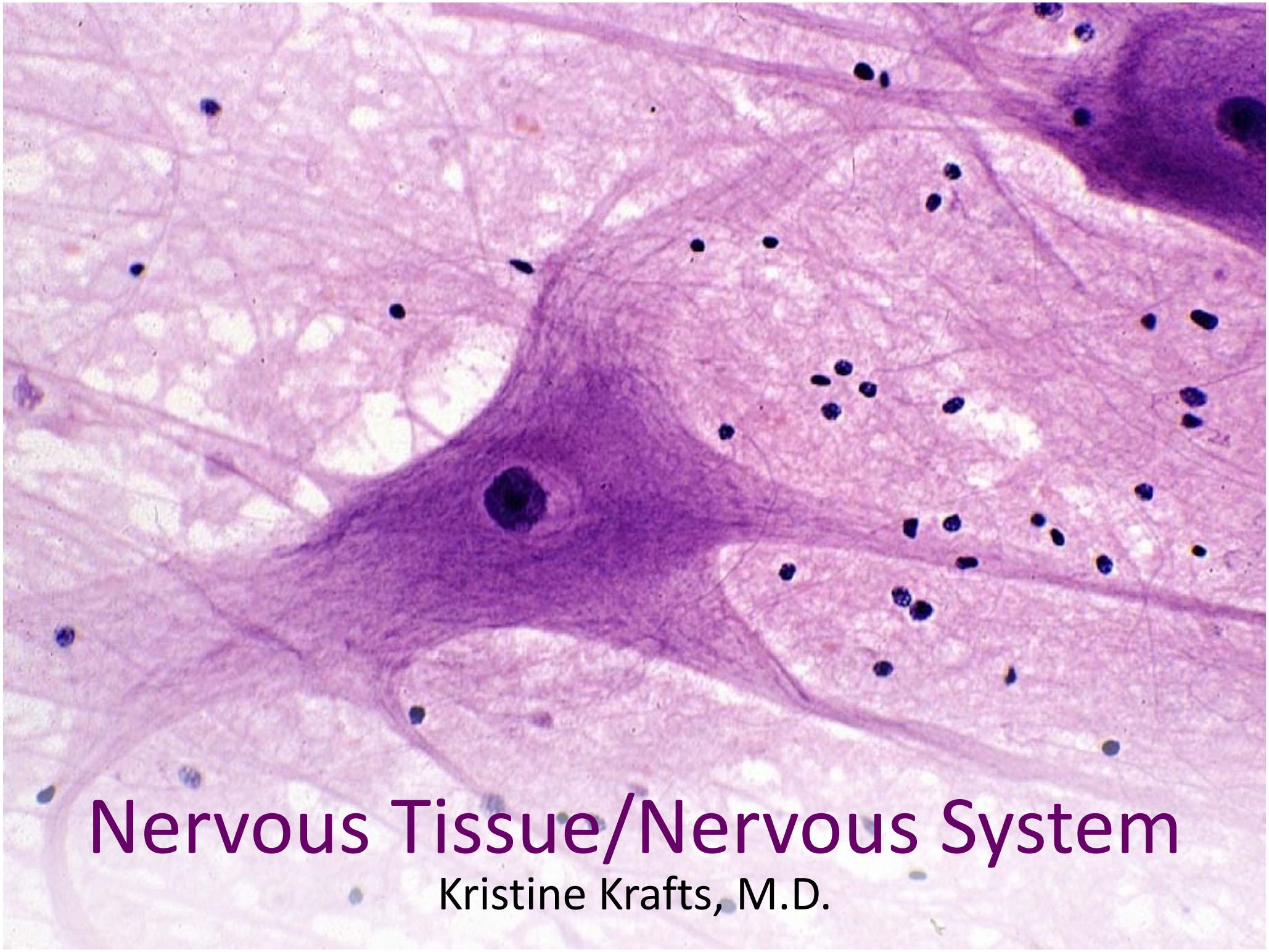


Nervous Tissue/Nervous System

Kristine Krafts, M.D.

Nervous System Lecture Objectives

- Describe the anatomical and functional organization of the nervous system.
- Describe the histologic features of neurons, their processes, and synapses.
- Describe the histologic features and functions of glial cells.

More Nervous System Lecture Objectives

- Describe how what myelin does and how it is produced in the central vs. peripheral nervous system.
- Describe the histologic structure of gray vs. white matter in the cerebrum, cerebellum, and spinal cord.
- Describe the structure of the meninges. Where does the cerebrospinal fluid reside?
- Describe the structure and function of the blood brain barrier and glymphatics.

Nervous System Lecture Outline

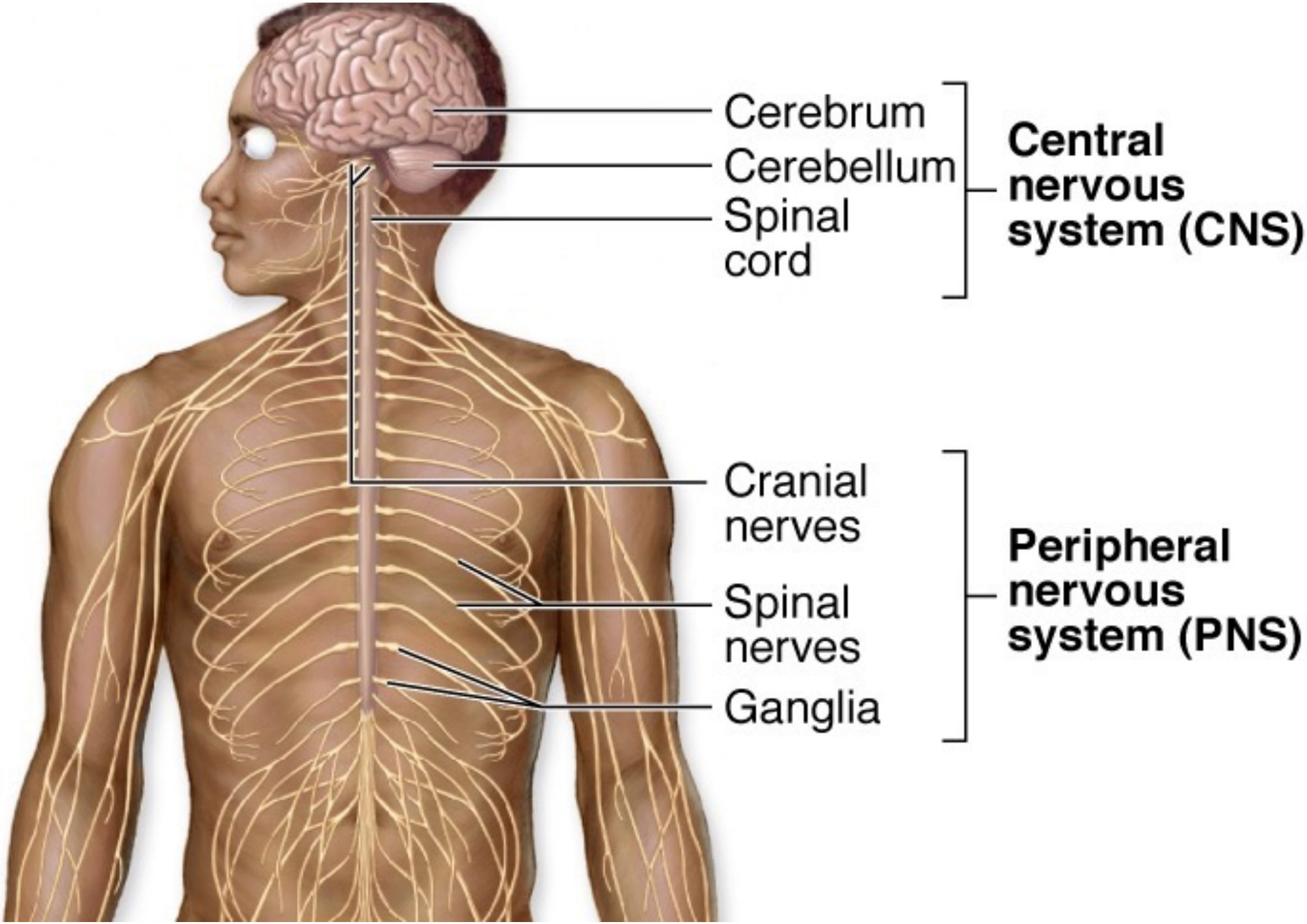
- Organization of the nervous system
- Cells of the nervous system
- Central nervous system

Nervous System Lecture Outline

- Organization of the nervous system

Organization of Nervous System

- Central nervous system (CNS) = brain + spinal cord
- Peripheral nervous system (PNS) = peripheral nerves + nerve ganglia (groups of nerve cell bodies outside the CNS)
- Peripheral nervous system has motor and sensory components.

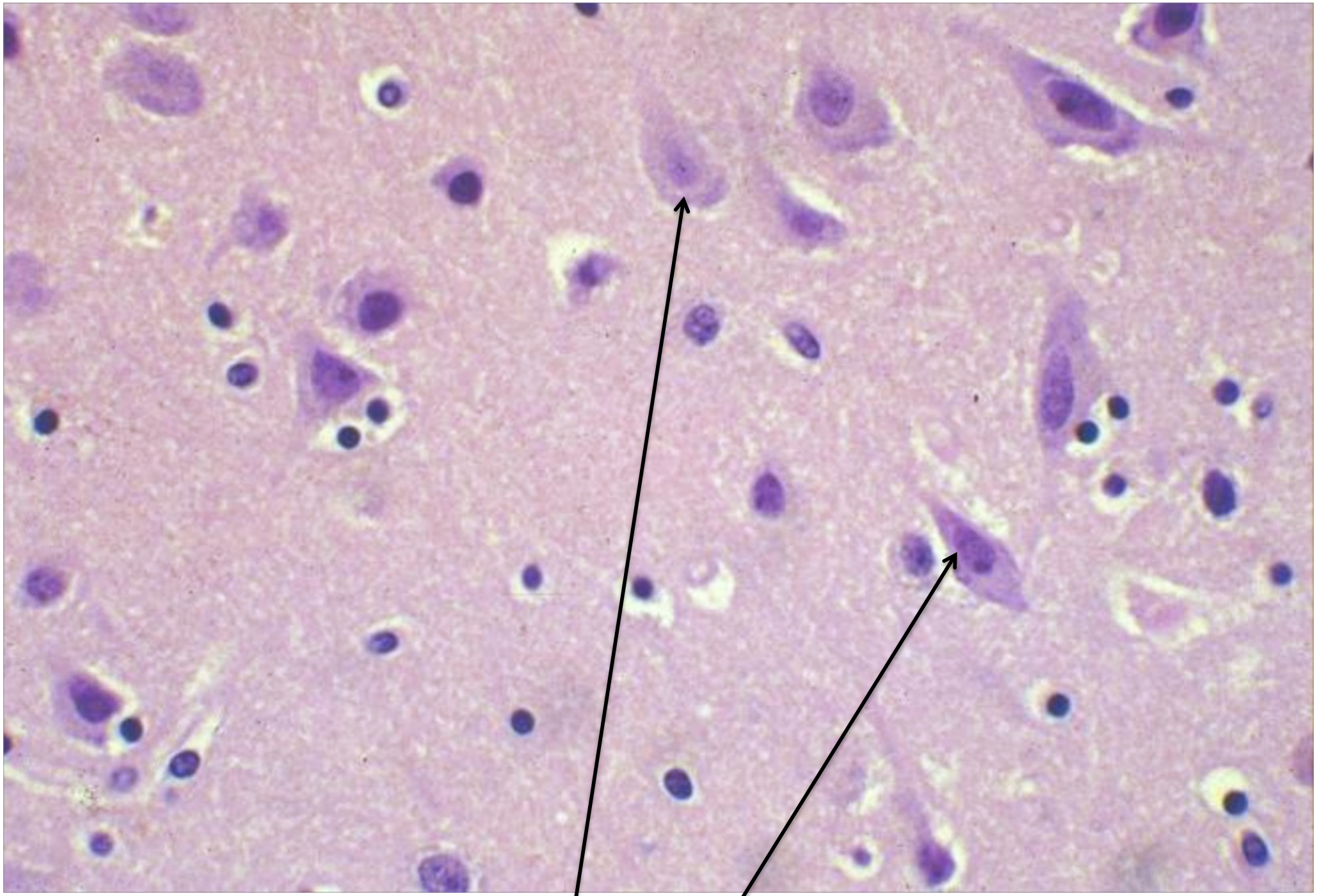

Cerebrum
Cerebellum
Spinal cord
Central nervous system (CNS)
Cranial nerves
Spinal nerves
Ganglia
Peripheral nervous system (PNS)

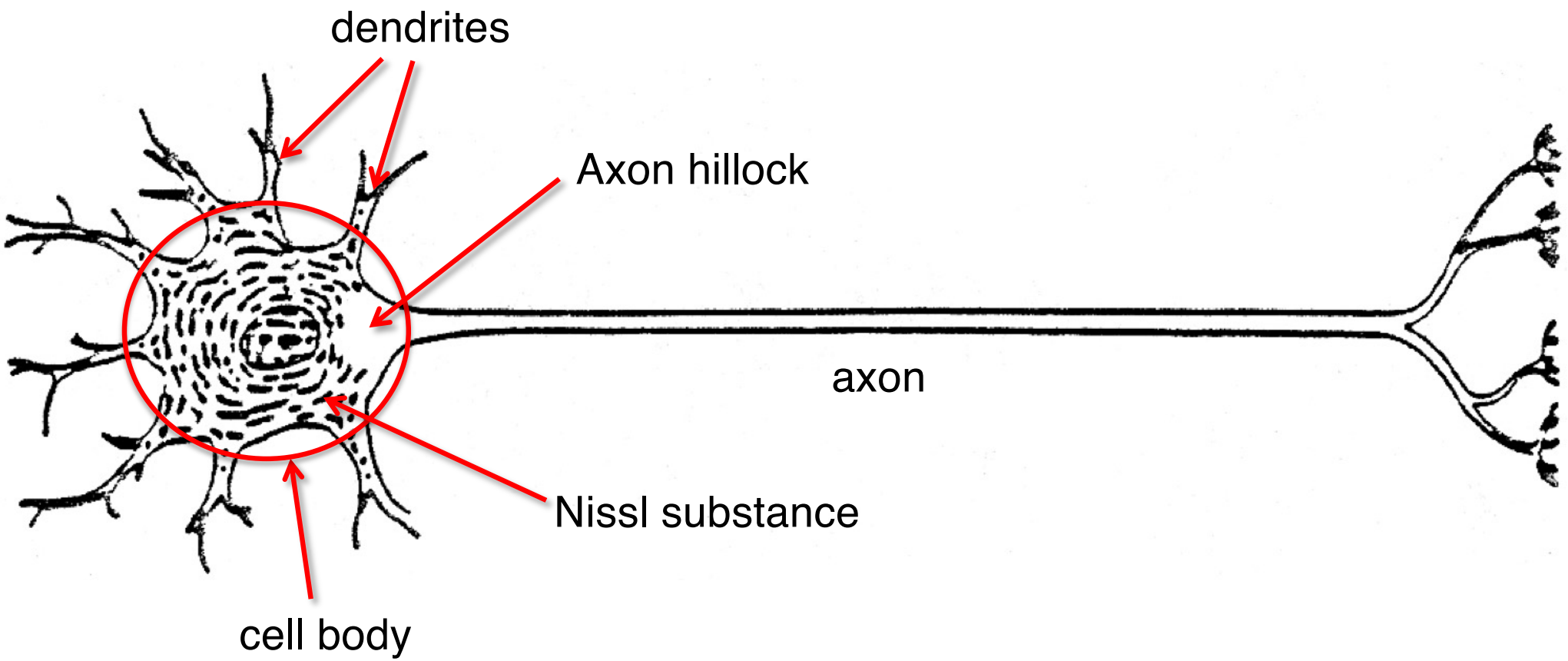
Nervous System Lecture Outline

- Organization of the nervous system
- Cells of the nervous system
  - Neurons
  - Glial cells

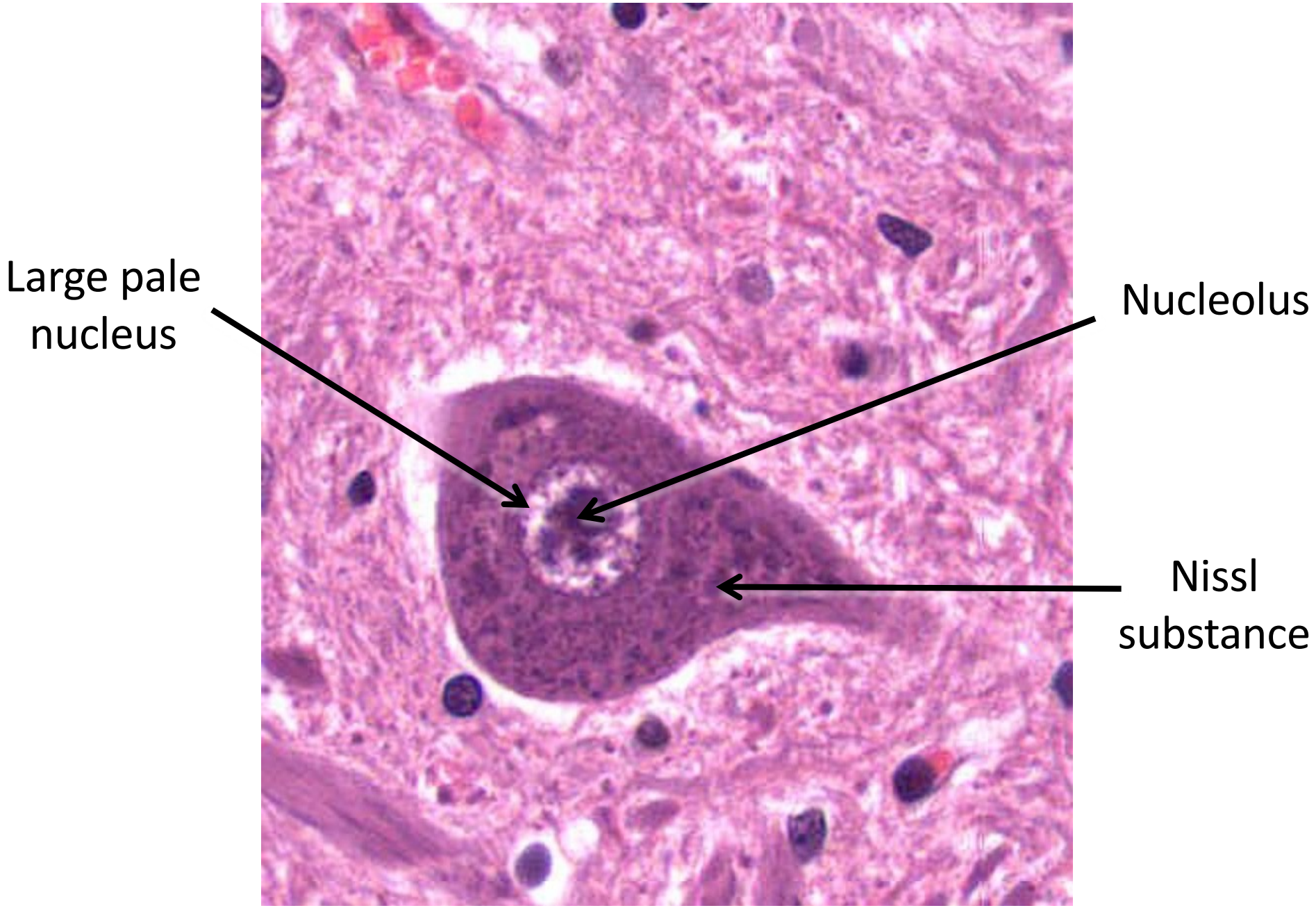
Nervous System Lecture Outline

- Organization of the nervous system
- Cells of the nervous system
  - Neurons

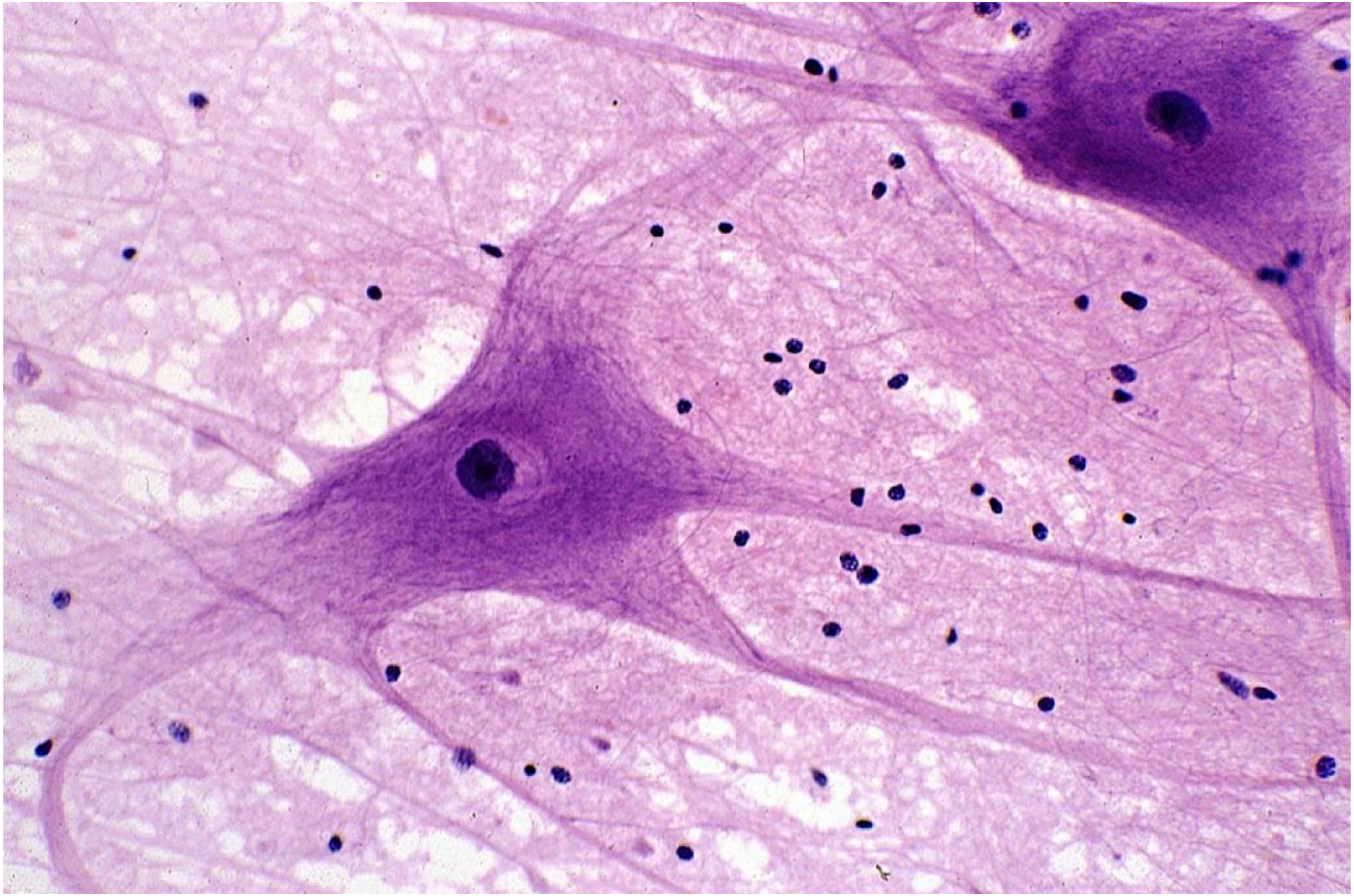

Neurons



- **Cell body** maintains the cell; can receive synaptic input
- Tons of **Nissl substance** (rough ER)
- Multiple **dendrites** (receive impulses)
- One **axon** (sends out impulses) – originates at "axon hillock"
- Cytoskeleton contains neurofilaments (for structure) and microtubules (for transport along axons)



Neuron cell body



Gorgeous, sexy neuron and neuropil

Gorgeous, sexy J. Crew shimmer net skirt

Gorgeous, sexy Louis Vuitton tulle skirt

This year's September issue!

Gorgeous, sexy Michael Kors tulle skirt

Bella Hadid
in a gorgeous,
sexy Loewe
net dress


Gorgeous, sexy Precious Lee,
Paloma Elsesser, & Devyn Garcia
in gorgeous, sexy John Galliano
sheer net tulle dresses

Nervous System Lecture Outline

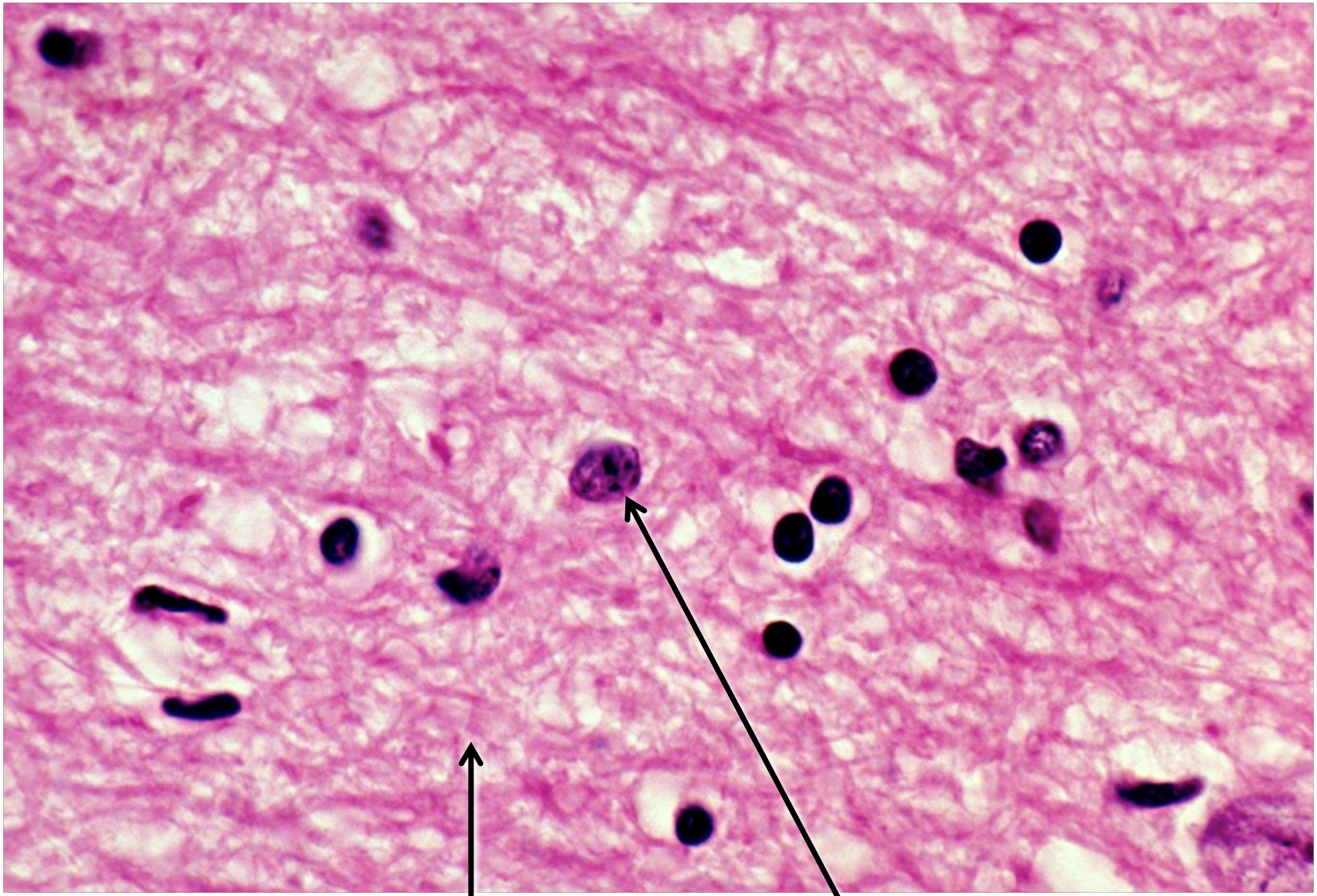
- Organization of the nervous system
- Cells of the nervous system
  - Neurons
  - Glial cells

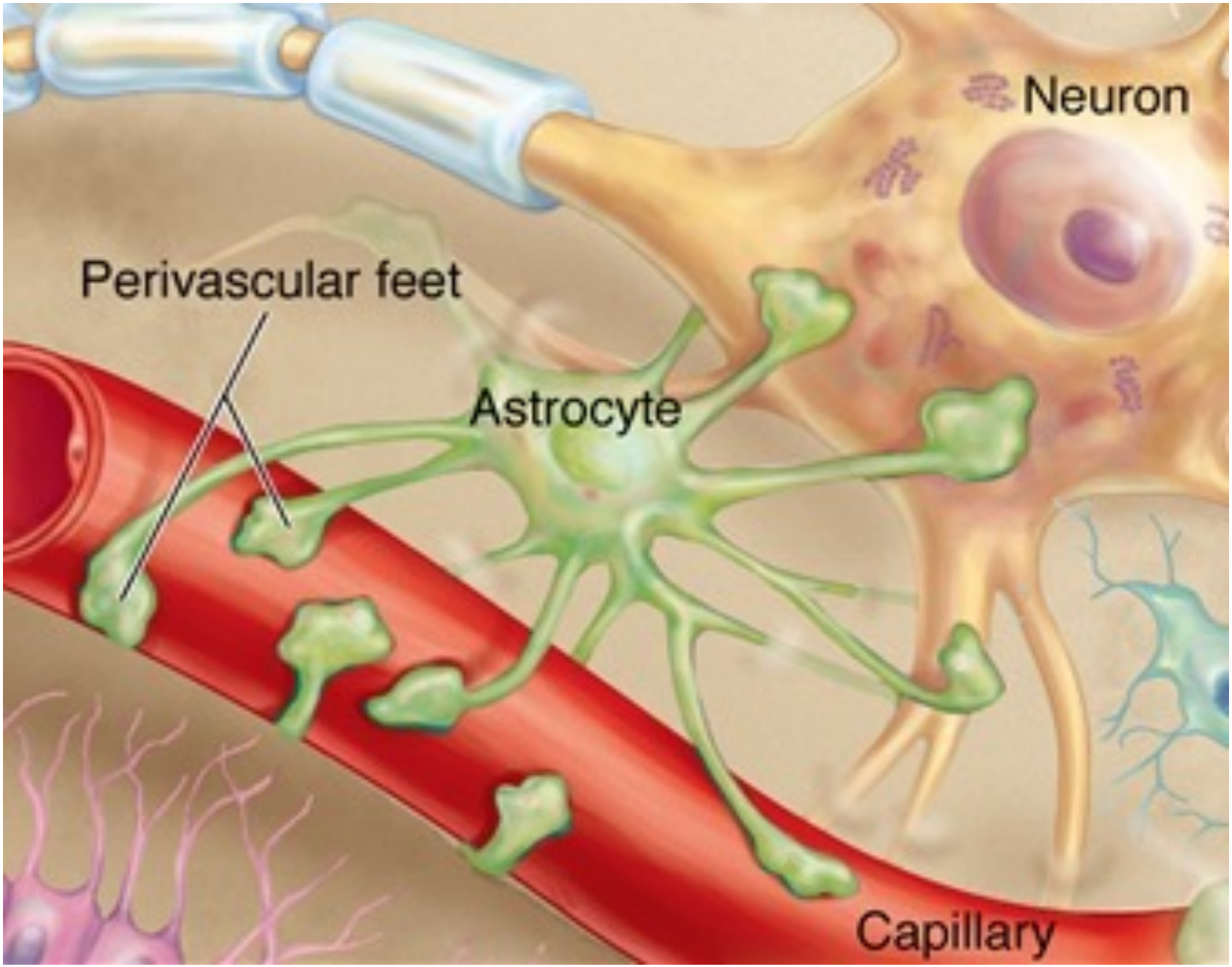
Glial Cells

- 10x more abundant than neurons in brain
- Support and protect neurons
- Five types, each with different functions:
  - Astrocyte
  - Oligodendrocyte
  - Schwann cell
  - Ependymal cell
  - Microglial cell

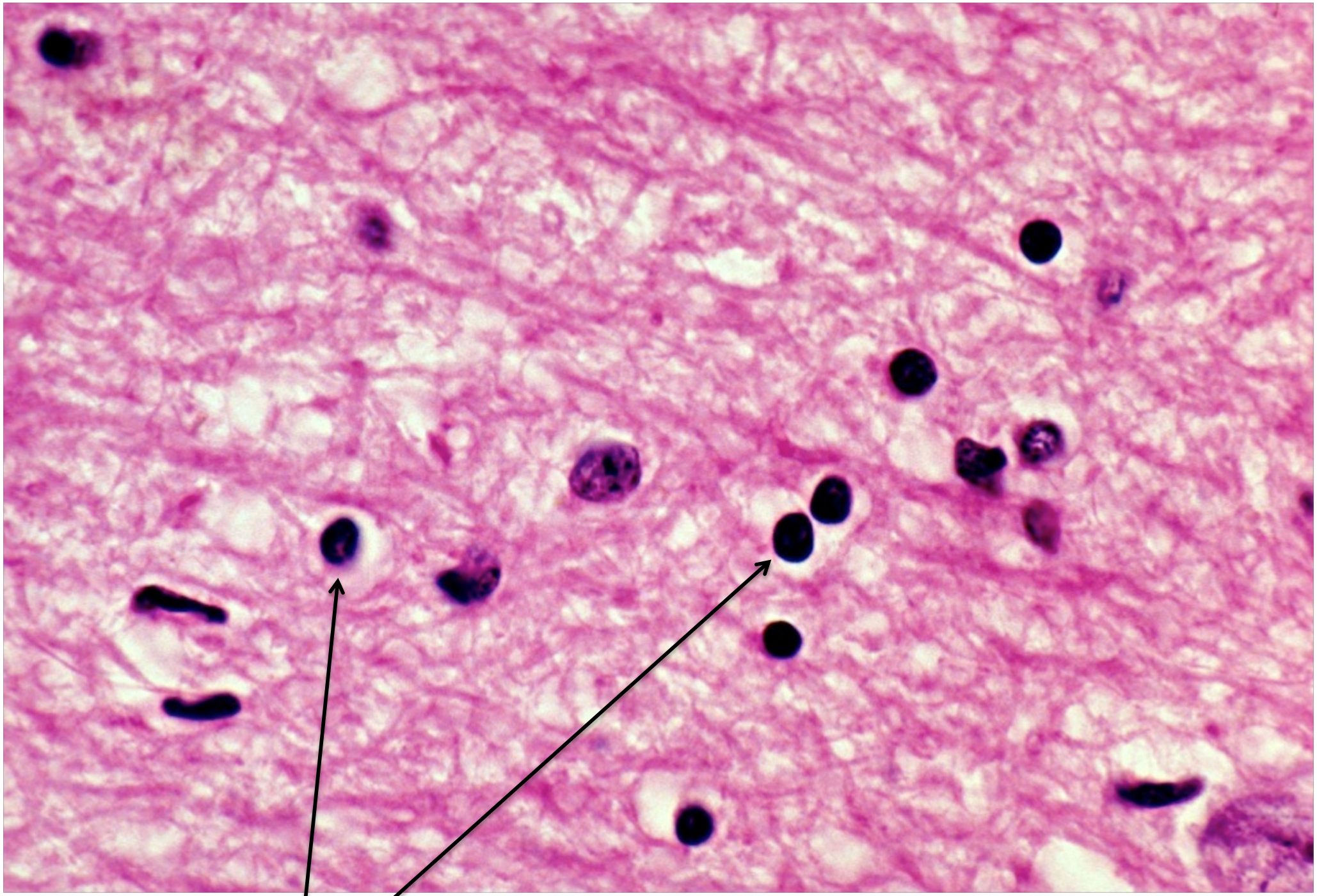
Location and Function of Glial Cells

Glial cell type	Location	Main functions
Astrocyte	CNS	Provides structural support, participates in blood-brain barrier
Oligodendrocyte	CNS	Makes myelin
Schwann cell	PNS	Makes myelin
Ependymal cell	CNS	Lines cavities of CNS
Microglial cell	CNS	Eats up debris and dead cells

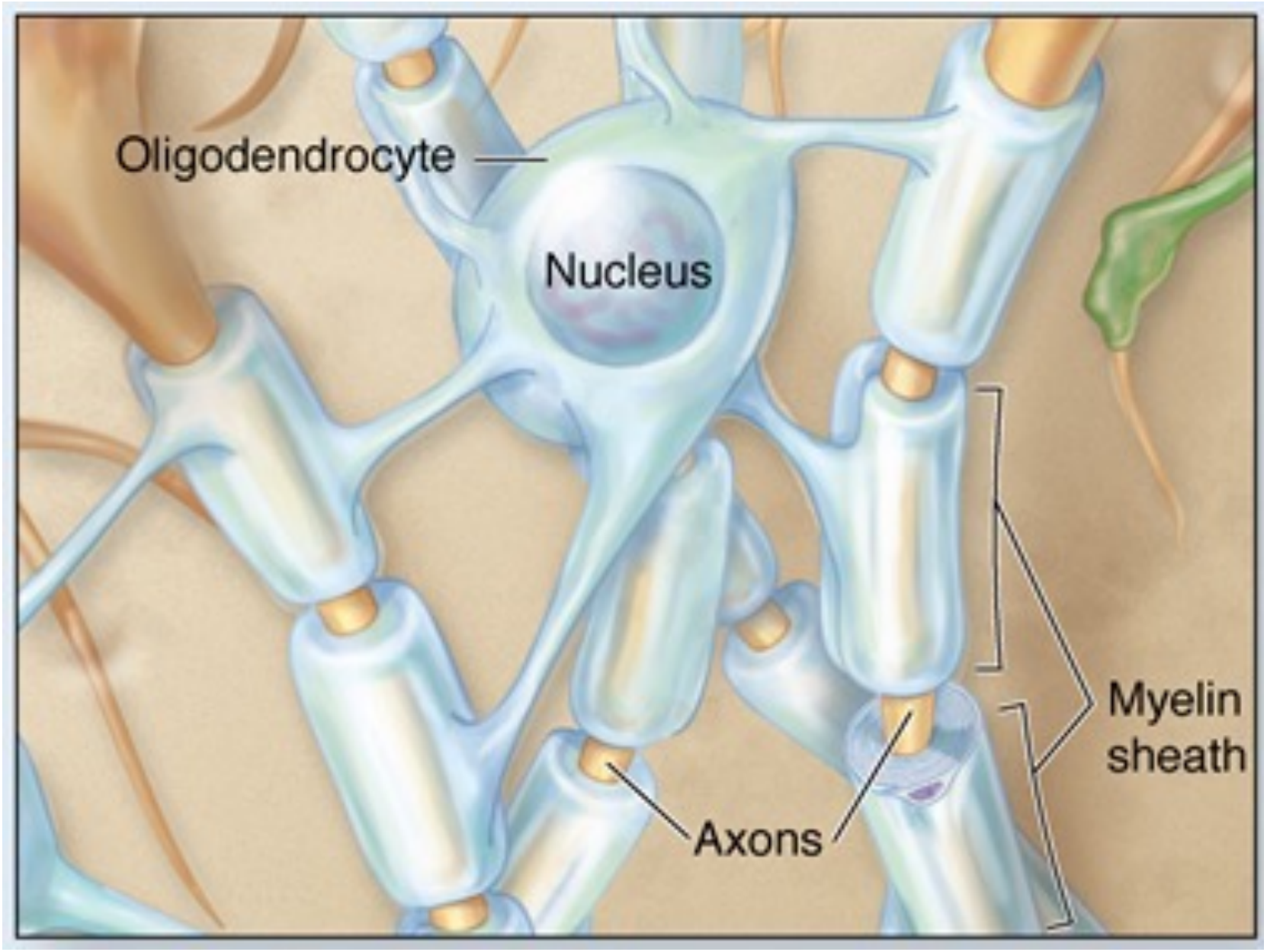

Neuropil and an astrocyte



Astrocyte foot processes bind to capillaries and neurons

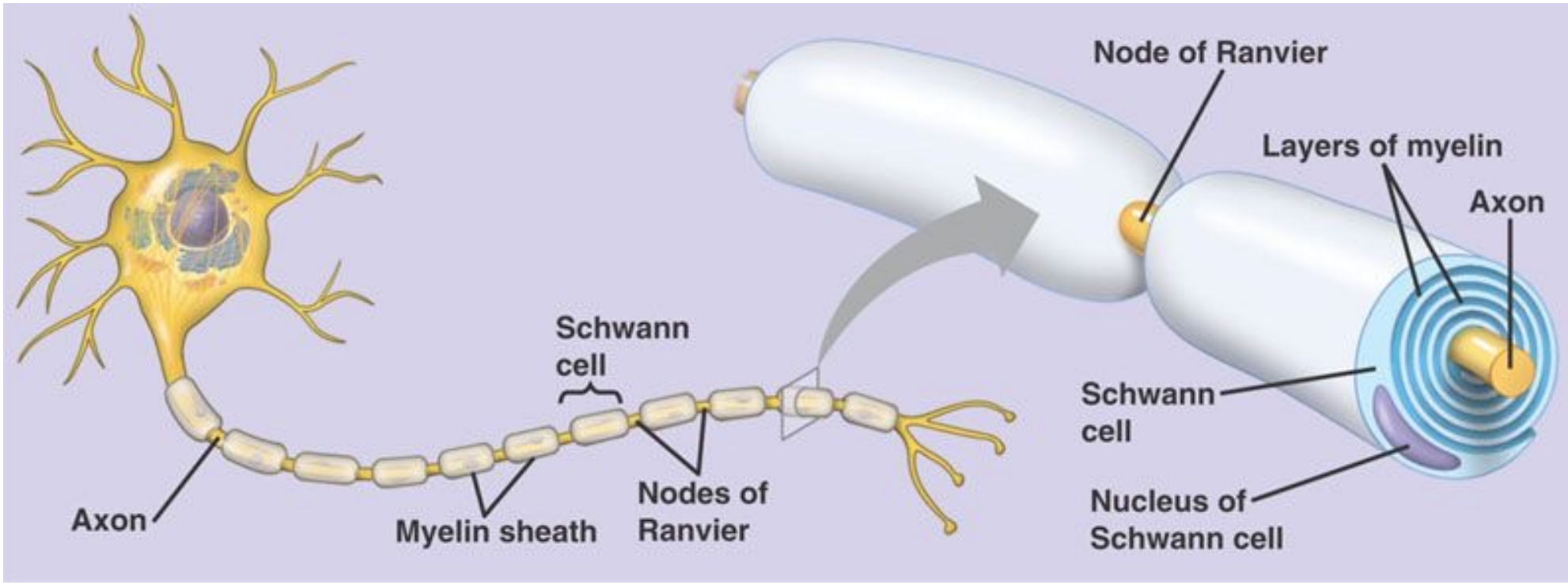


Oligodendrocytes are smaller and darker than astrocytes.



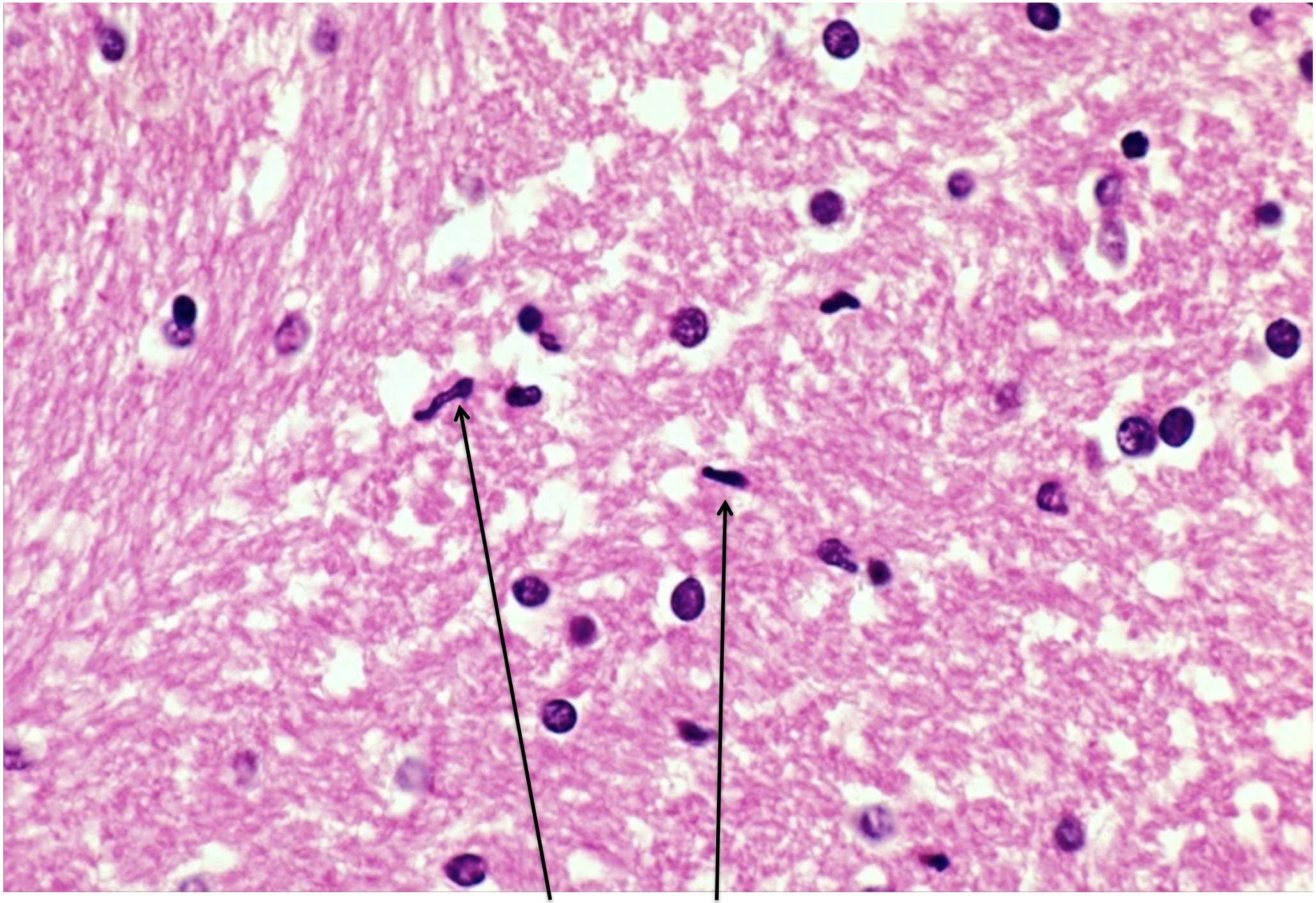
Oligodendrocytes produce myelin in the CNS.

Schwann Cells



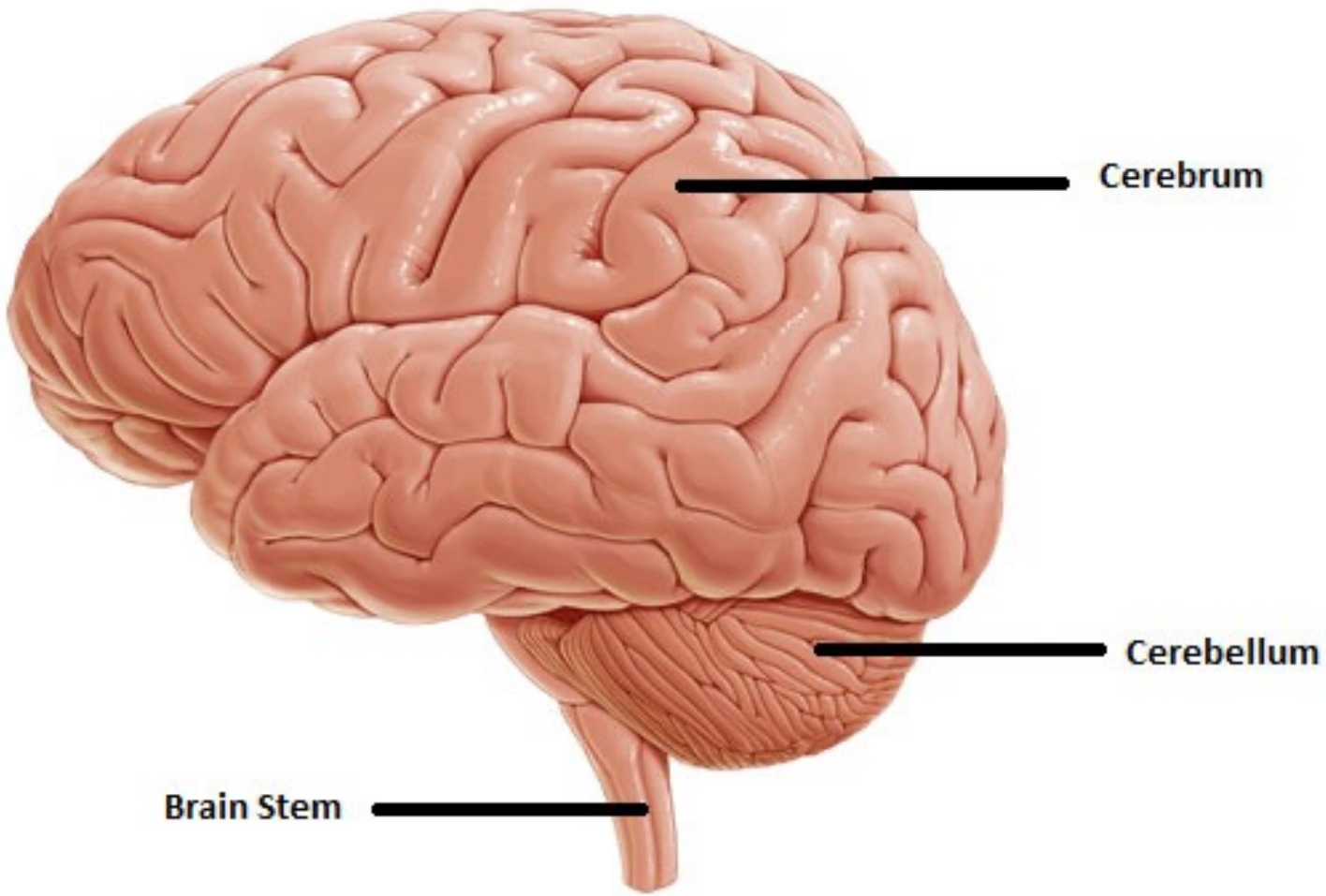
Schwann cells produce myelin in the PNS.


Ependymal cells

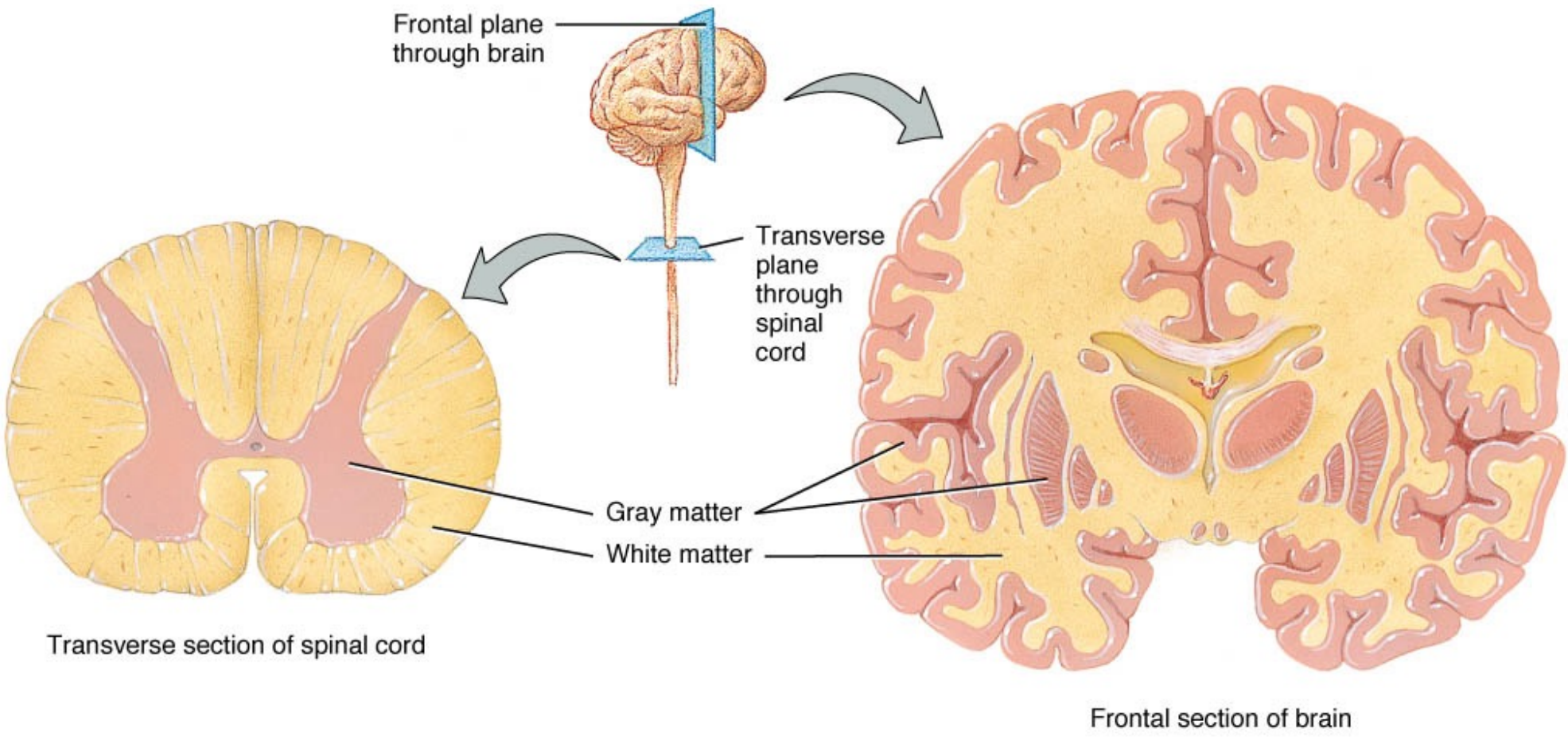

Microglial cells

Nervous System Lecture Outline

- Organization of the nervous system
- Cells of the nervous system
- Central nervous system
  - Cerebrum
  - Cerebellum
  - Spinal cord
  - Meninges
  - Glymphatics and blood brain barrier



Gross anatomy of brain

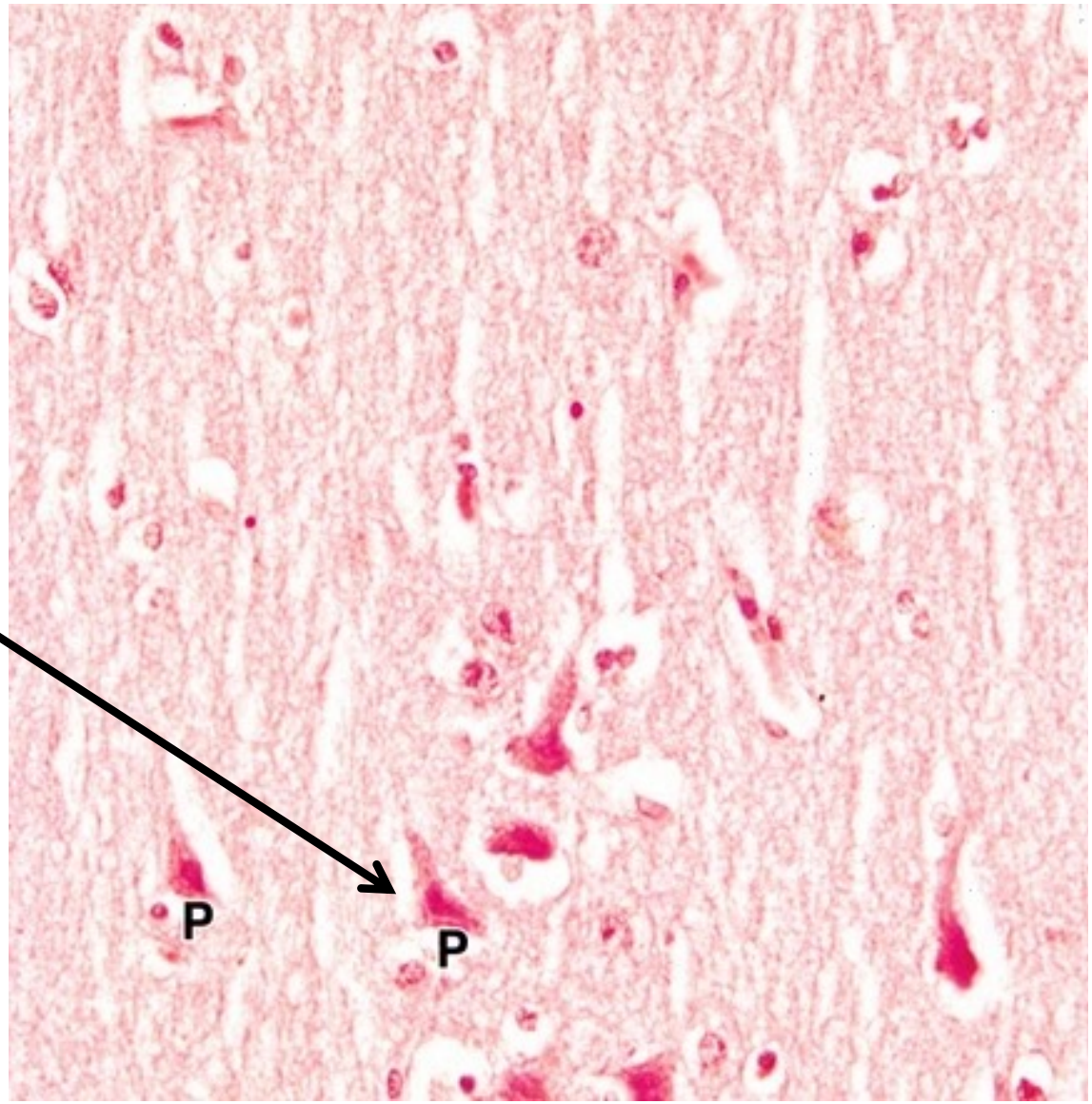

Frontal plane through brain
Transverse plane through spinal cord
Gray matter
White matter
Transverse section of spinal cord
Frontal section of brain

Gray Matter and White Matter

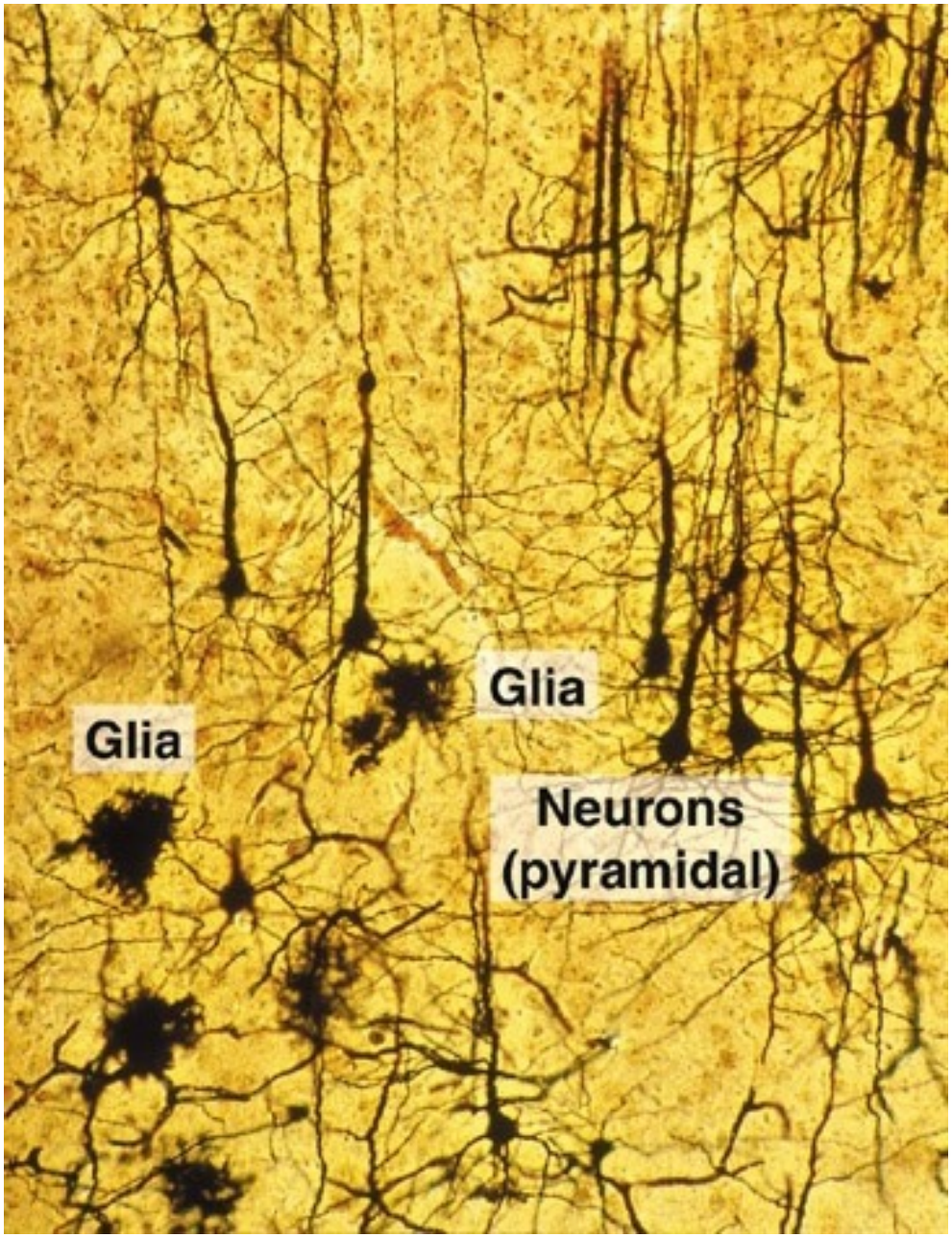
- Gray matter contains neuron cell bodies, dendrites, unmyelinated axons, glial cells and synapses
- White matter contains myelinated axons and oligodendrocytes
- Brain: gray matter outside (and way deep inside), white matter inside
- Spinal cord: white matter outside, gray matter inside

Cerebral Cortex

- Cerebral cortex (= gray matter of the cerebrum) has 6 poorly-defined layers.
- Pyramidal neurons are the most abundant neurons in the cerebral cortex.

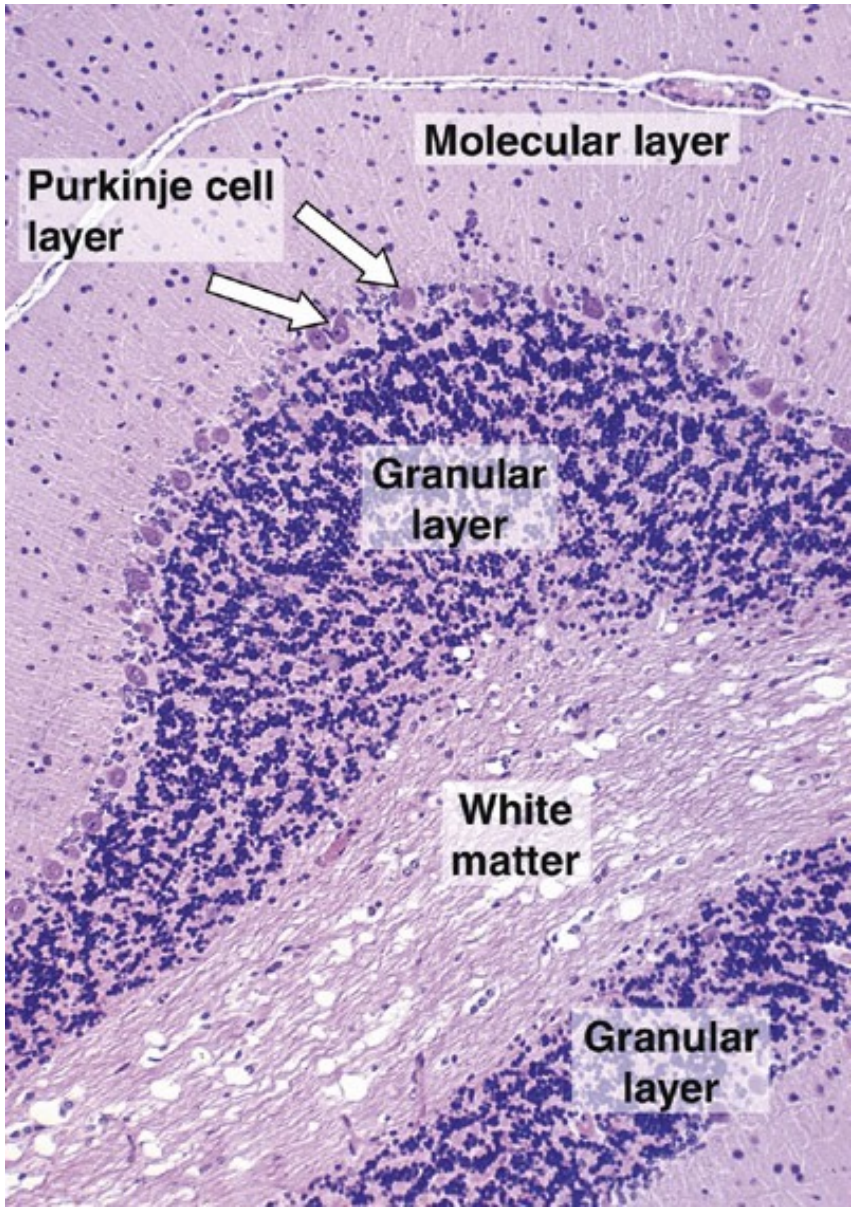


Cerebral Cortex



- Note long dendrites of pyramidal neurons extending toward surface of cortex.
- This is a silver stain which really highlights neural cells.

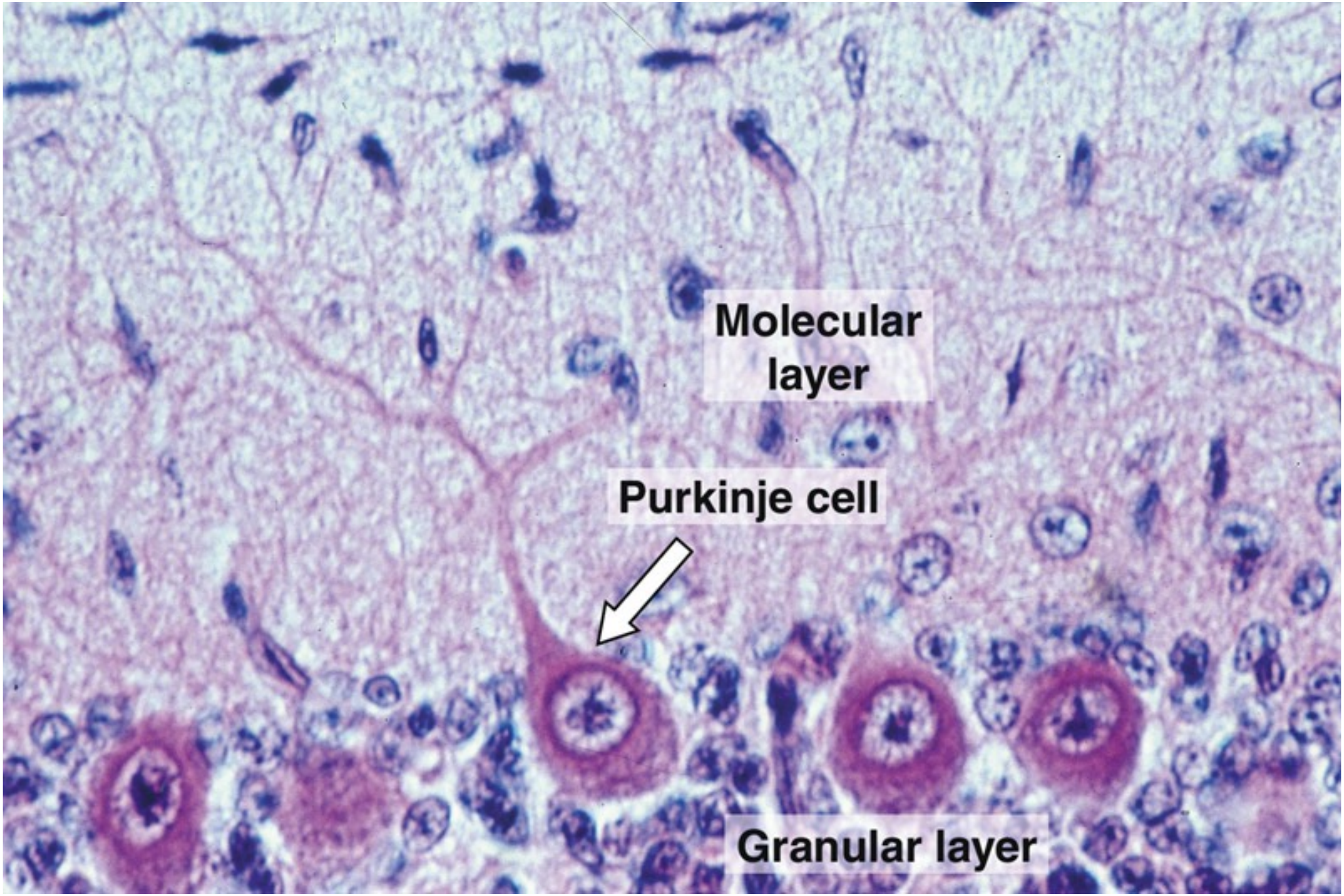
Cerebellum



Gray matter (outside) has 3 layers:

1. Molecular layer.
   Outermost layer. Contains granular cell axons, Purkinje dendrites, and glial cells.
2. Purkinje cell layer.
   Middle layer. Contains large, prominent “Purkinje” neurons.
3. Granular layer.
   Innermost layer. Contains very small neurons.

White matter is on the inside.

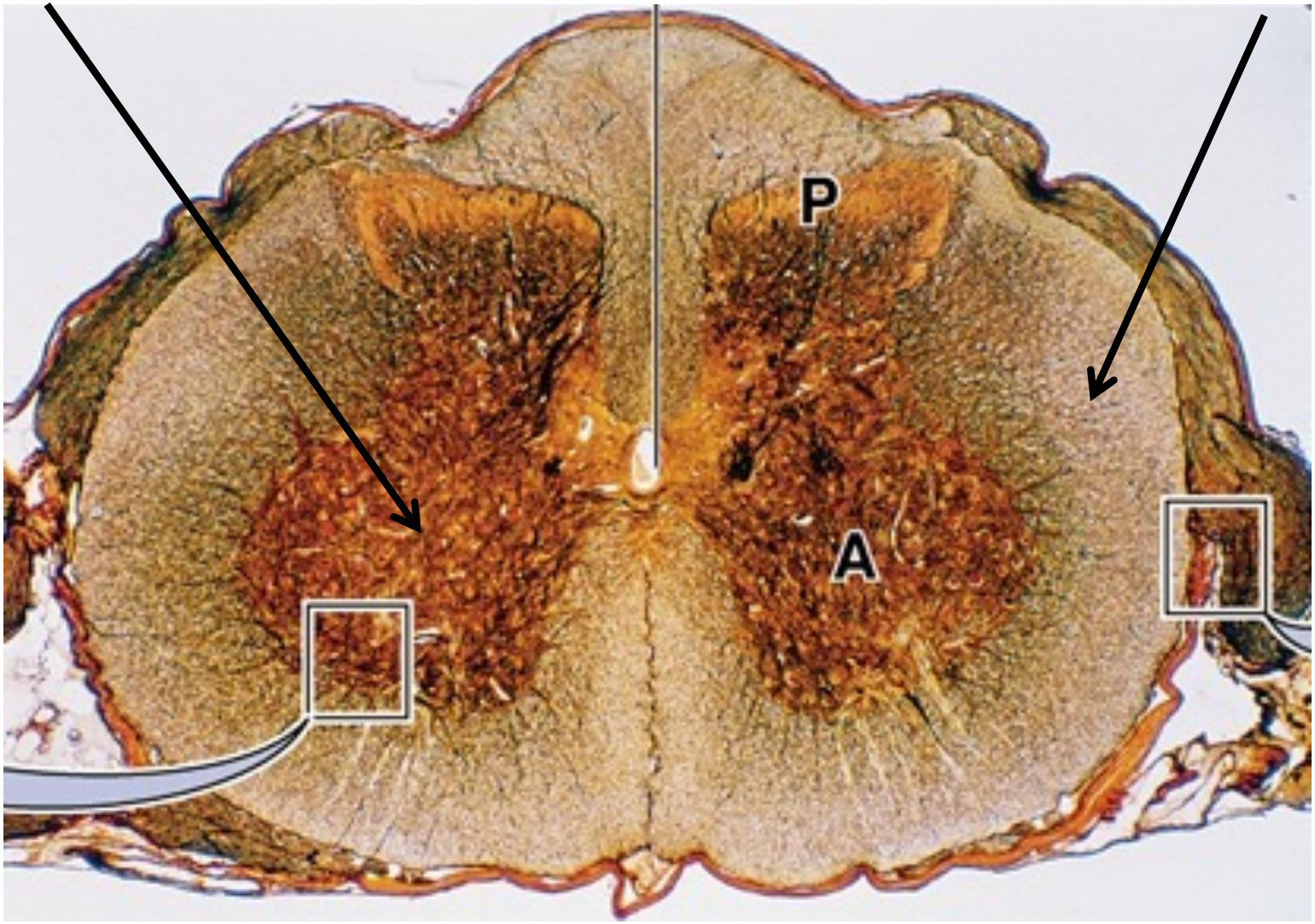


Cerebellum: gray matter

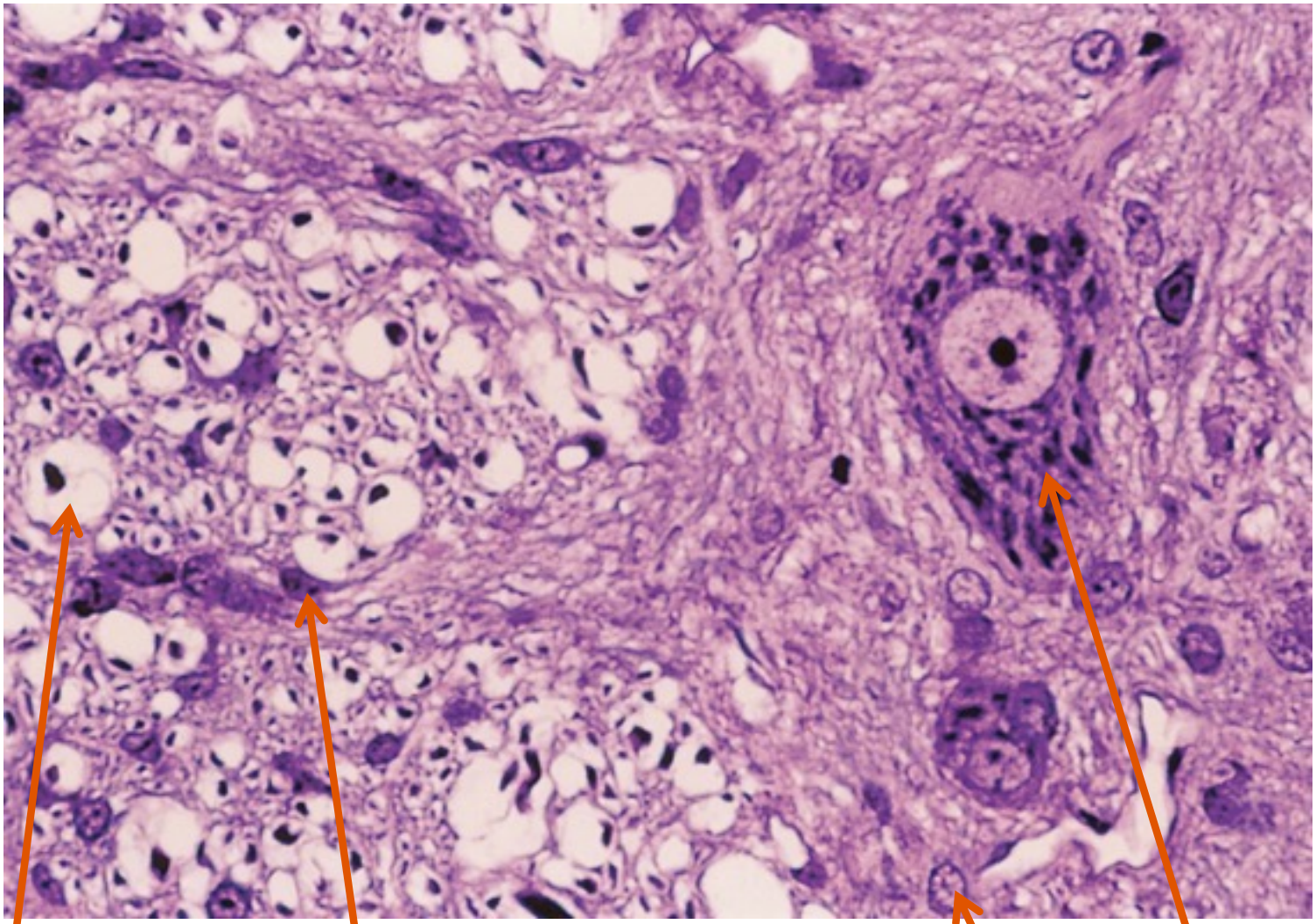
Spinal Cord Cross Section

Gray matter inside

White matter outside



Spinal Cord



White matter: myelinated axons and oligodendrocytes.

Gray matter: neurons and glial cells.

Meninges

Protective tissue layers surrounding brain and spinal cord.

Dura mater (“tough mother”)

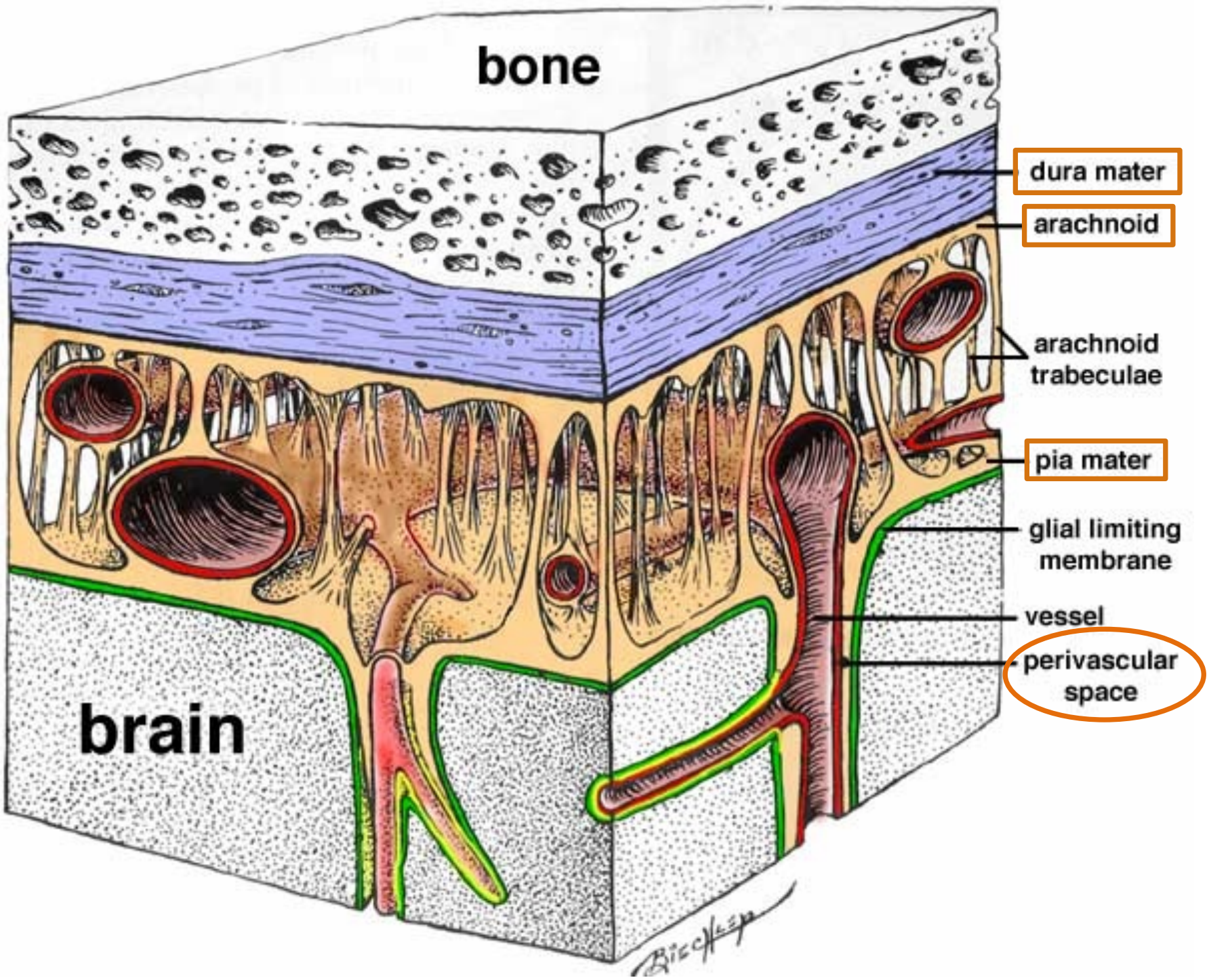
Outermost layer. Dense connective tissue.

Arachnoid (“spider-like”)

Middle layer. Two parts: one is in contact with dura mater. Other contains trabeculae (like spider legs) which connect arachnoid with pia.

Pia mater (“tender mother”)

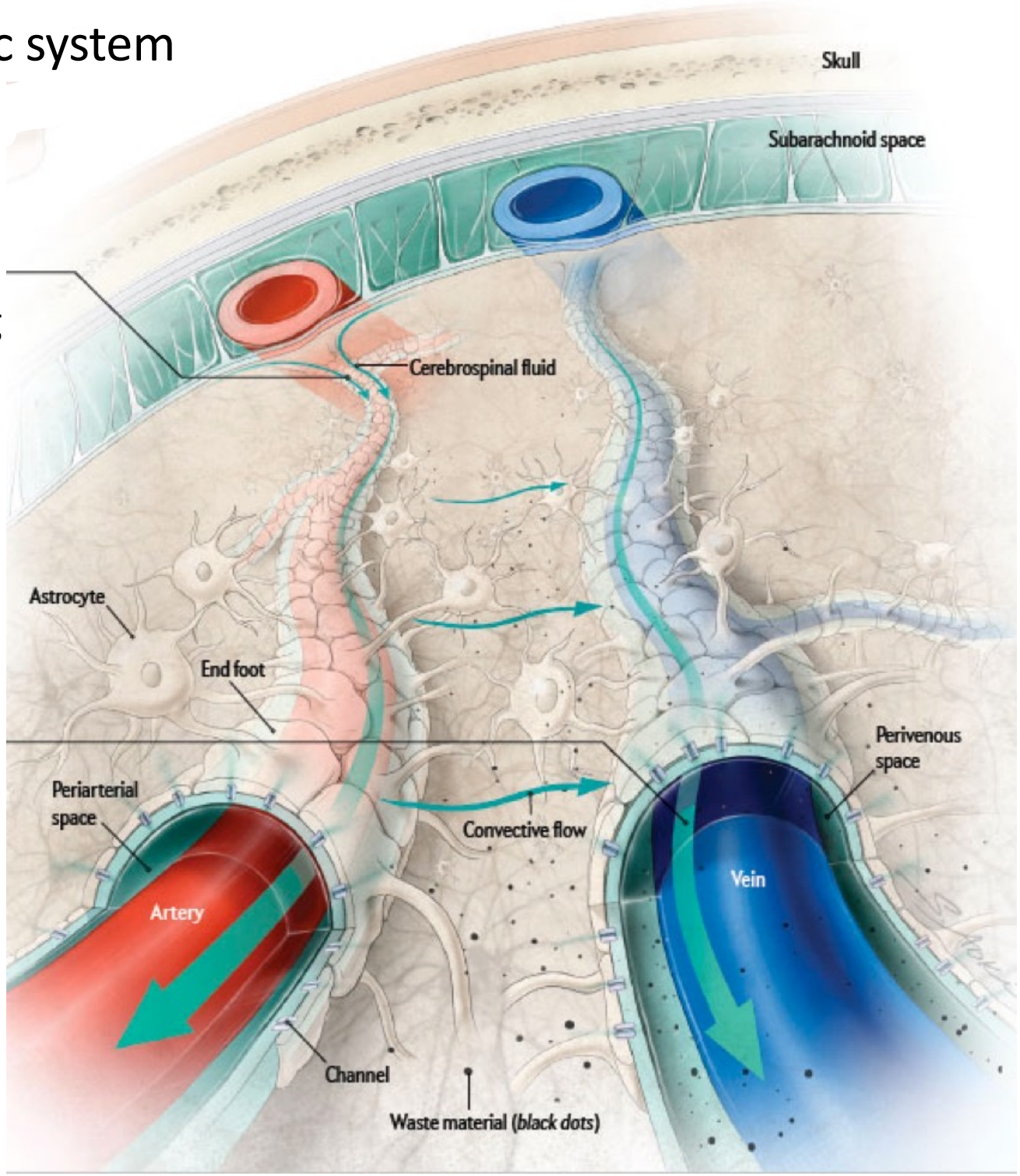
Innermost layer. Loose connective tissue tightly adherent to surface of brain/spinal cord.


bone
dura mater
arachnoid
arachnoid trabeculae
pia mater
glial limiting membrane
vessel
perivascular space
brain

Glymphatic system

At night, space around arteries opens, allowing CSF to flow in.

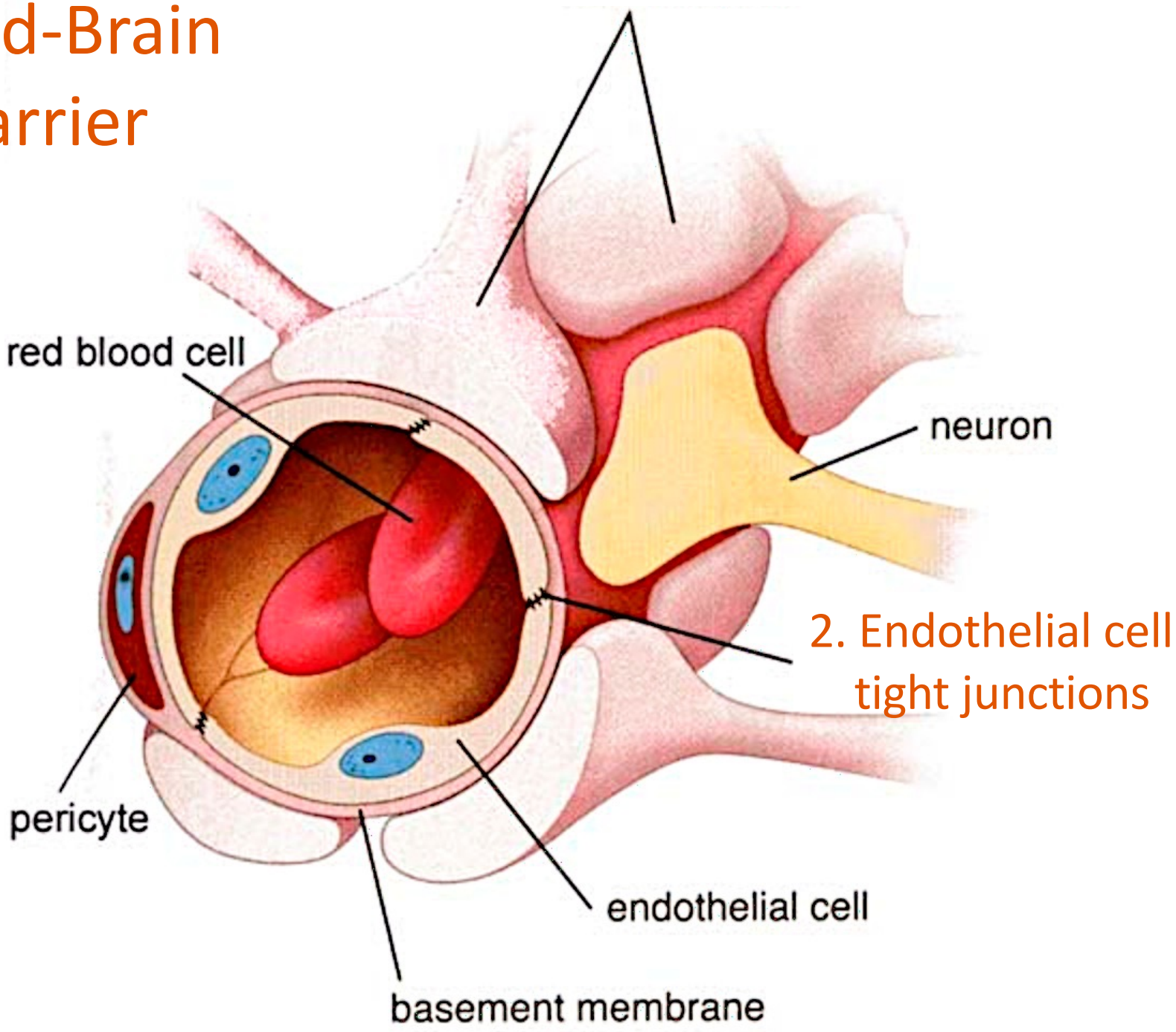
Brain waste material is dumped into veins and taken out like trash!



Blood-Brain Barrier

- Prevents passage of some drugs and toxins from blood into CNS tissue
- Exists because capillaries in brain are less permeable than capillaries elsewhere.
  - Brain capillaries have tight (occluding) junctions between endothelial cells.
  - Astrocyte foot processes surround capillaries and form part of barrier.

Blood-Brain Barrier



Nervous System Lecture Outline

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