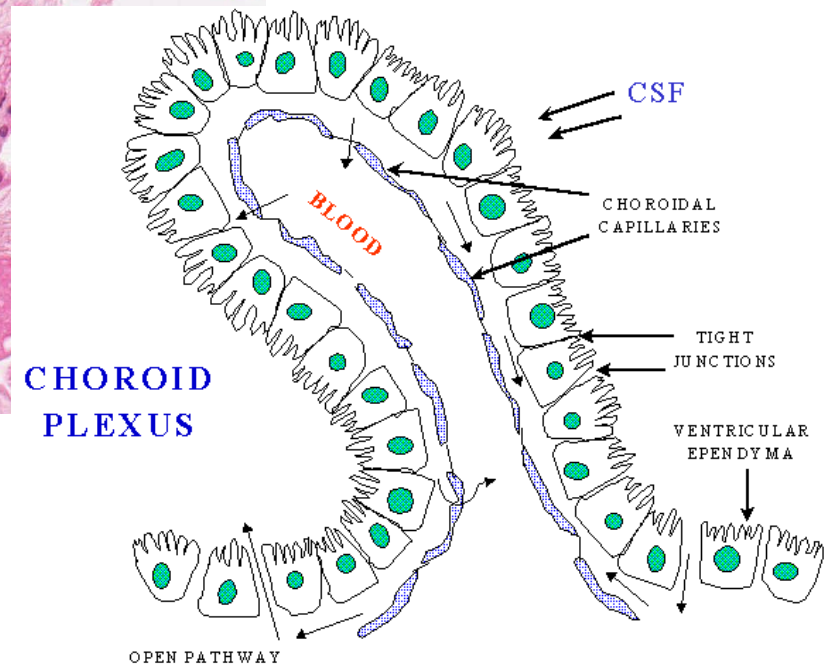
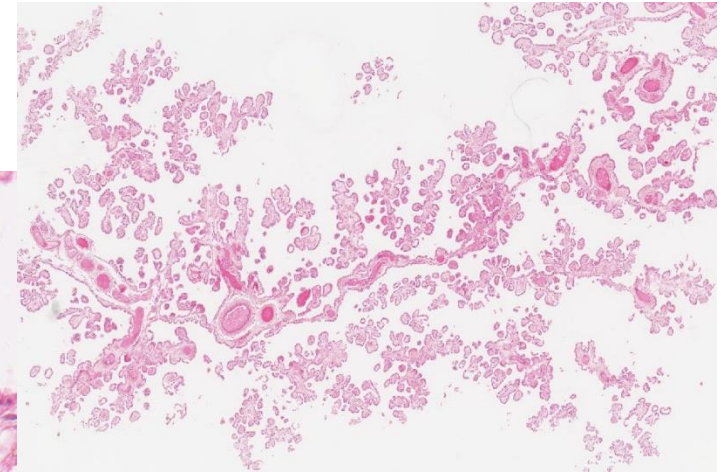
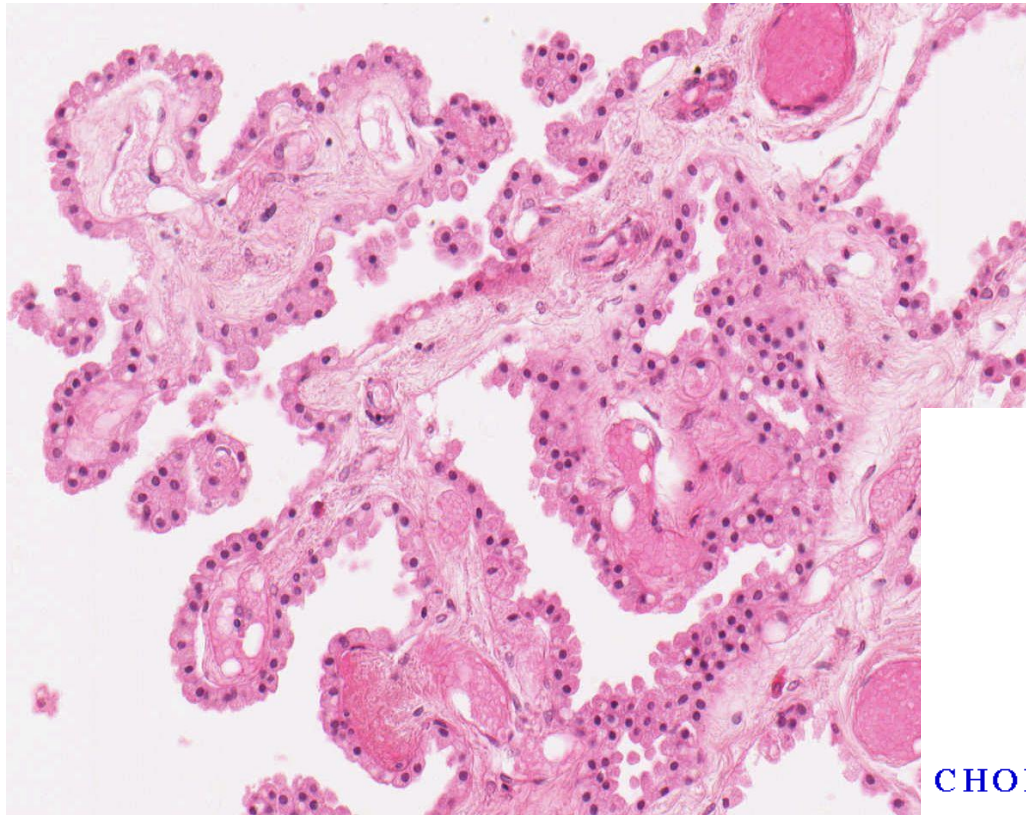
↑ 13.1.11 Pia mater, membrana limitans gliae superficialis, TEM



Pia mater obklopuje vnější povrch všech částí CNS. Je to nejvnitřnější mozková plena, velmi jemná, bohatá na cévy. Astrocyty tvoří těsně pod pia mater tzv. membrana limitans gliae superficialis.

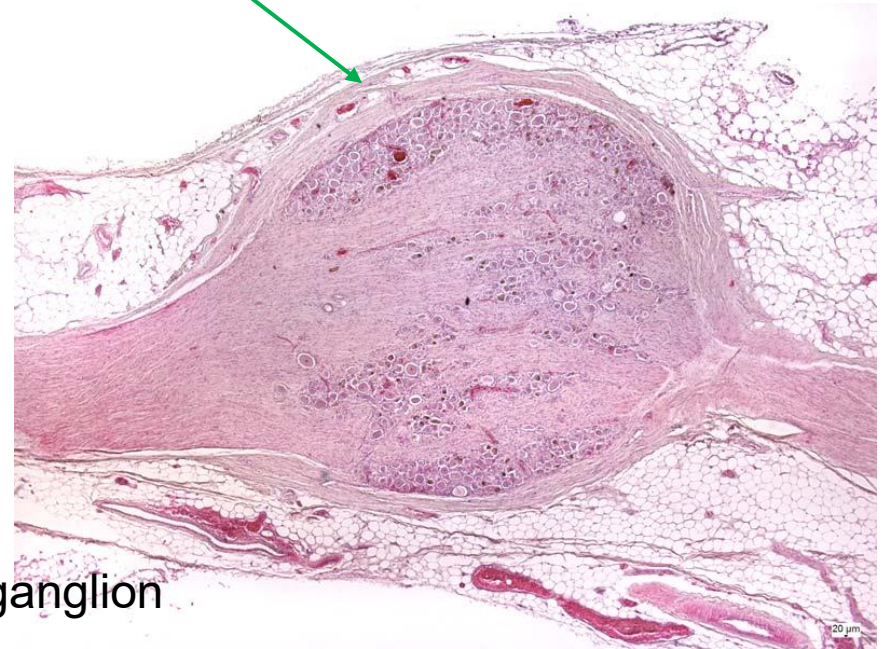
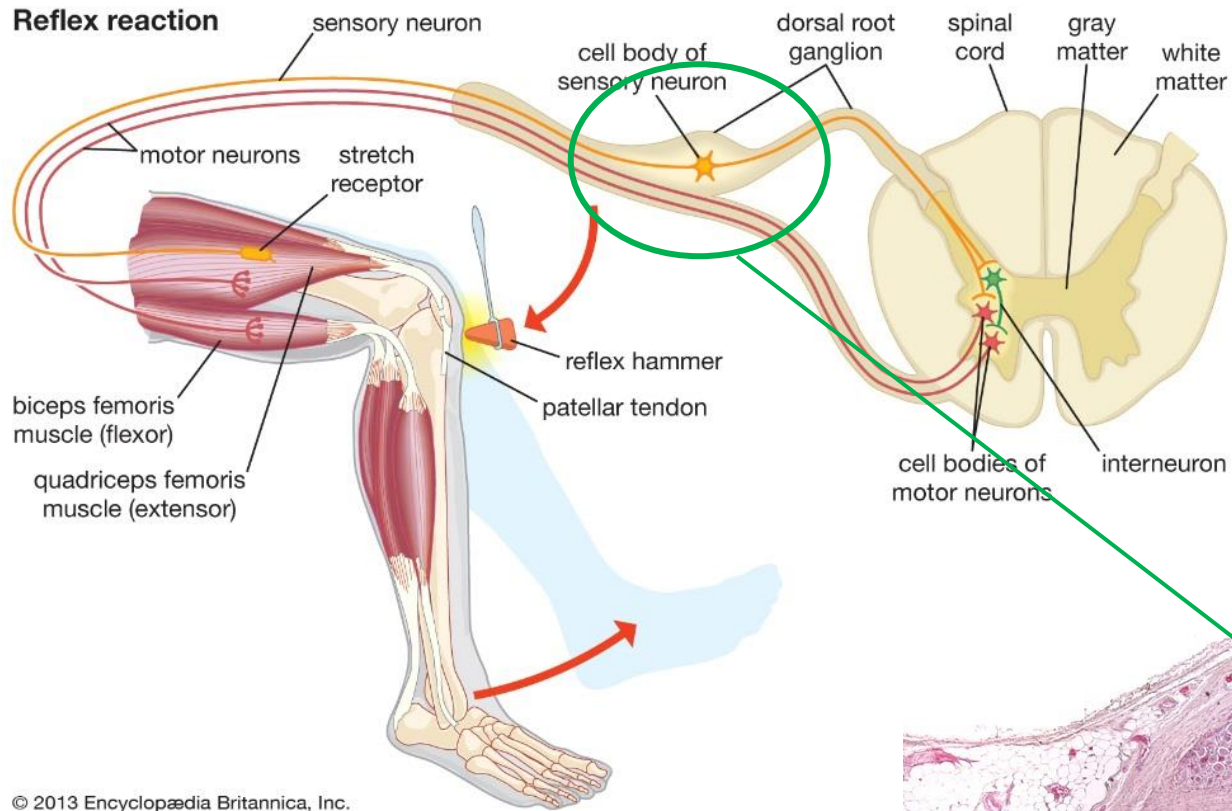
Plexus choroideus (v mozkových komorách)

produkce mozkomíšního moku

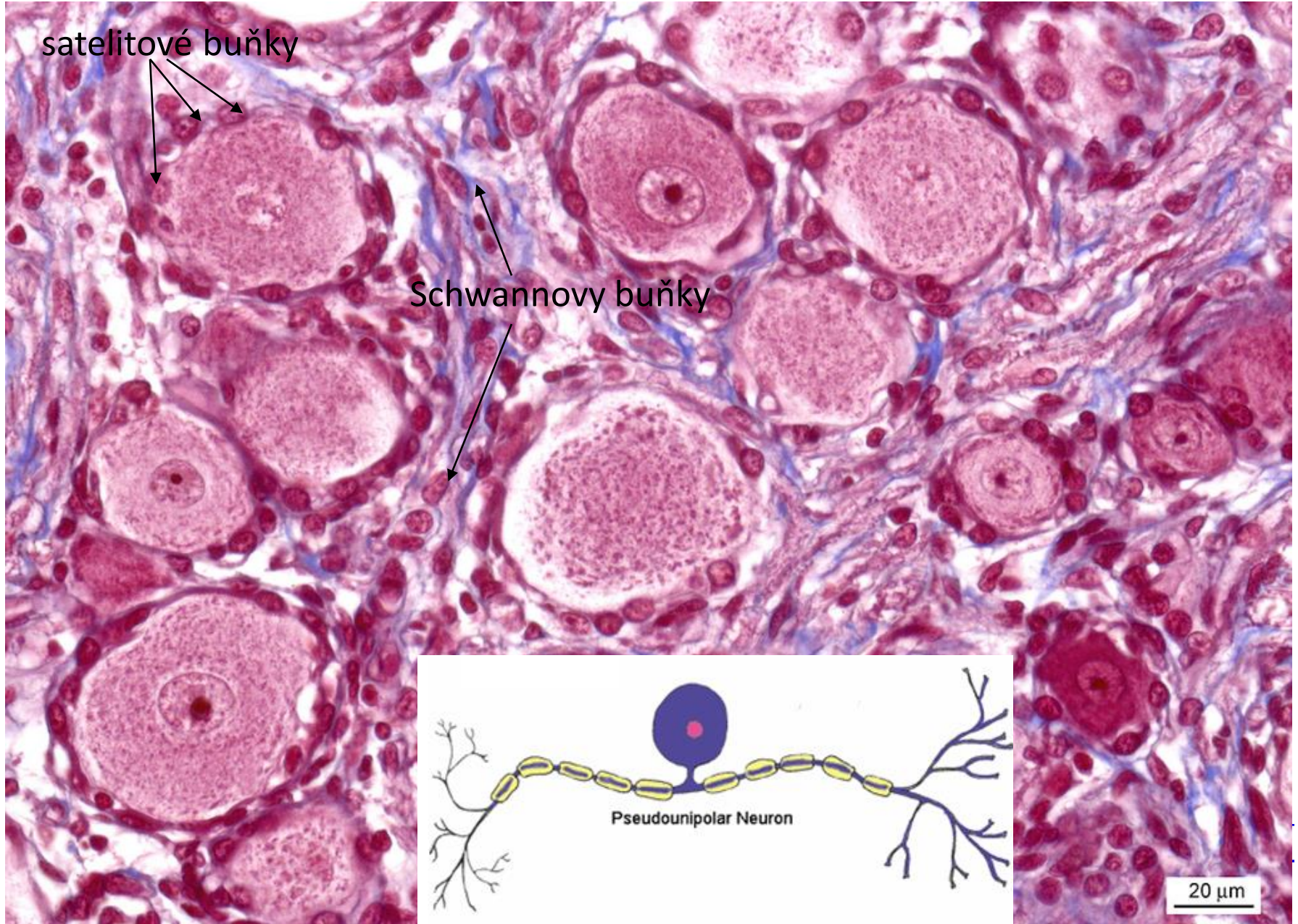


vaskularizovaná pia mater + ependym

PNS – míšní ganglion (*ganglion spinale*)

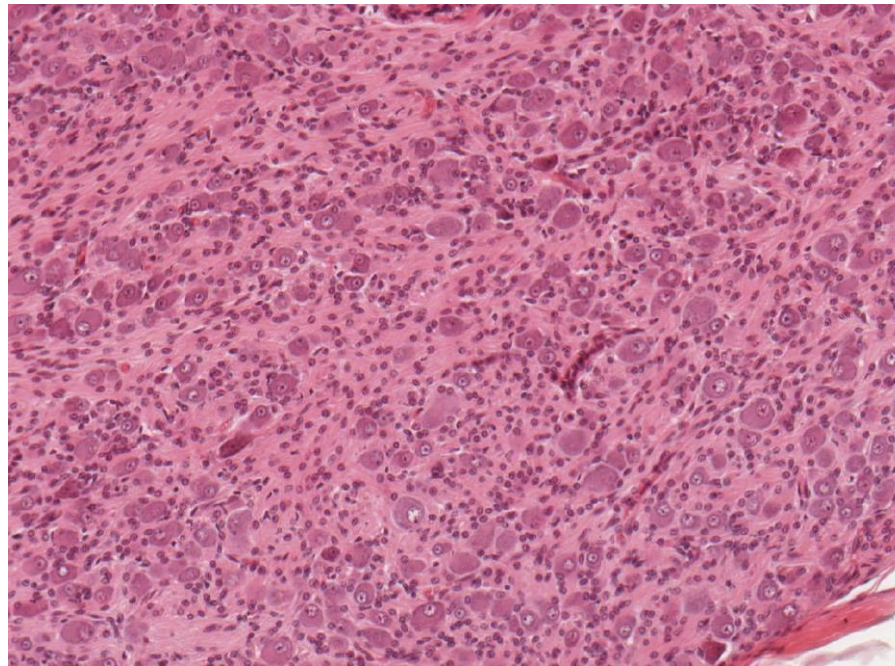
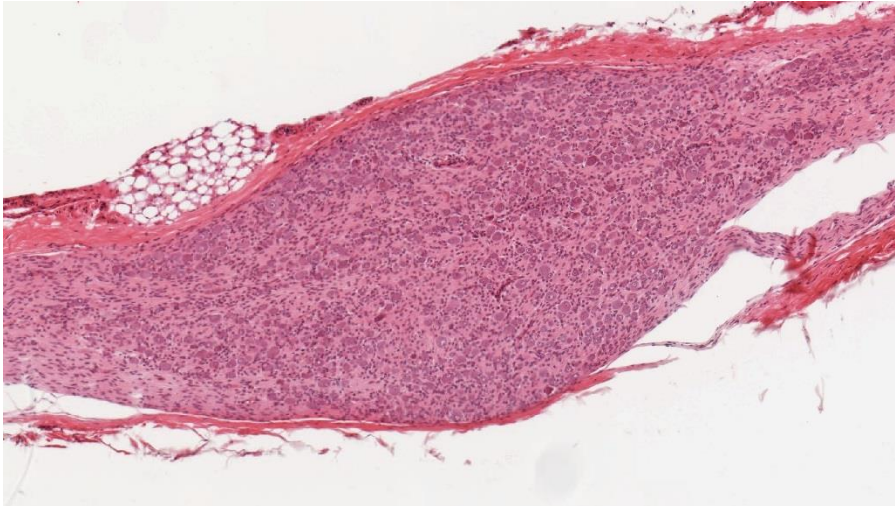


Ganglion spinale (DRG) – pseudounipolární neuron



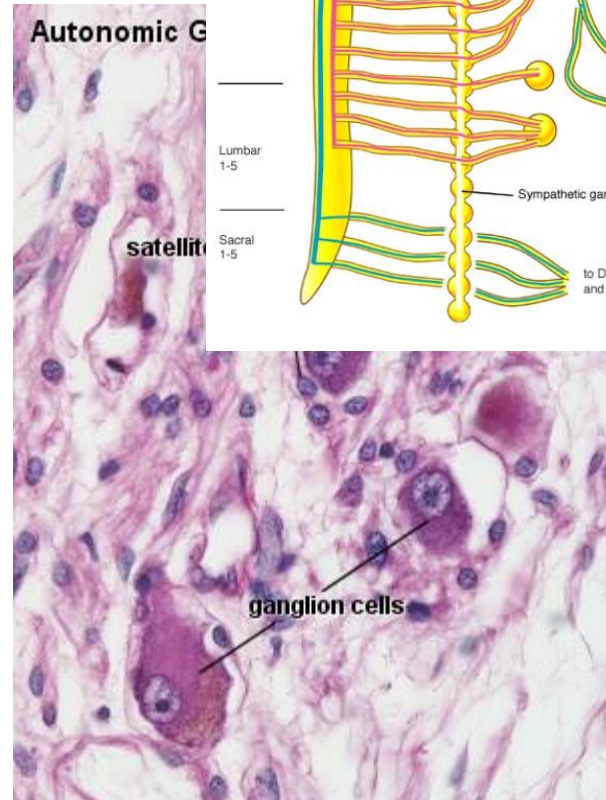
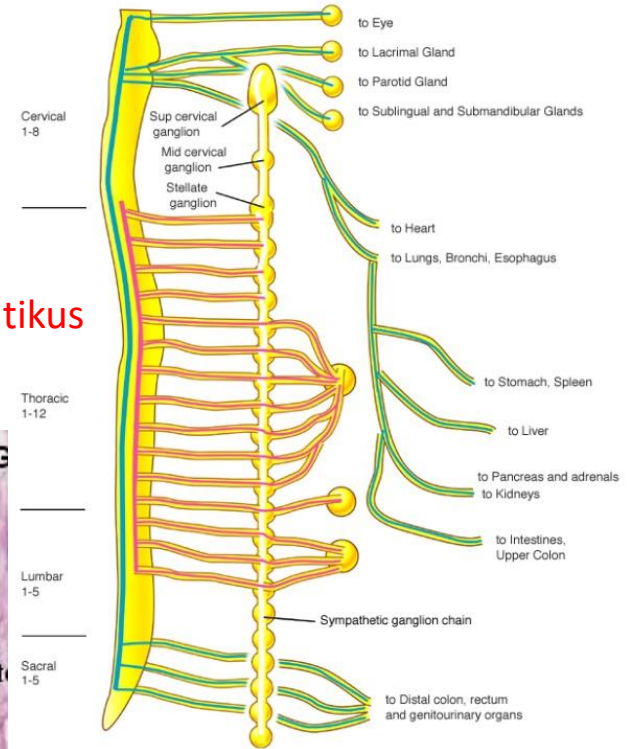
Ganglia autonomní

multipolární neurony a neuroglie



parasymptikus

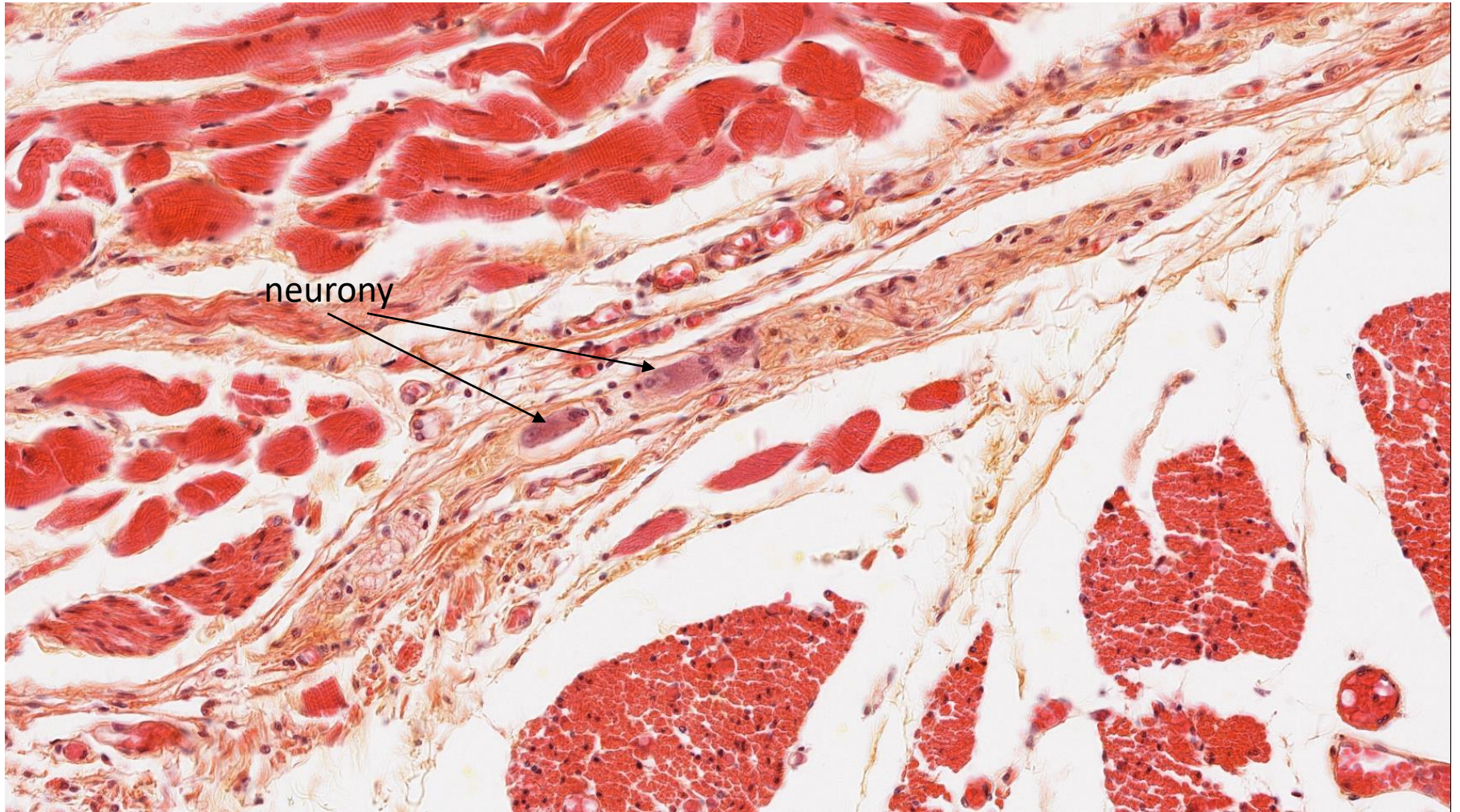
sympatikus



Ganglia autonomní

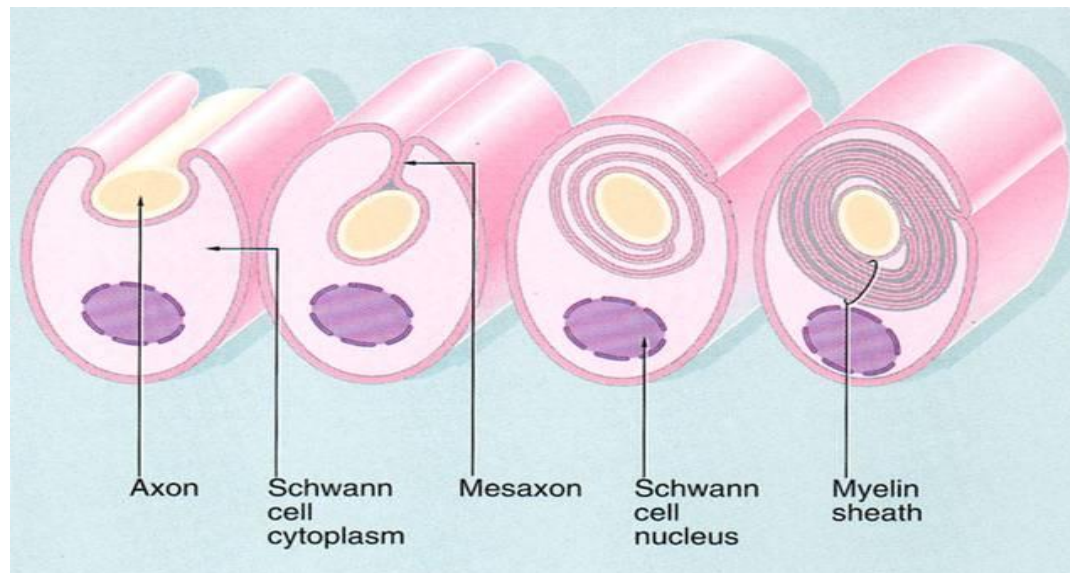
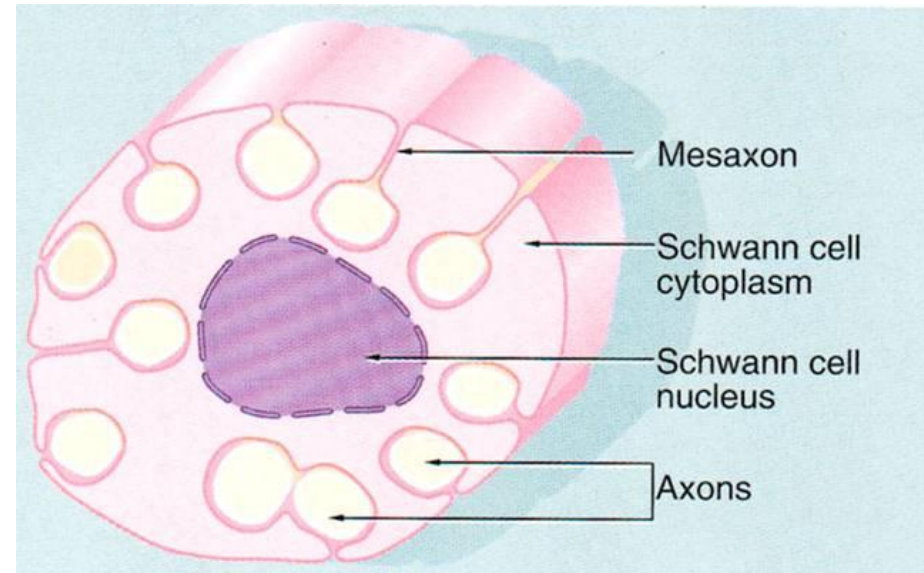
intramurální ganglia ve stěně vnitřních orgánů – př. *plexus myentericus* v *tunica muscularis externa*

jícen, HEŠ



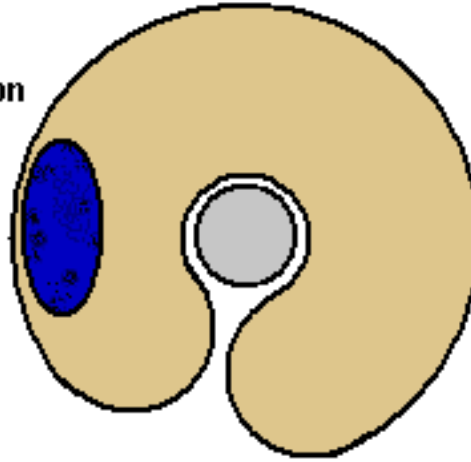
PNS – nervy - nervová vlákna

- nervové vlákno = axon + obal
- 2 typy nervových vláken:
 - **nemyelinizovaná**
jen *neurilema* (autonomní nervy - šedá vlákna Remakova)
 - **myelinizovaná**
Schwannova pochva (*neurilema*) + myelinová pochva (cerebrospinální nervy - bílá vlákna)

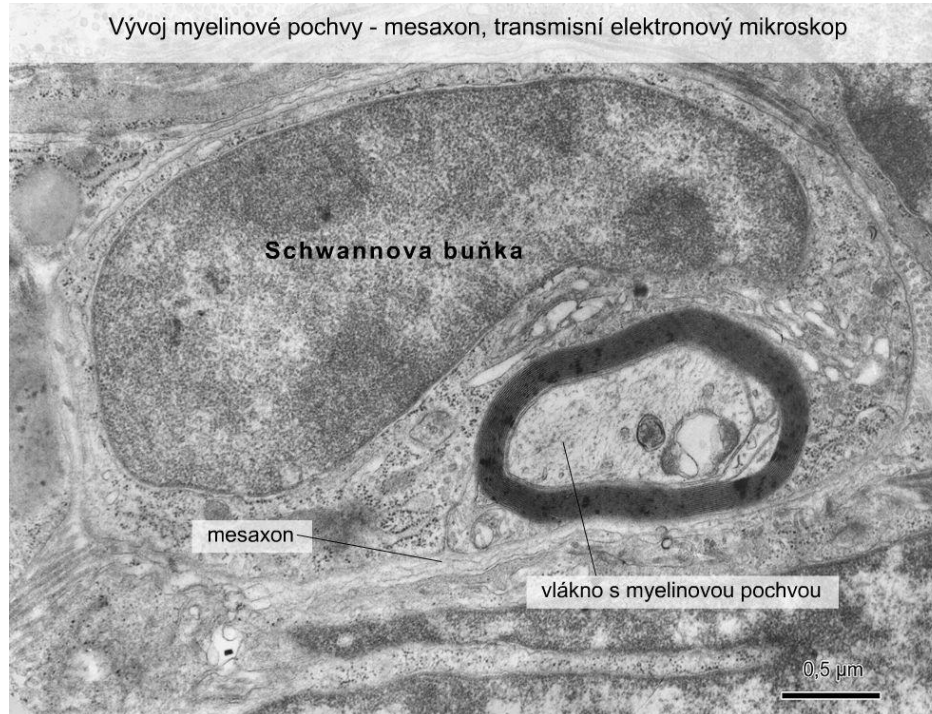


PNS - nervová vlákna – tvorba myelinu

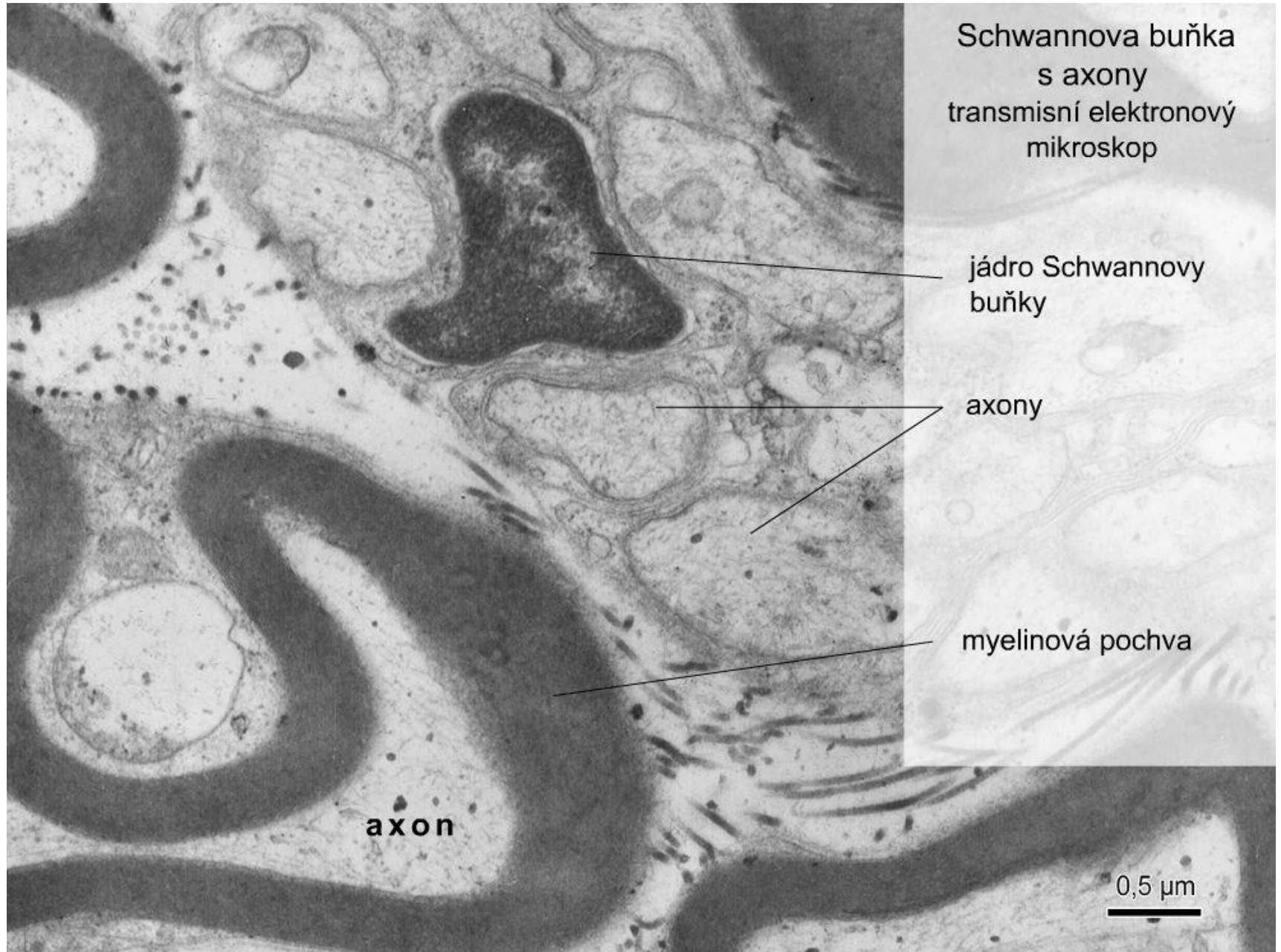
Myelination of
a peripheral axon



Vývoj myelinové pochvy - mesaxon, transmisní elektronový mikroskop



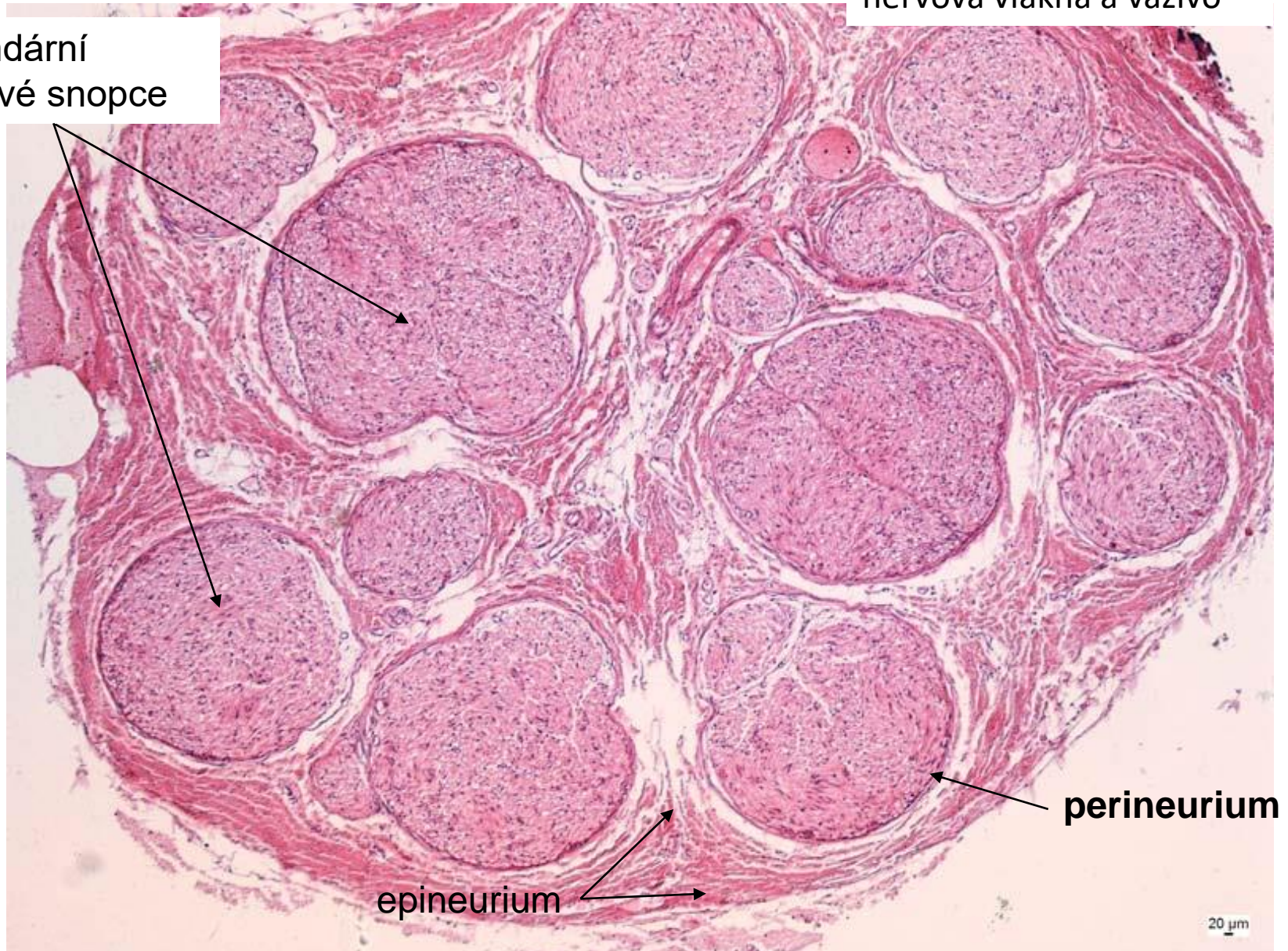
PNS - nervová vlákna



Periferní nerv

nervová vlákna a vazivo

sekundární
nervové snopce

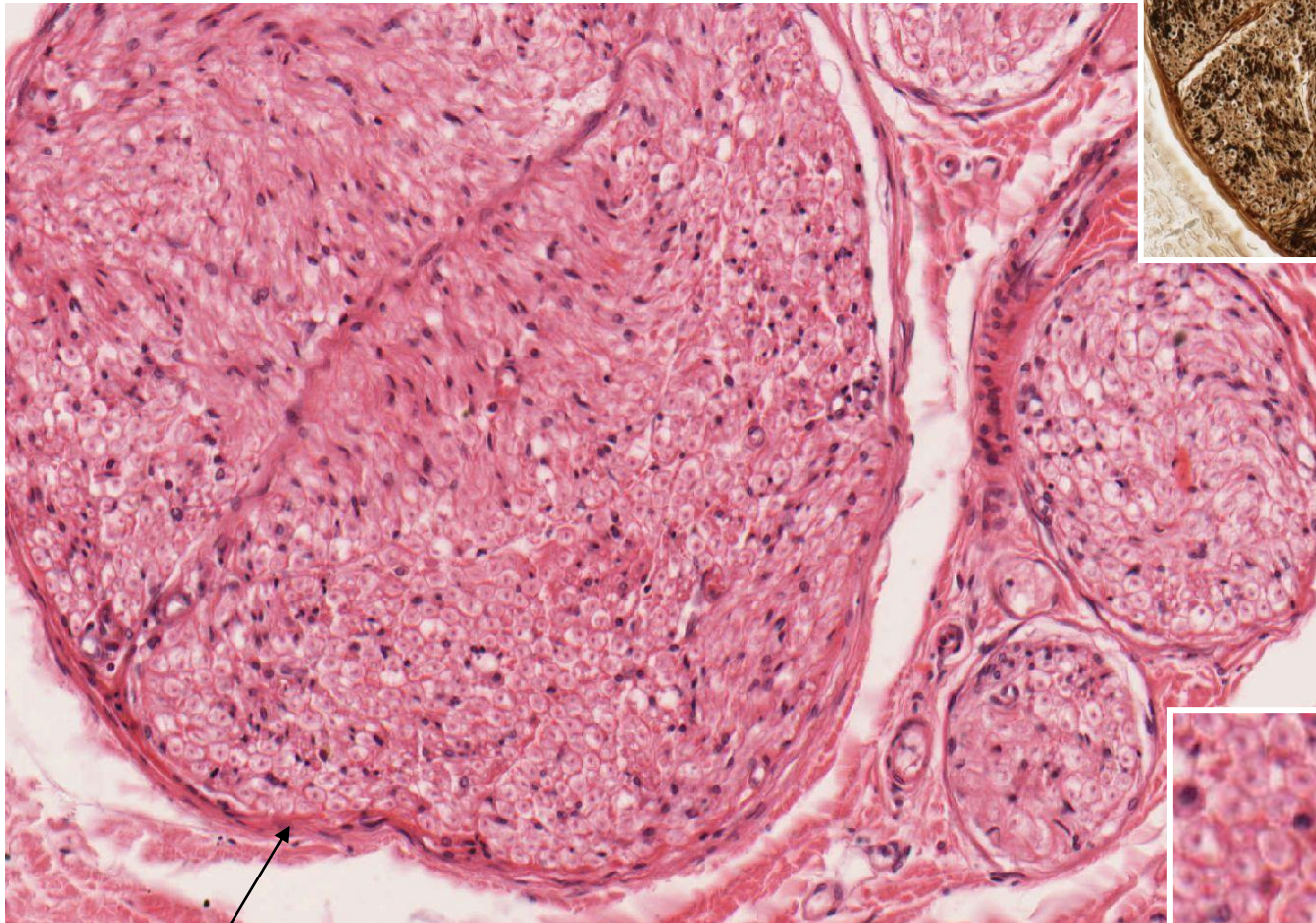


perineurium

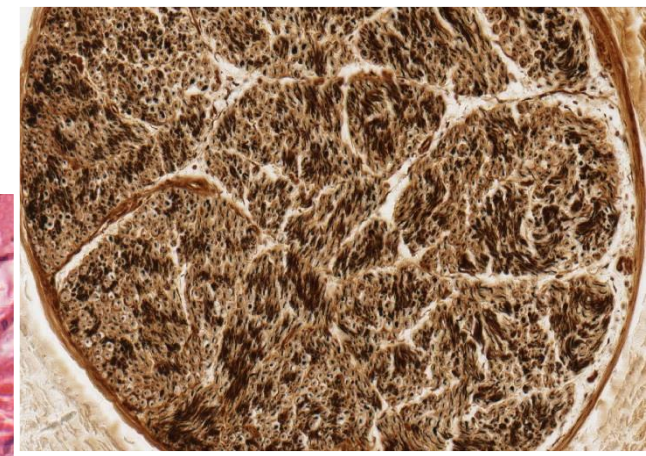
epineurium

20 μm

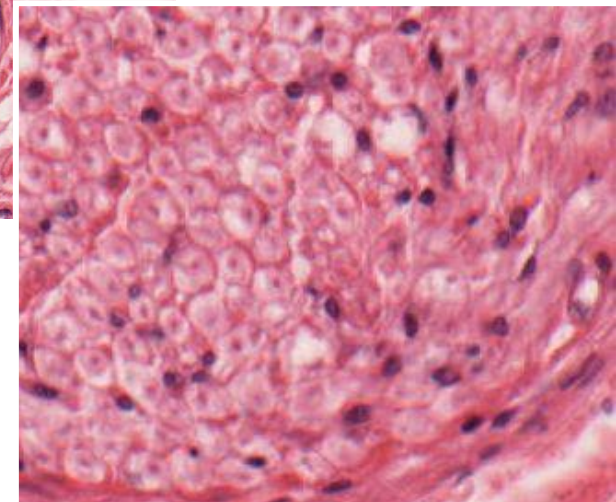
Periferní nerv



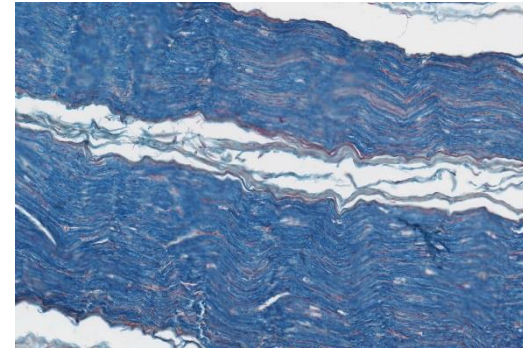
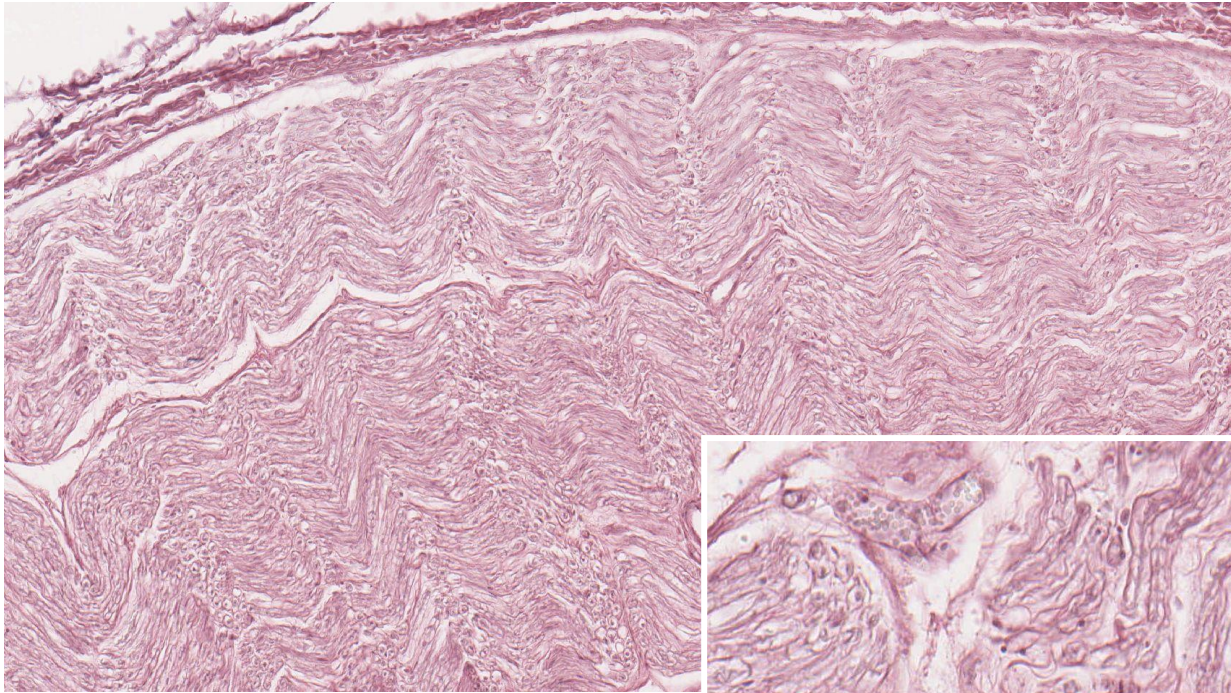
perineurium



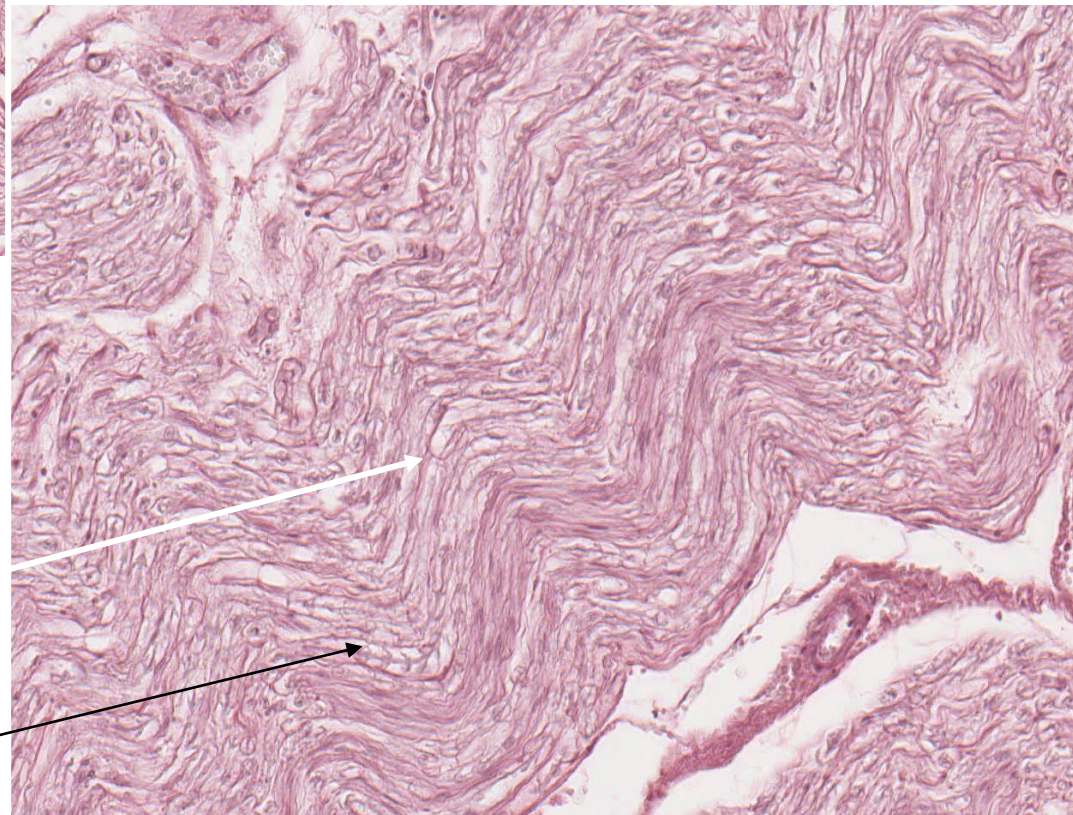
impregnace



Periferní nerv



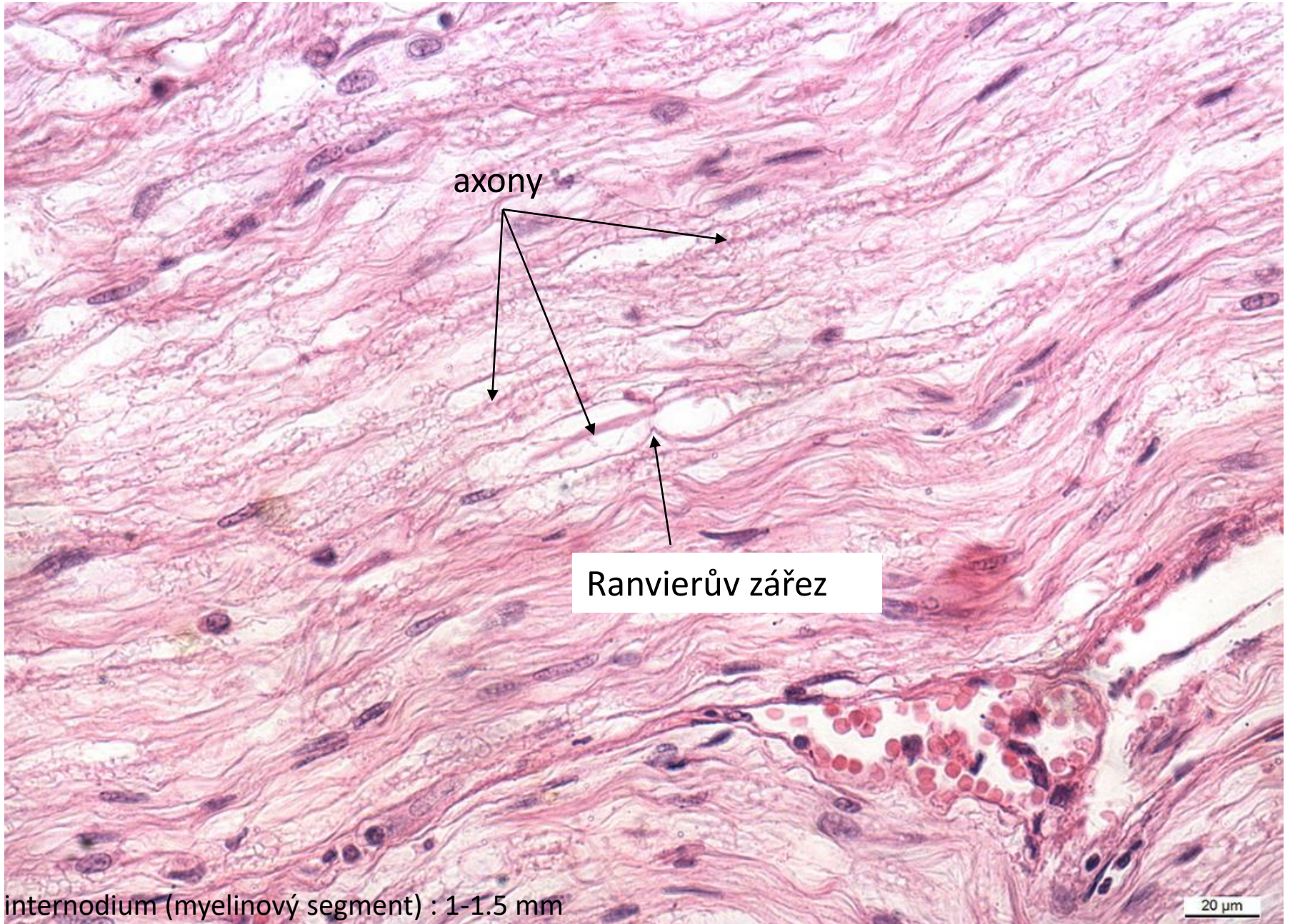
barvení na myelin - luxolová modř



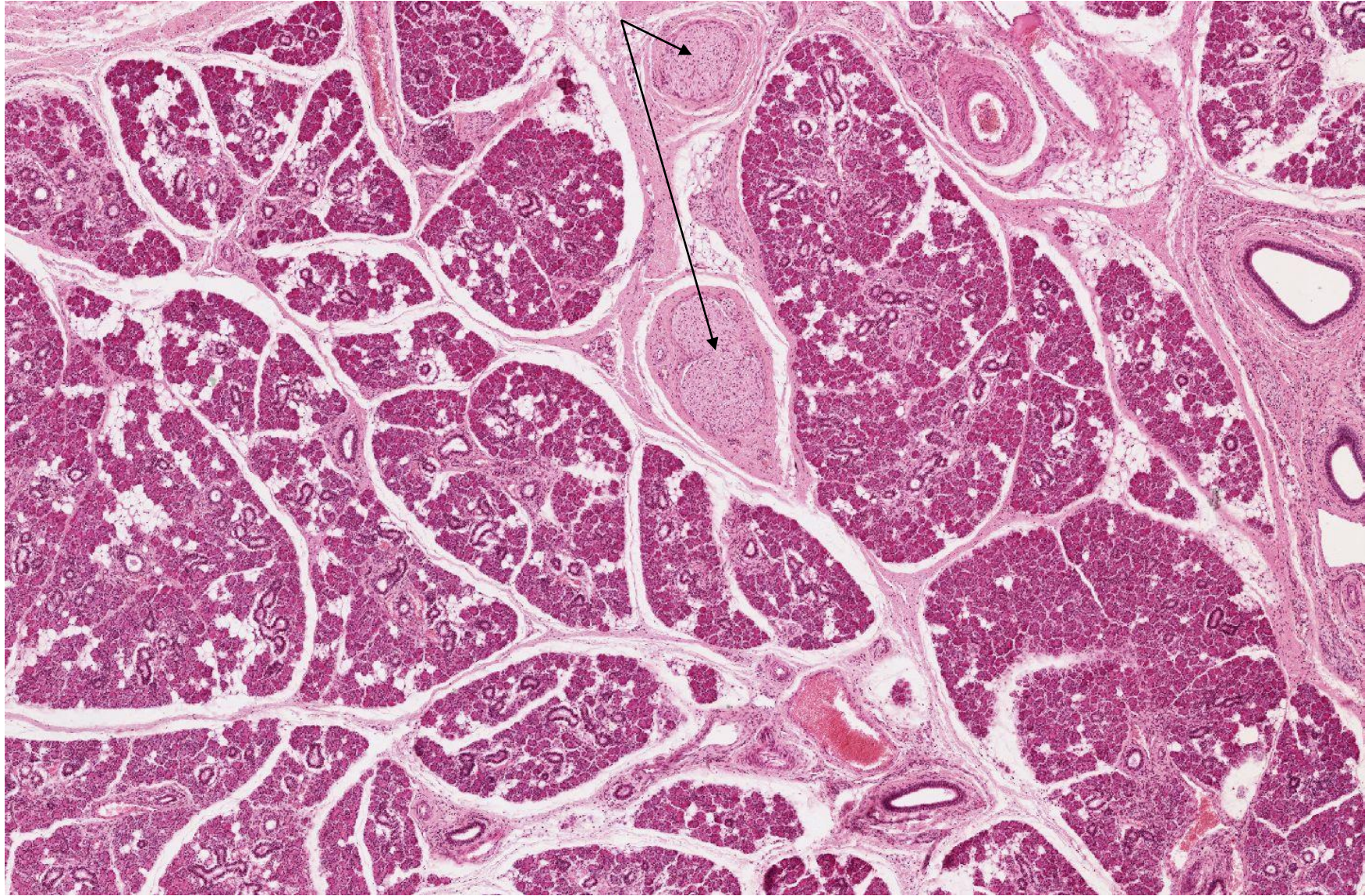
Ranvierův
zářez

Schmidt-Lantermanovy
náručky

Periferní nerv – podélný řez



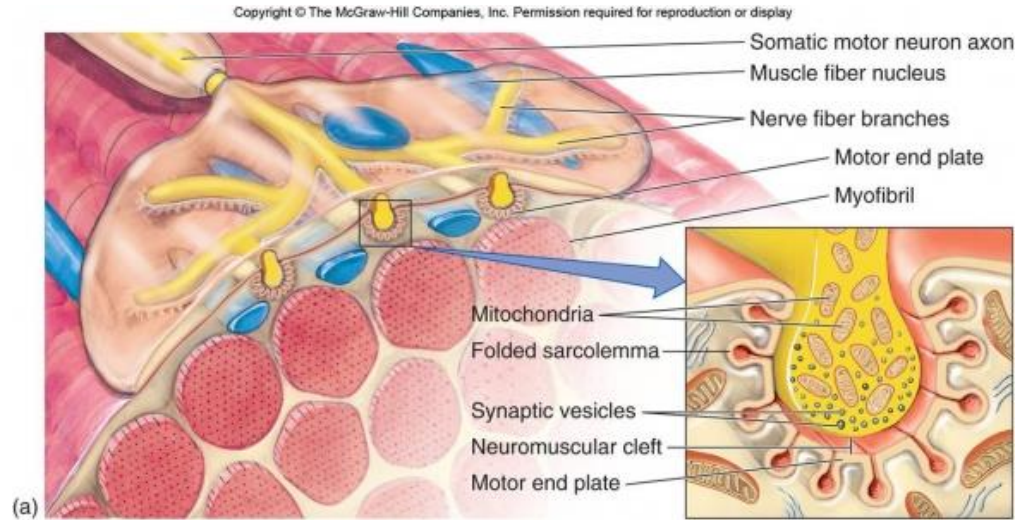
Periferní nervy – ve tkáních



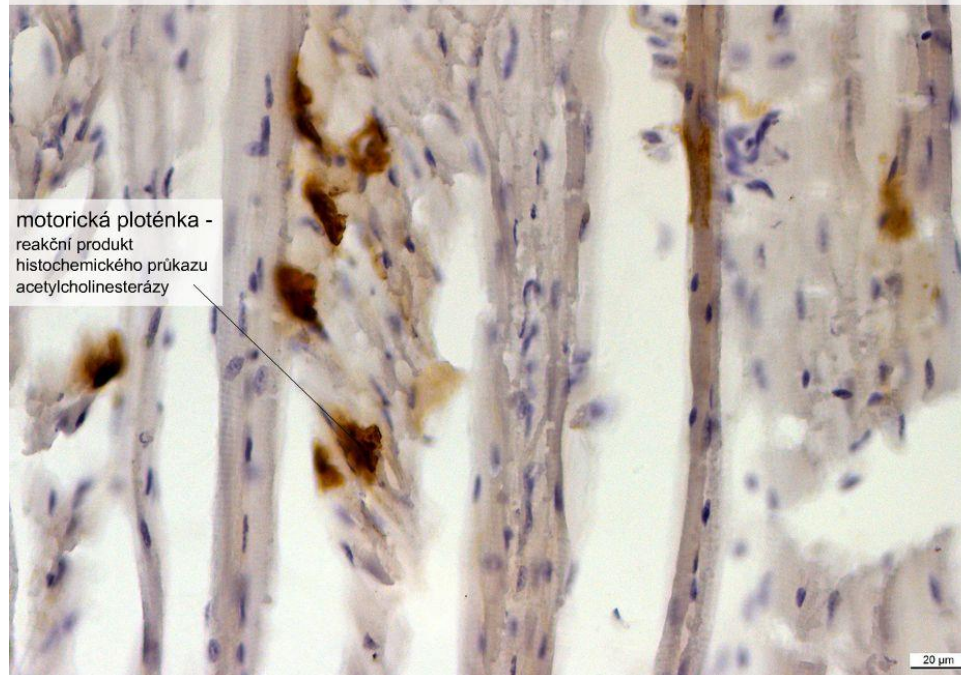
glandula parotis

Motorická ploténka

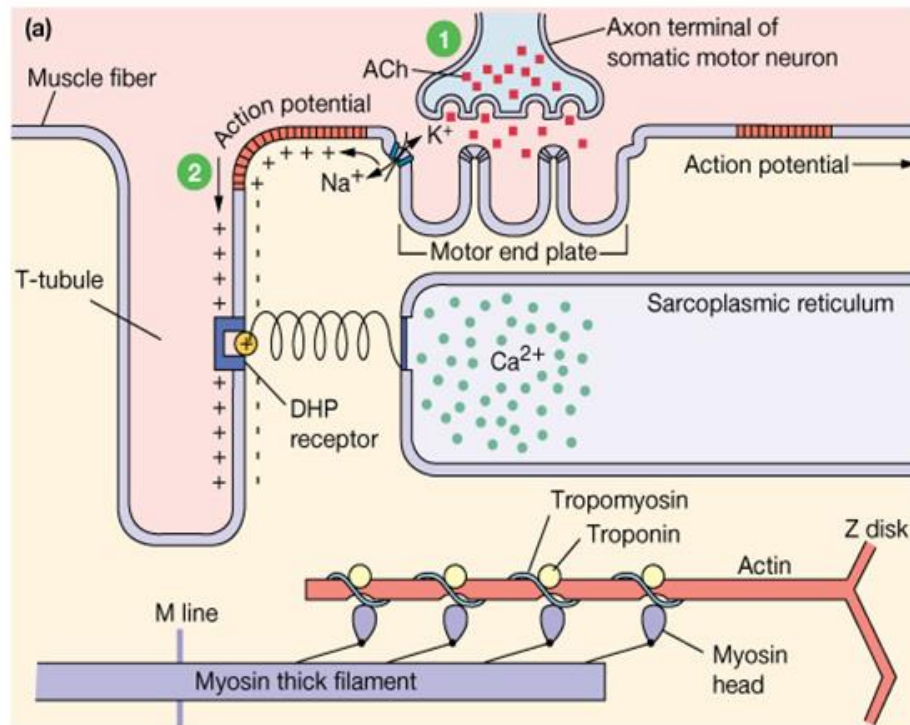
speciální velkoplošná
synapse



Motorická ploténka, (průkaz acetylcholinesterázy), objektiv 40×



Motorická ploténka - funkce



1 Somatic motor neuron releases ACh at neuromuscular junction.

2 Net entry of Na^+ through ACh receptor-channel initiates a muscle action potential.

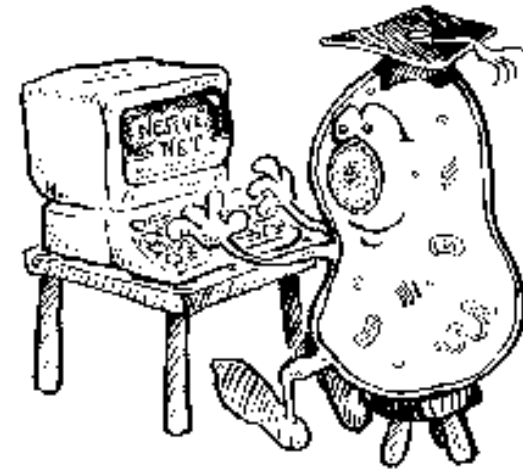


Motorická jednotka – soubor všech svalových vláken, která inervačně náleží k jednomu motoneuronu, např. okohybné svaly – 3-5 svalových vláken na 1 motoneuron, *mm. glutei* – 100-200 svalových vláken na 1 motoneuron

AuCl_2

Nervový systém

- 75. Cortex cerebri
- 76. Cortex cerebri /impregnace/
- 77. Cerebellum /impregnace/
- 78. Cerebellum /Nisslova substance/
- 79. Medulla spinalis
- 80. Plexus choroideus
- 81. Ganglion spinale
- 82. Ganglion spinale /impregnace/
- 83. Ganglion vegetativní
- 84. Periferní nerv – příčně
- 85. Periferní nerv – příčně /myelin/
- 86. Periferní nerv – podél
- 87. Periferní nerv – podél /myelin/



Děkuji Vám za pozornost.
Jana Dumková

otázky a komentáře na:
jdumkova&med.muni.cz