In the name of Allah

Histology of Nervous system

Embryology

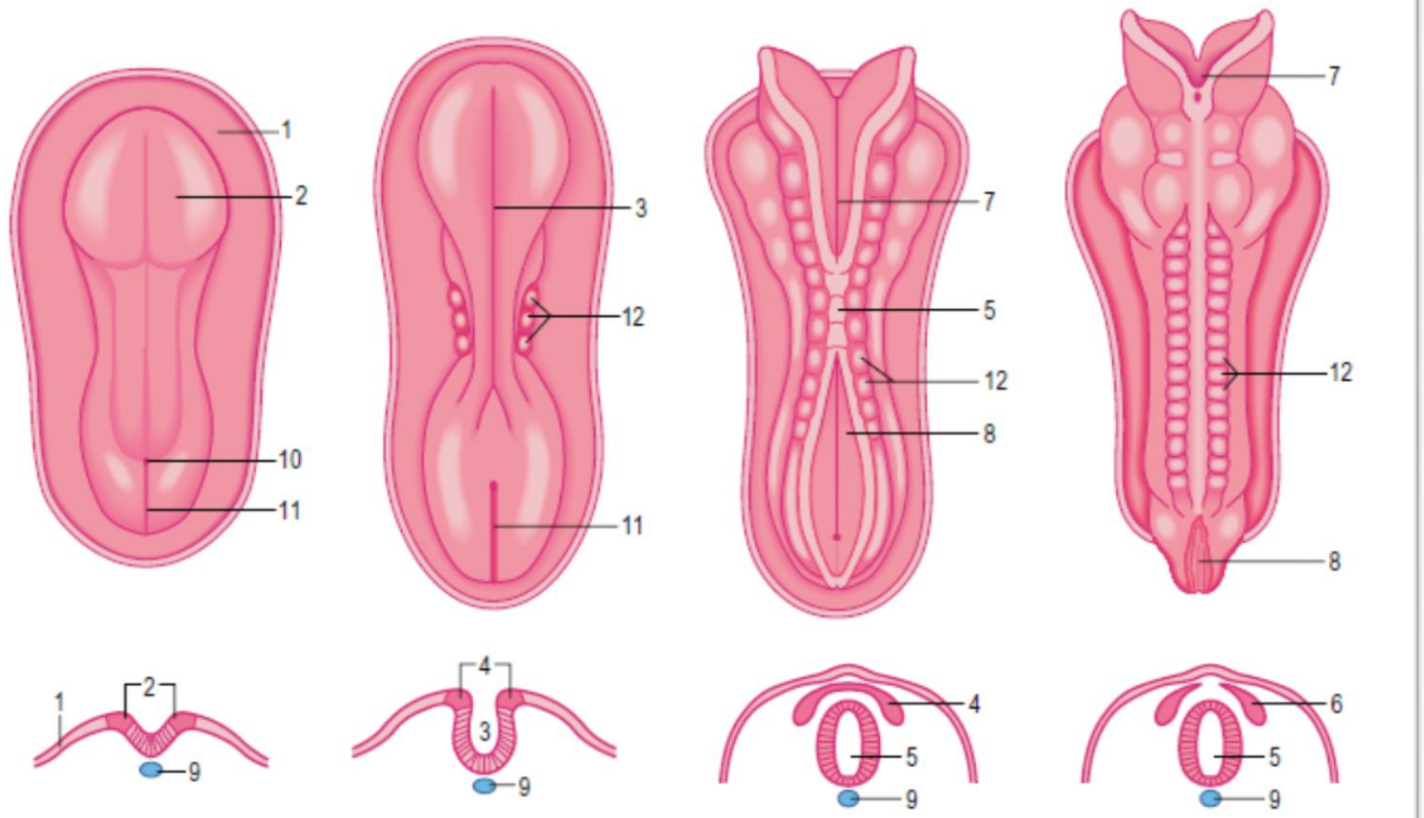
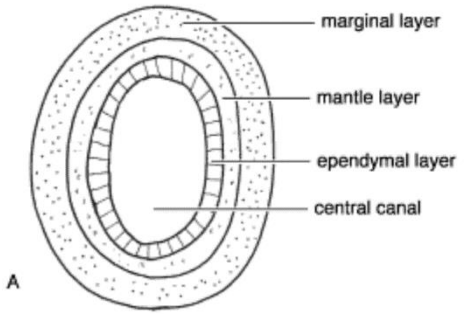
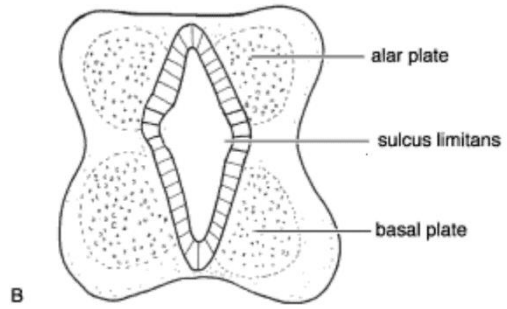
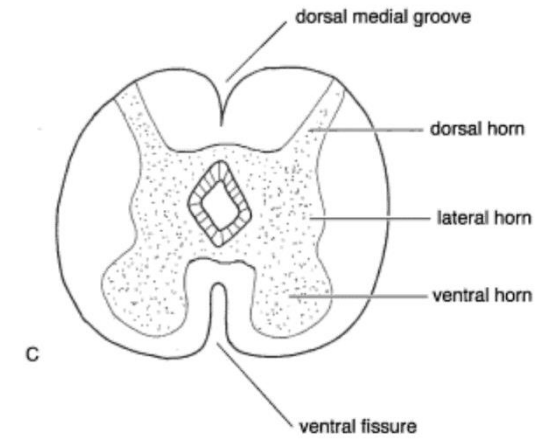


Fig. 8-1: Development of the neural tube and the neural crest. The lateral edges of the neural plate are elevated and become the neural folds. The depressed midregion of the neural plate is called the neural groove. The neural folds continue to rise, appose in the midline and fuse to create the neural tube, which becomes covered by future epidermal ectoderm. As the neural folds rise and fuse, cells at the lateral border of the neuroectoderm (neural crest cells) begin to dissociate from their neighbours, undergo an epithelio-mesenchymal transition, and leave the neuroectoderm. 1: Surface ectoderm; 2: Neural plate; 3: Neural groove; 4: Neural crest; 5: Neural tube; 6: Spinal ganglion; 7: Anterior neuropore; 8: Posterior neuropore; 9: Notochord; 10: Primitive node; 11: Primitive streak; 12: Somites.







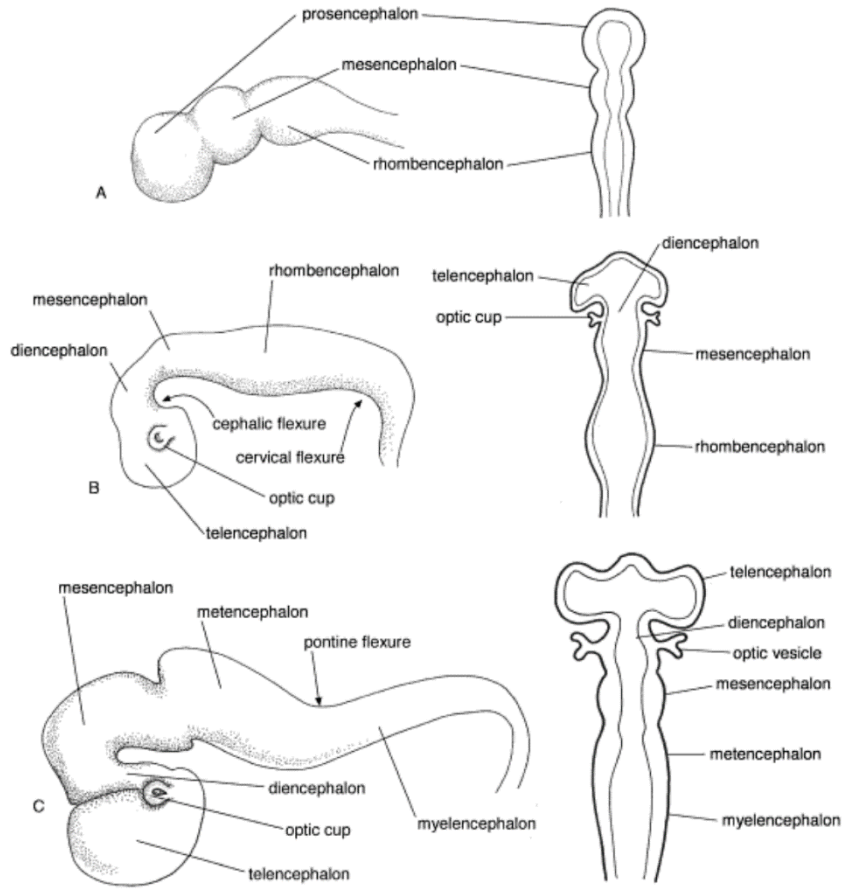
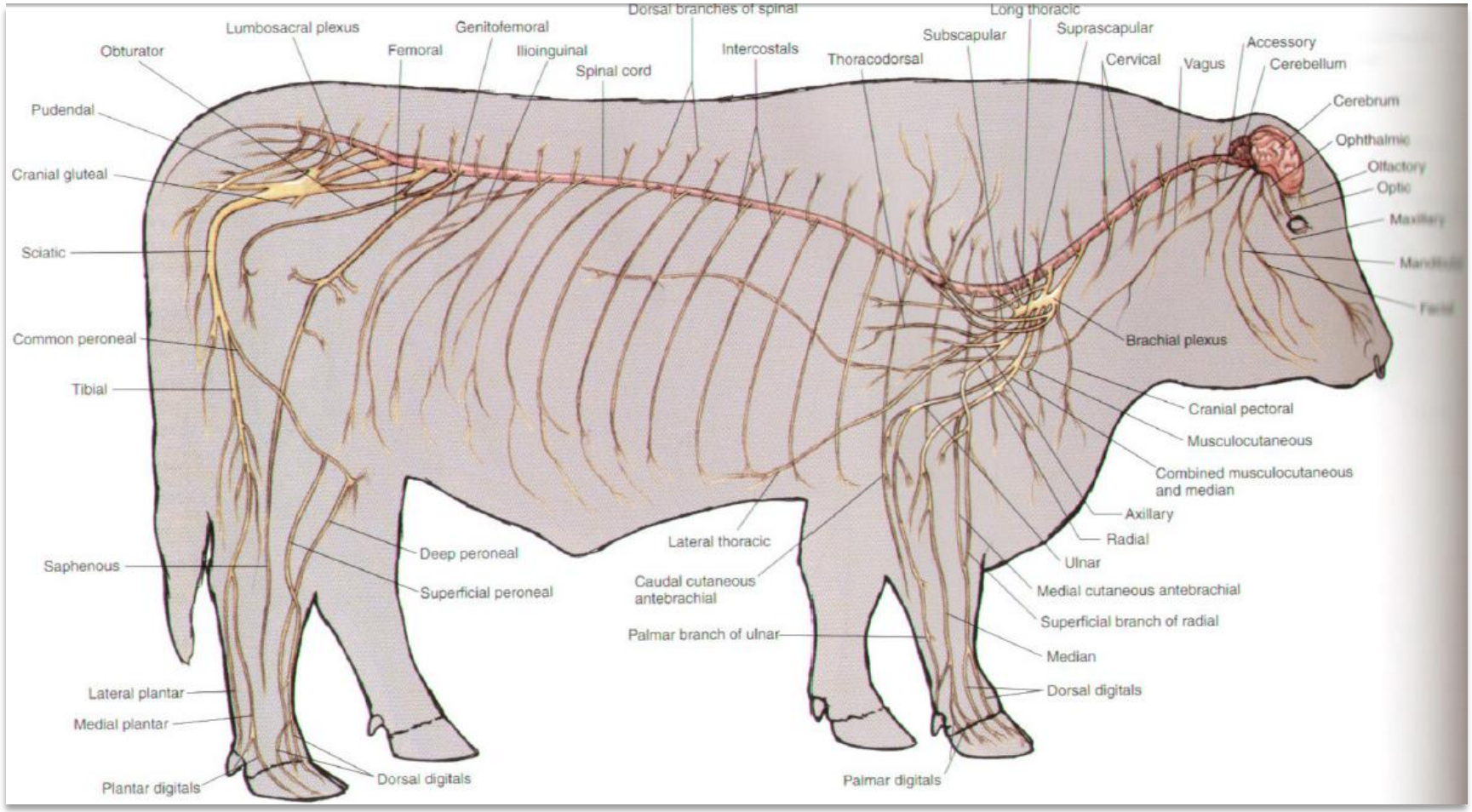


Figure 13.11 Left lateral views and sections through the developing brain. A, The three primary brain vesicles. B, Cephalic flexure and cervical flexure, and development of the telencephalon and diencephalon. C, Pontine flexure and development of the metencephalon and myelencephalon.


Dorsal branches of spinal
Long thoracic
Lumbosacral plexus
Genitofemoral
Subscapular
Suprascapular
Accessory
Obturator
Femoral
Ilioinguinal
Intercostals
Thoracodorsal
Cervical
Vagus
Cerebellum
Spinal cord
Pudendal
Cerebrum
Ophthalmic
Cranial gluteal
Olfactory
Optic
Maxillary
Sciatic
Brachial plexus
Common peroneal
Cranial pectoral
Tibial
Musculocutaneous
Combined musculocutaneous and median
Axillary
Lateral thoracic
Radial
Deep peroneal
Ulnar
Saphenous
Caudal cutaneous antebrachial
Medial cutaneous antebrachial
Superficial peroneal
Superficial branch of radial
Palmar branch of ulnar
Median
Lateral plantar
Dorsal digitals
Medial plantar
Plantar digitals
Dorsal digitals
Palmar digitals

The central nervous system (CNS) comprises:

(1) nerve cells (neuronal cell bodies) and their dendrites and axons (both myelinated and unmyelinated)

(2) supporting cells, the neuroglia (oligodendroglia, astrocytes and microglia)

(3) dura, arachnoid, and pia

(4) blood vessels

The peripheral nervous system (PNS) contains:

(1) neurons (organized into clusters called ganglia)

(2) supporting cells including satellite cells associated with the ganglionic neurons

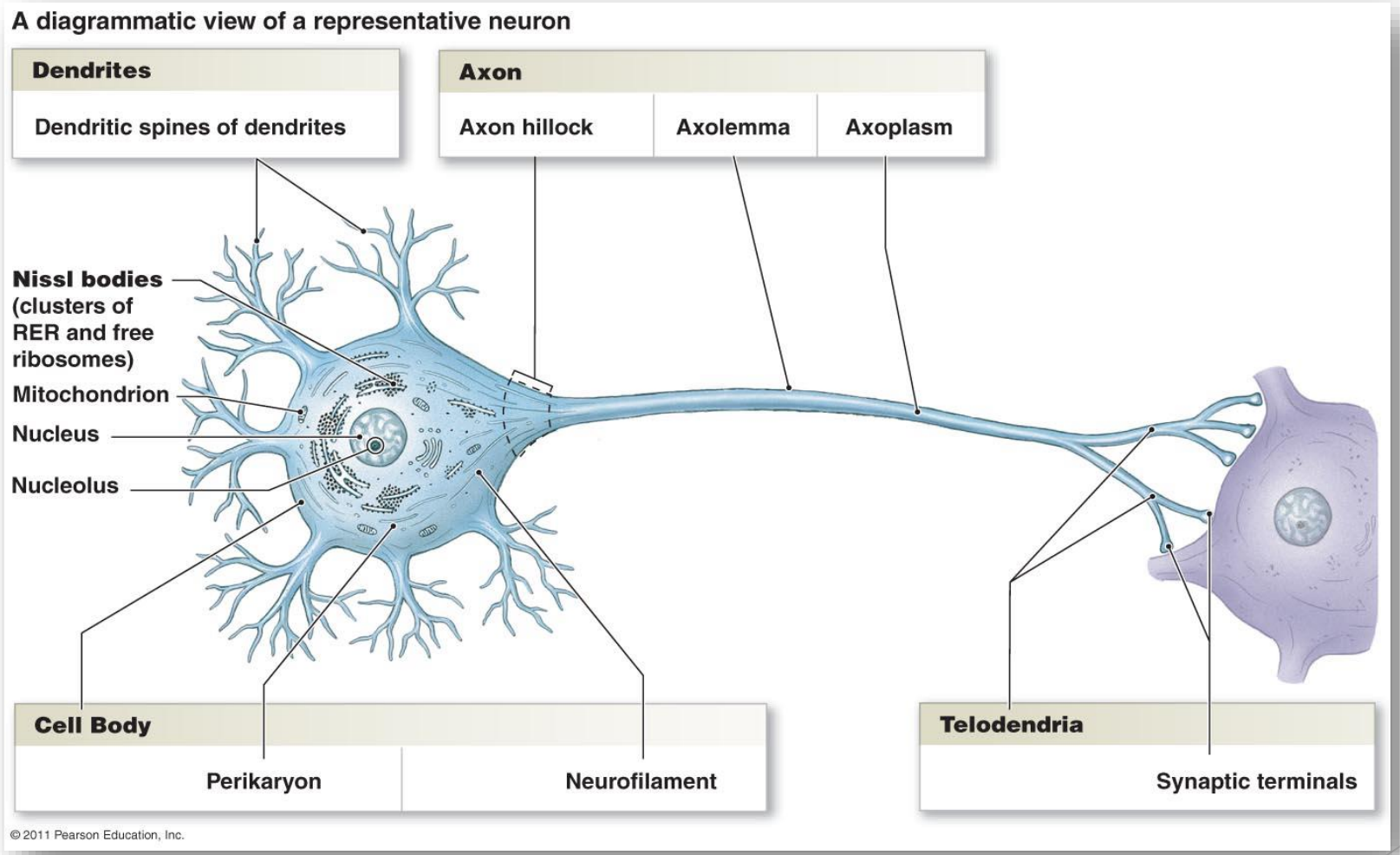
(3) Schwann cells associated with axons and forming the myelin sheath

(4) connective tissue elements (endoneurium, perineurium and epineurium)

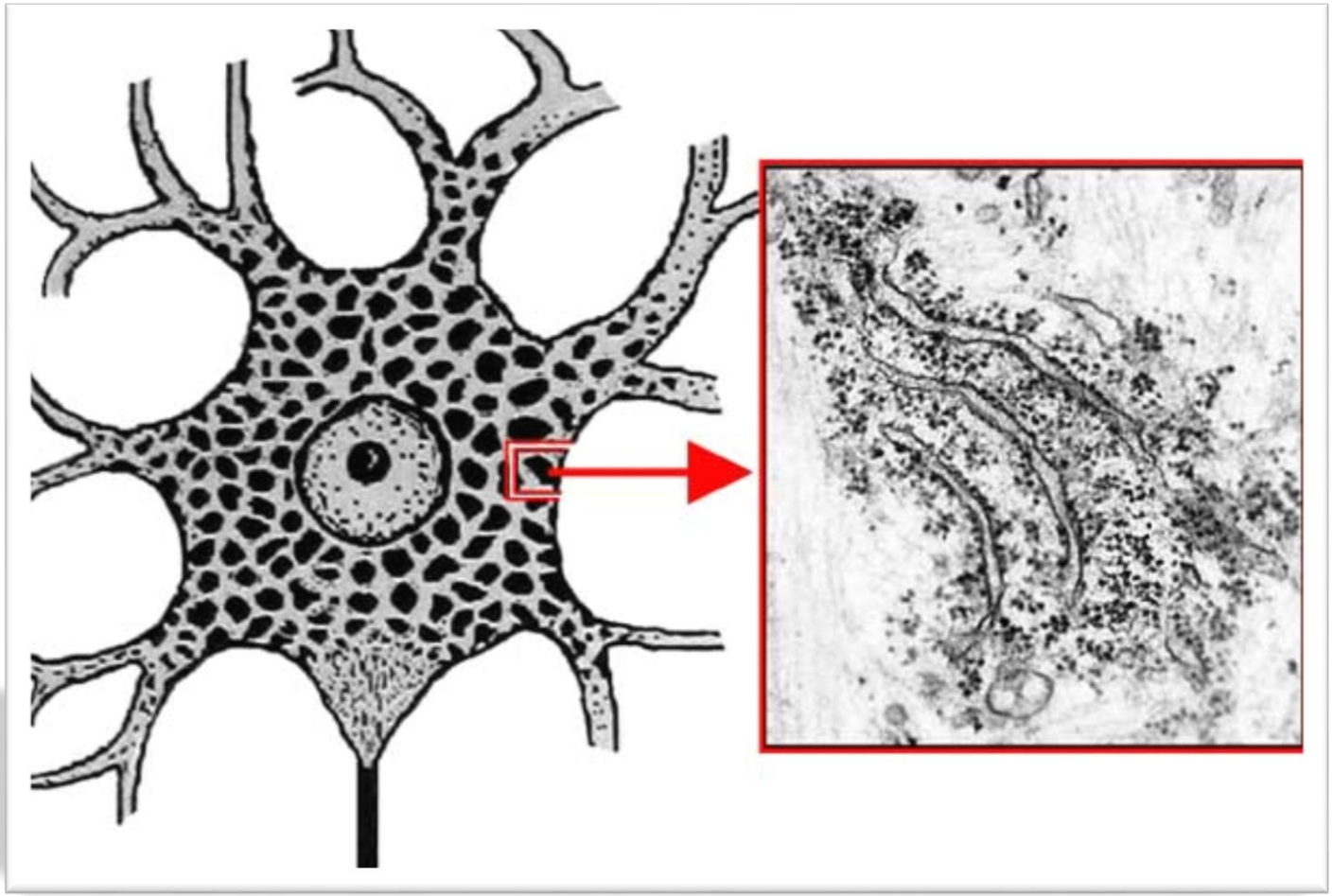
(5) blood vessels

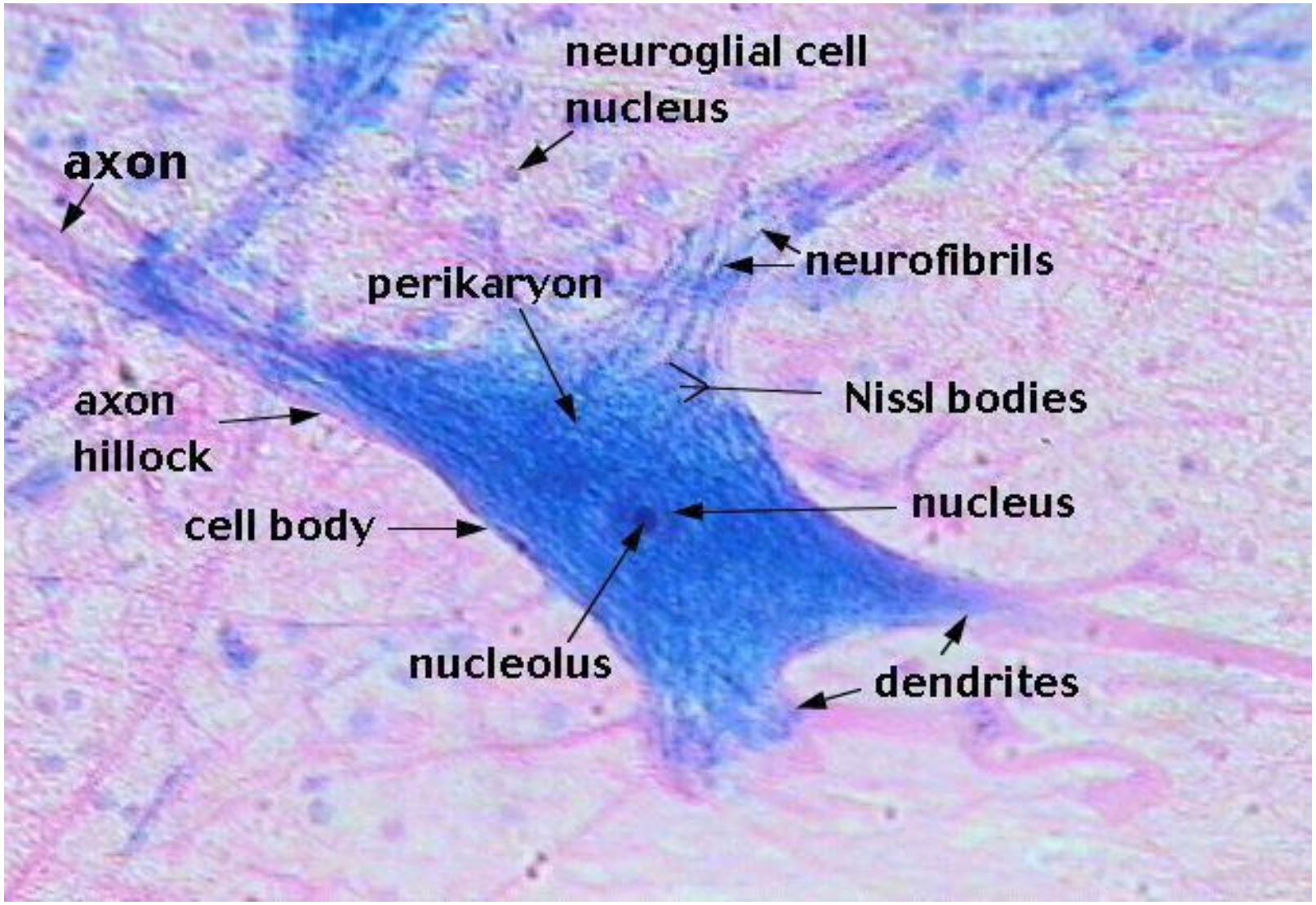
Neuron :

Soma (Perikaryon) + Cellular processes (Axon & Dendrites)

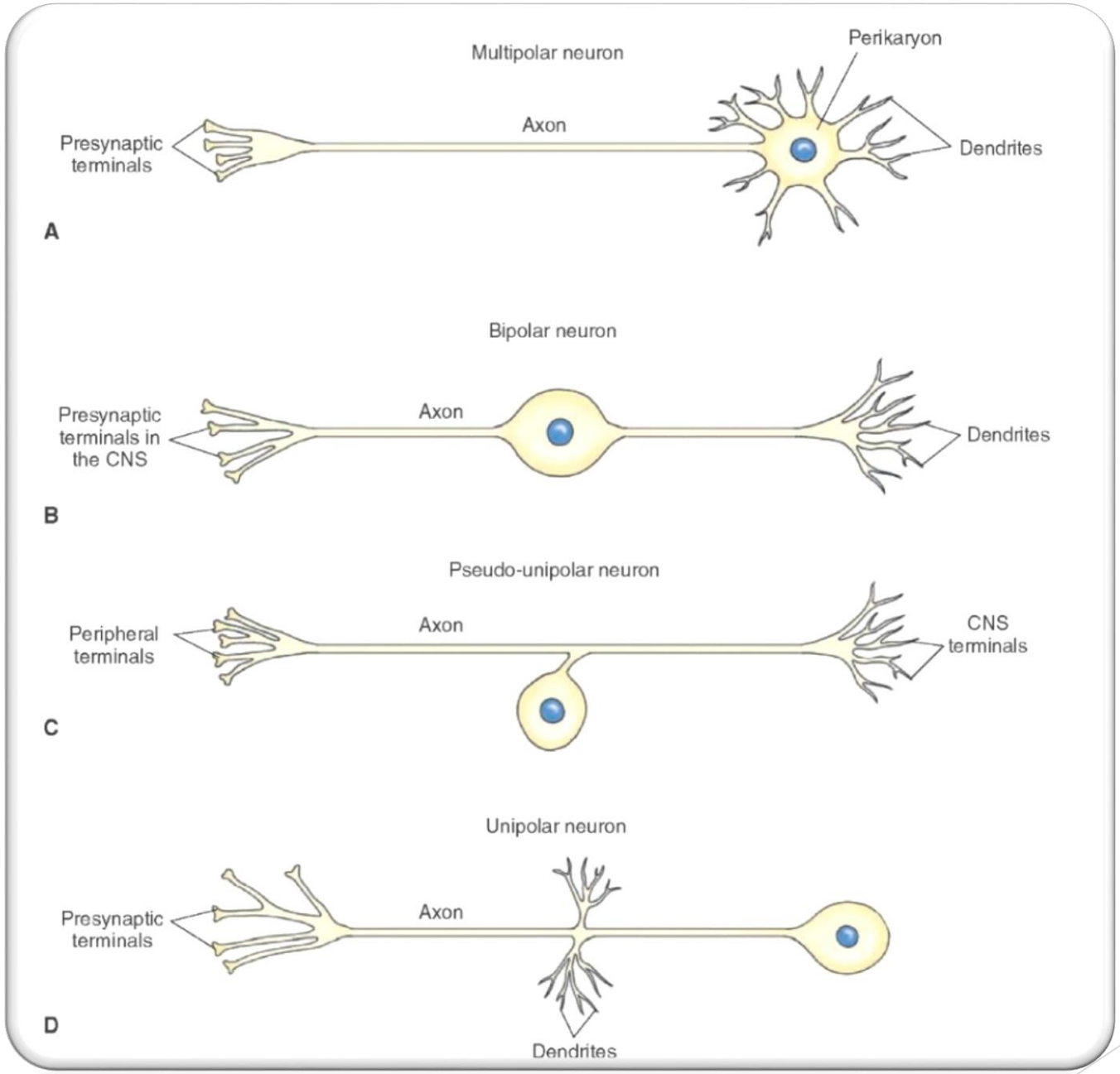


Nissl's body

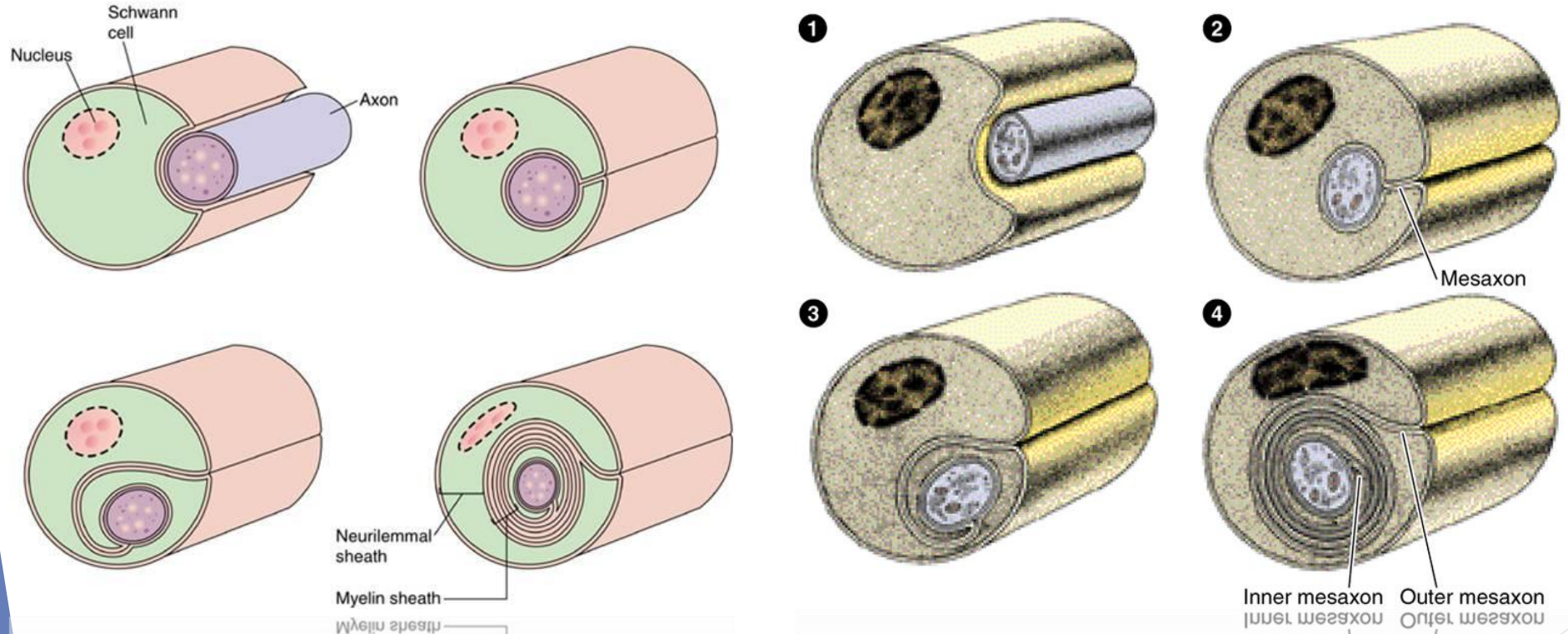



neuroglial cell nucleus
axon
neurofibrils
perikaryon
Nissl bodies
axon hillock
nucleus
cell body
nucleolus
dendrites

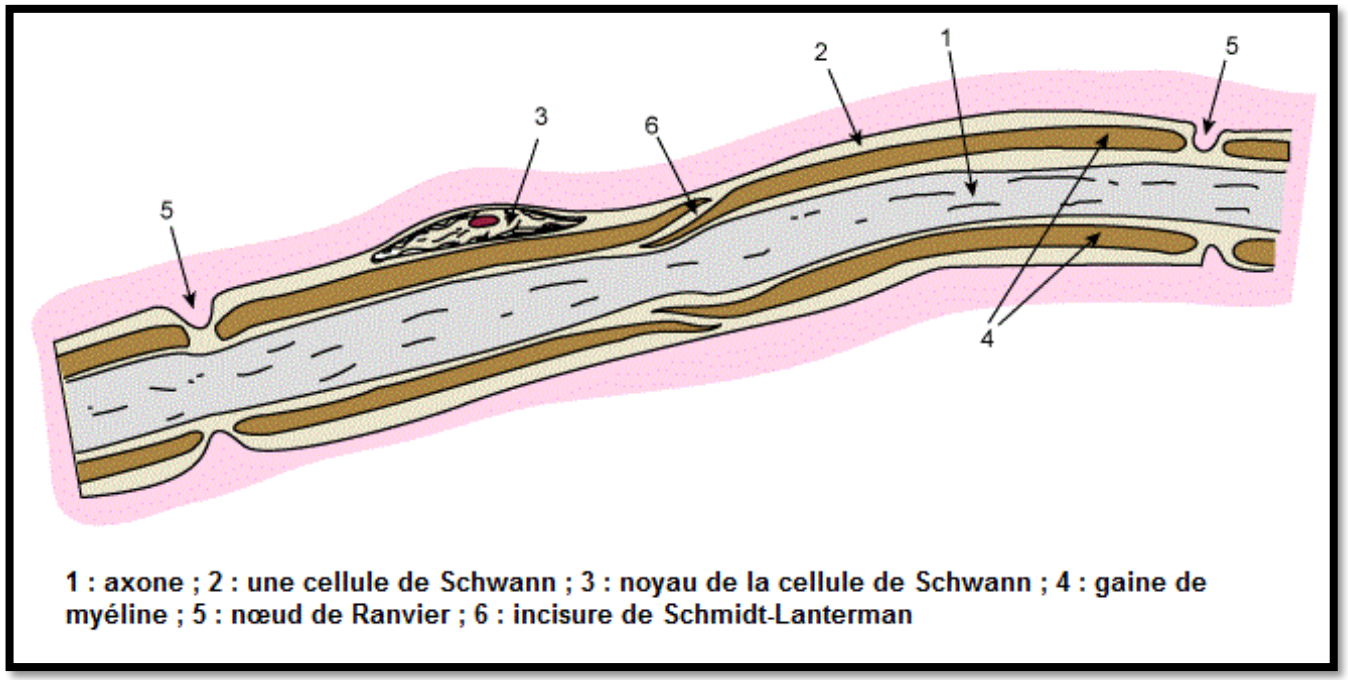
Types of neuron



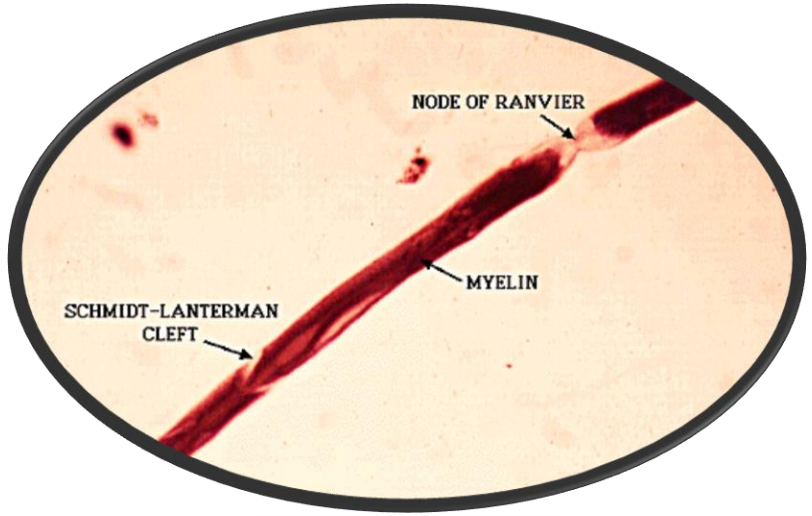
Myelinated and Unmyelinated Axon

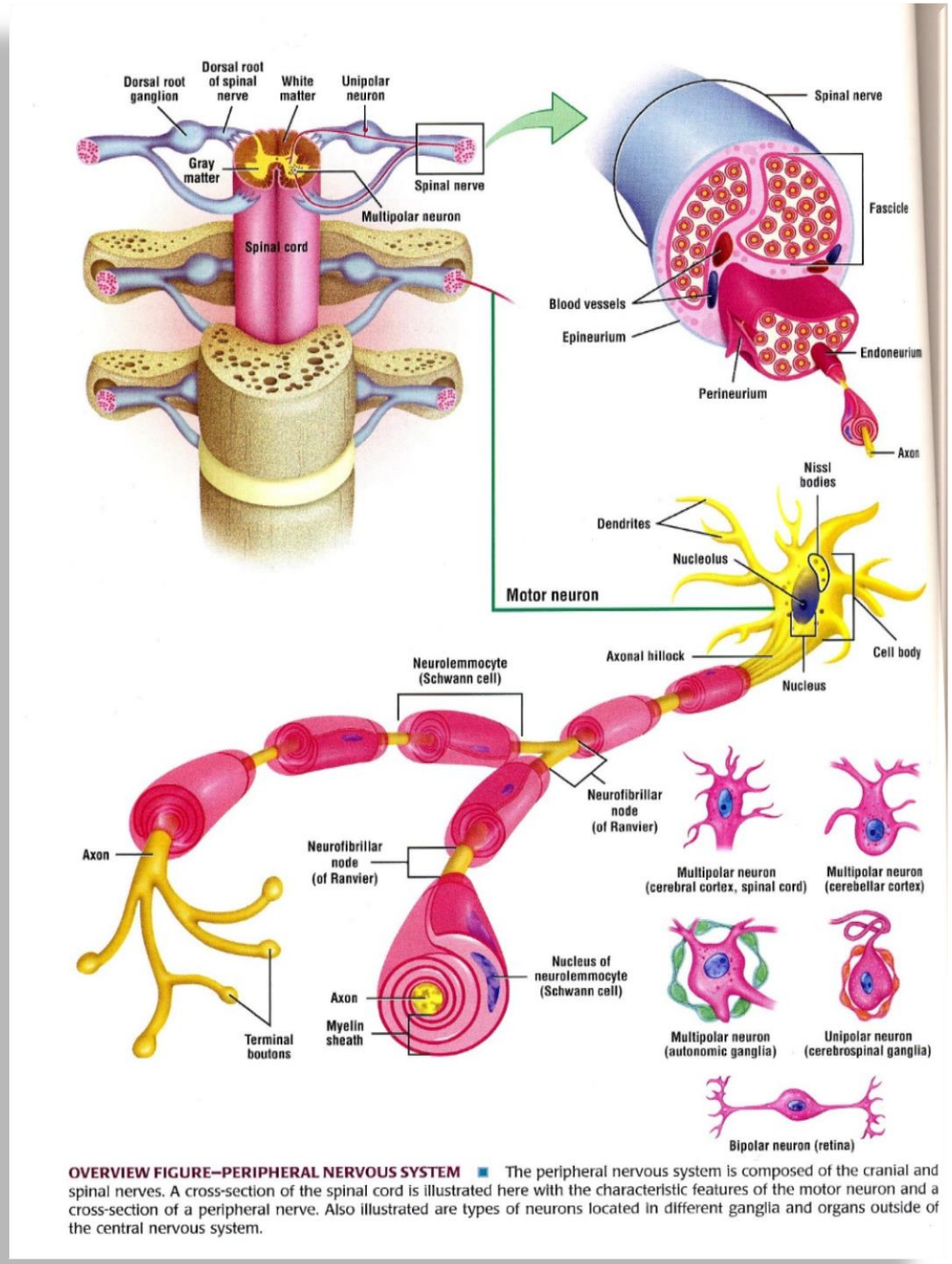


Shmidth - Lanterman incisure

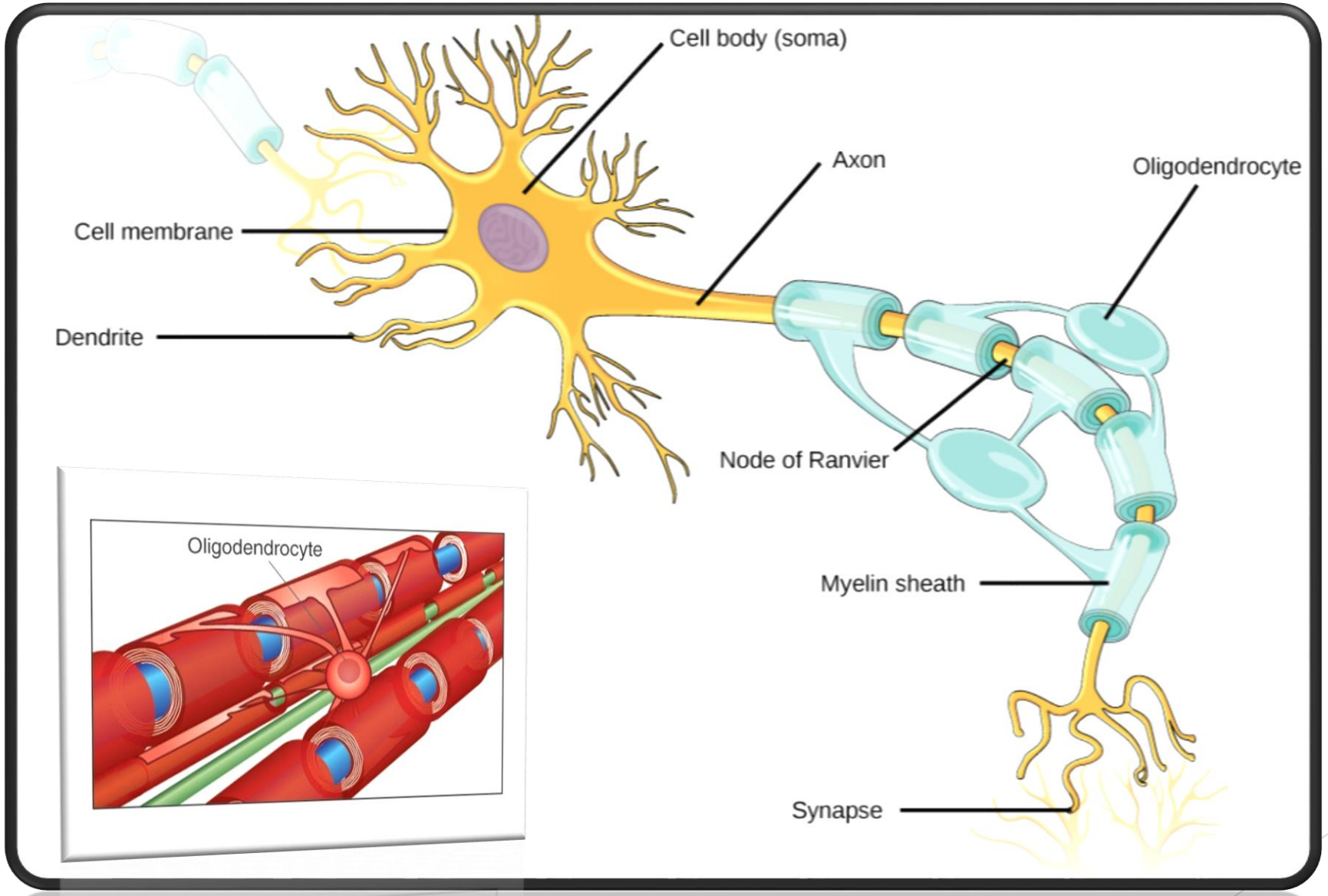


1 : axone ; 2 : une cellule de Schwann ; 3 : noyau de la cellule de Schwann ; 4 : gaine de myéline ; 5 : nœud de Ranvier ; 6 : incisure de Schmidt-Lanterman





OVERVIEW FIGURE–PERIPHERAL NERVOUS SYSTEM ■ The peripheral nervous system is composed of the cranial and spinal nerves. A cross-section of the spinal cord is illustrated here with the characteristic features of the motor neuron and a cross-section of a peripheral nerve. Also illustrated are types of neurons located in different ganglia and organs outside of the central nervous system.


Cell body (soma)
Axon
Oligodendrocyte
Cell membrane
Dendrite
Node of Ranvier
Myelin sheath
Synapse
Oligodendrocyte

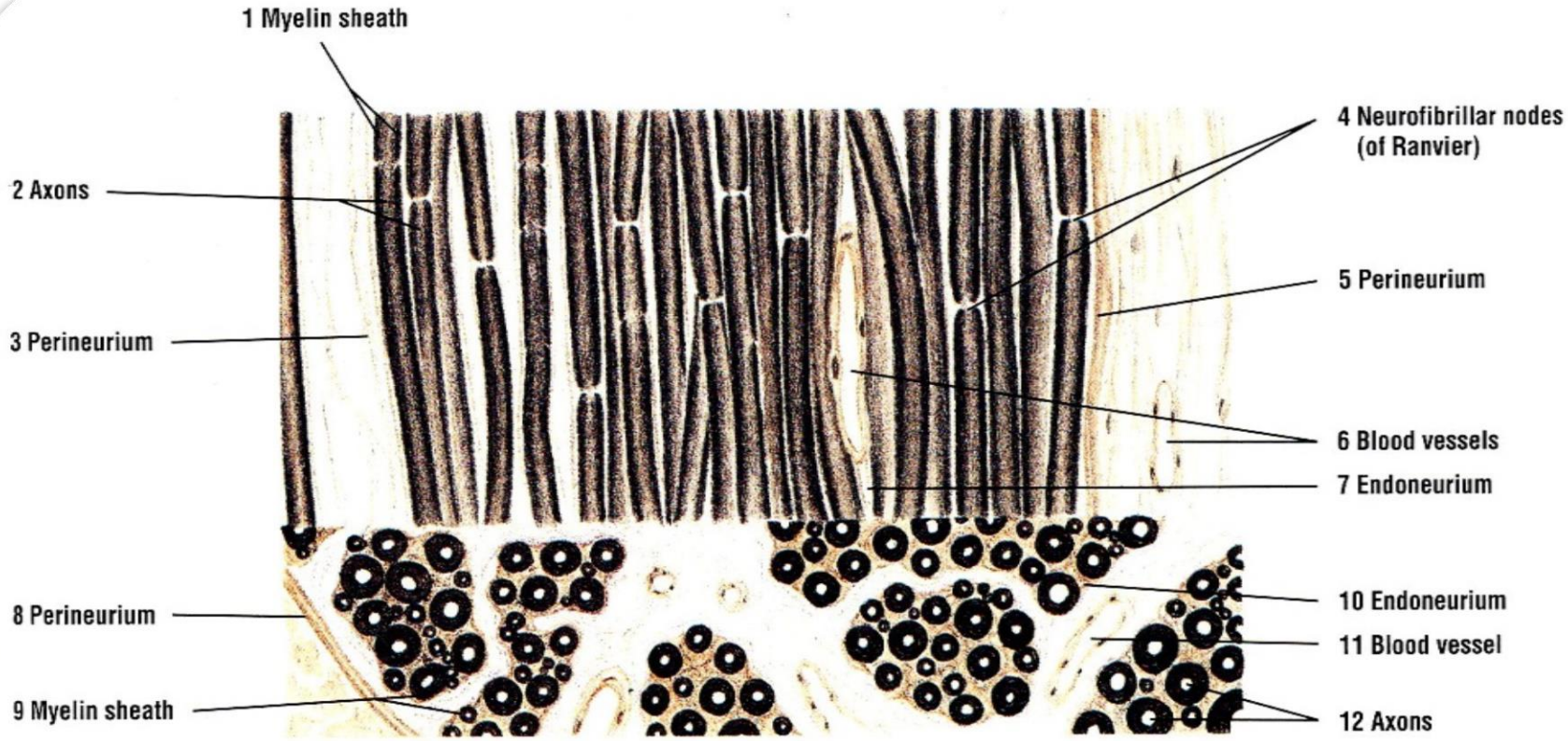


FIGURE 7.16 ■ Myelinated nerve fibers (longitudinal and transverse sections). Stain: osmic acid. High magnification.

Neuroglial cells

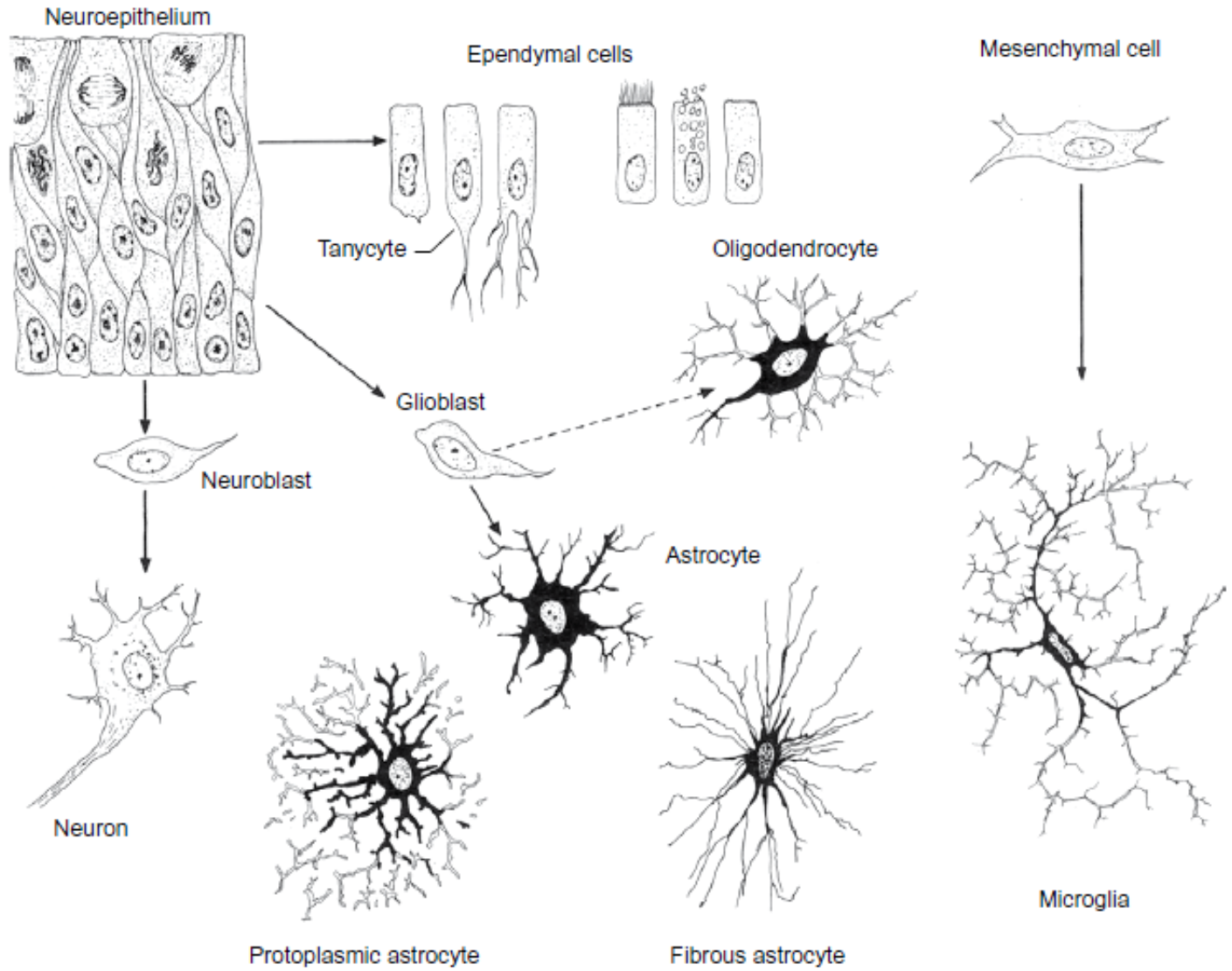
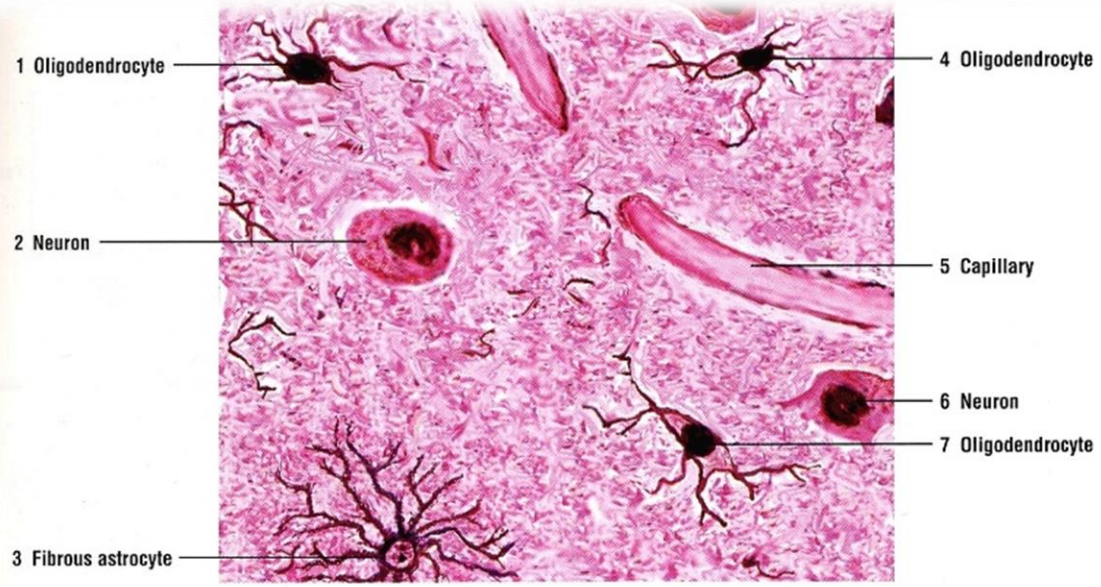


Fig. 10-3: Cell lineages in the developing central nervous system. Courtesy Sinowatz and Rüsse (2007).



URE 7.13 ■ Oligodendrocytes of the brain. Stain: silver impregnation (Cajal's method). Medium magnification.

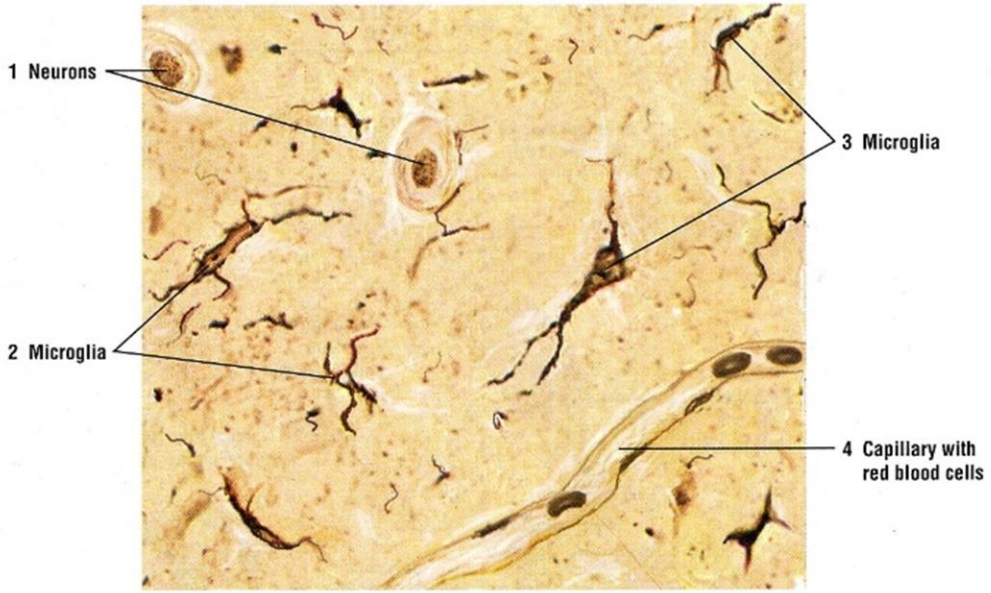
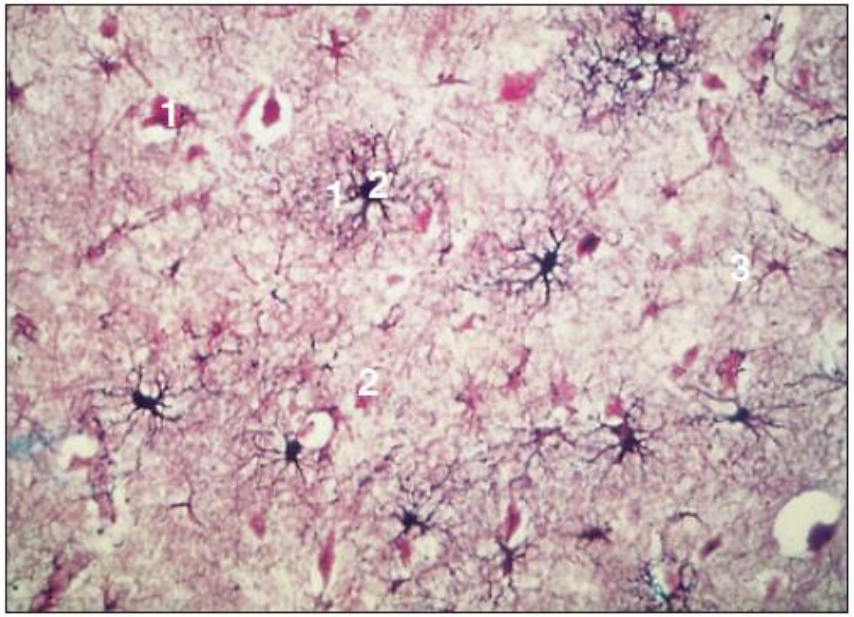
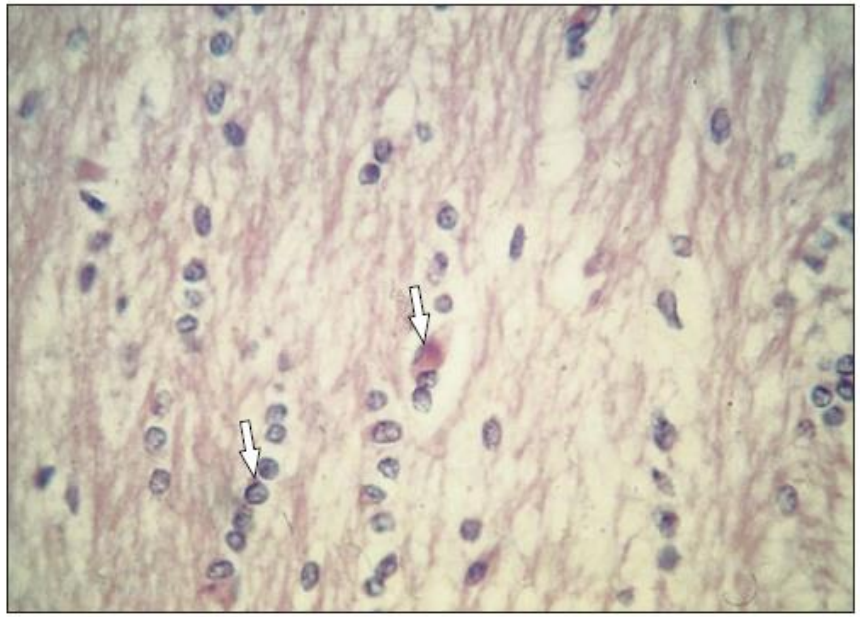


FIGURE 7.14 ■ Microglia of the brain. Stain: Hortega's method. Medium magnification.



13.17 Spinal cord (dog). (1) Neuron. (2) Nuclei of protoplasmic astrocytes. (3) Fibrous astrocytes. H & E. ×125.



13.18 Corpus callosum (dog). Oligodendrocyte nuclei in orderly columns (arrowed) providing the neurilemmal sheath in the central nervous system. H & E. ×125.

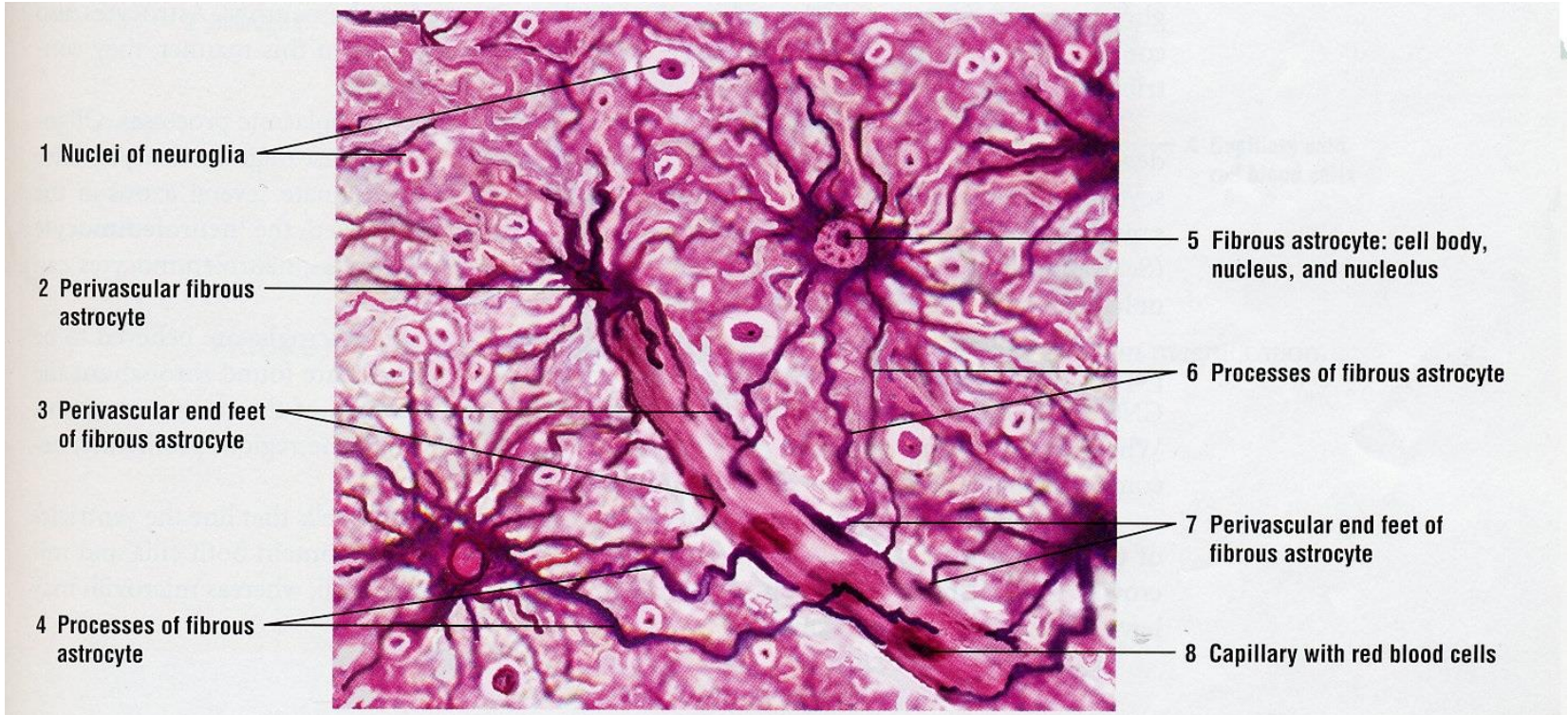


FIGURE 7.12 ■ Fibrous astrocytes and capillary in the brain. Stain: silver impregnation (Cajal's method.) Medium magnification.

Ependymal cell

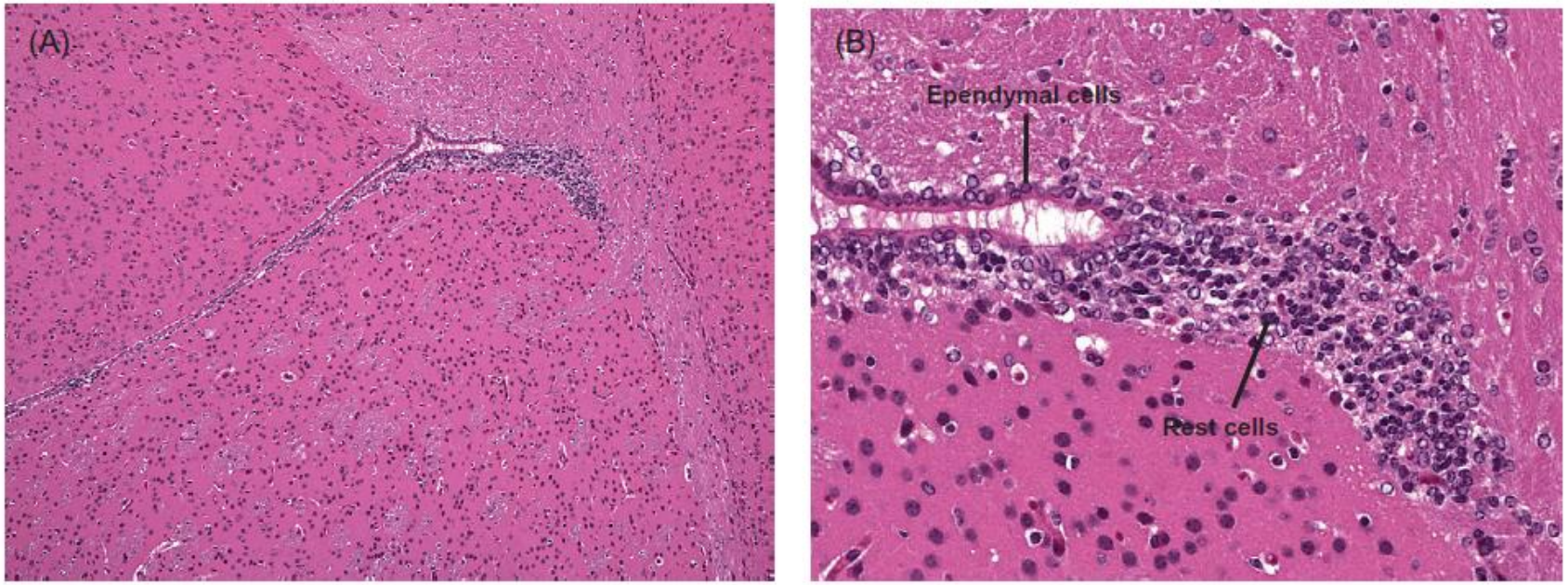
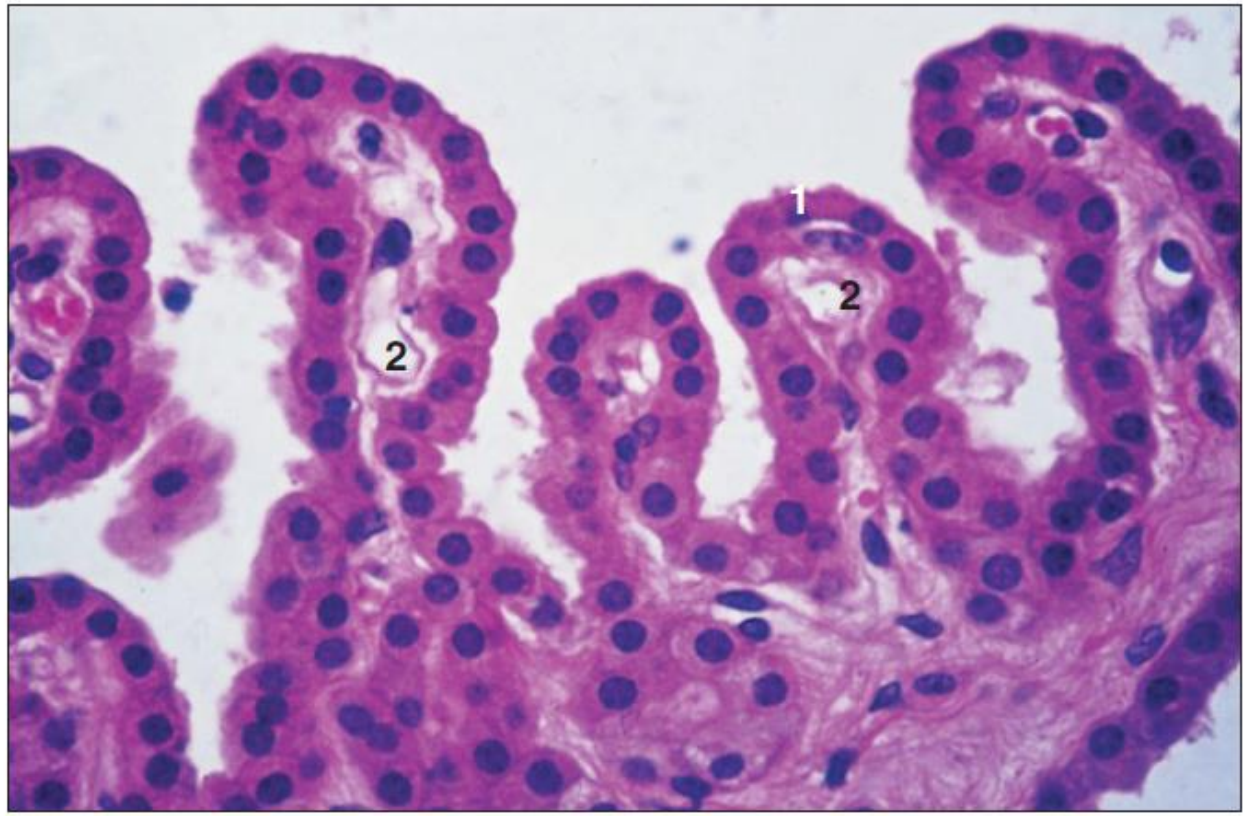


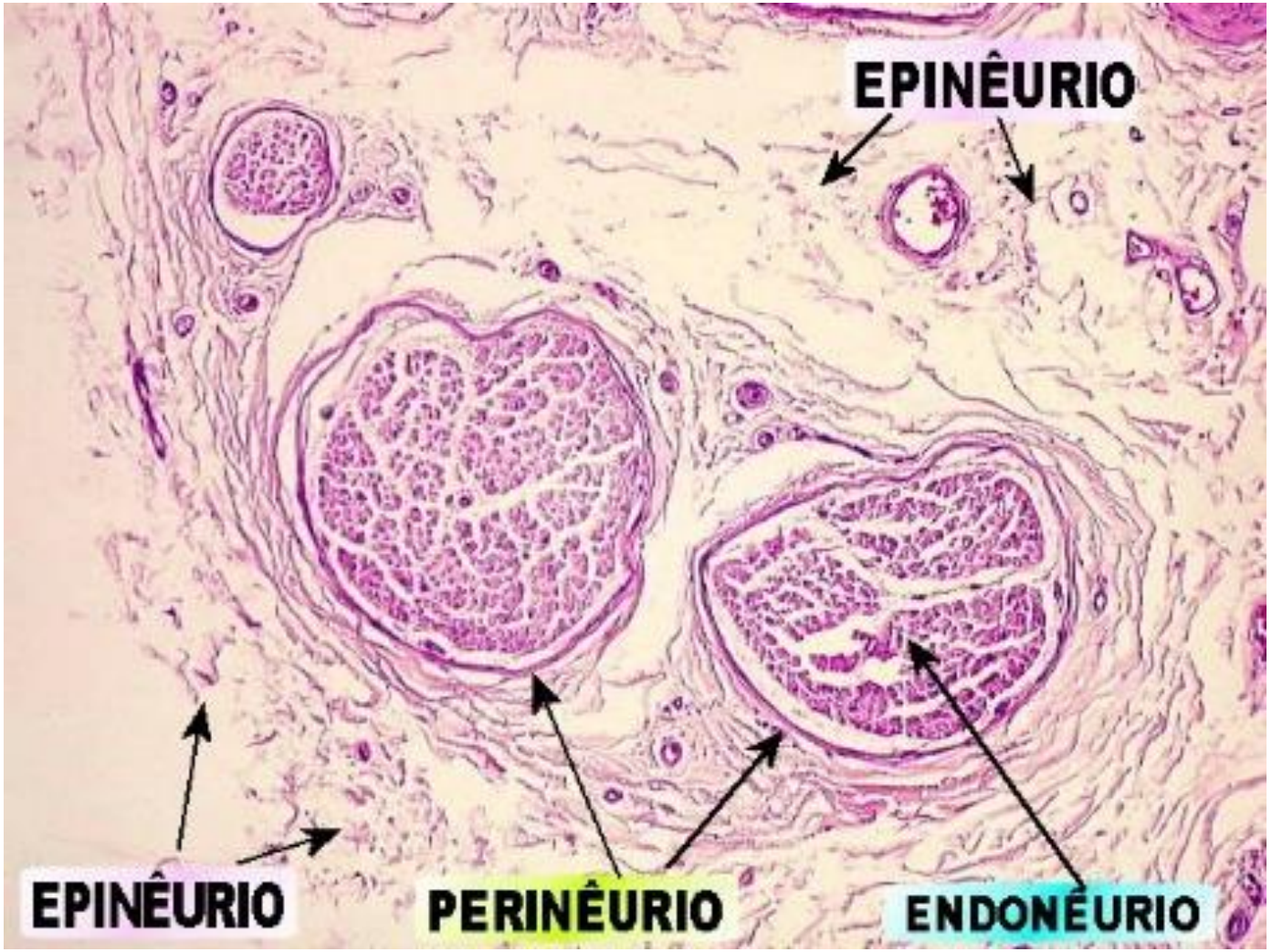
FIGURE 40 Mouse ependymal and cell "rests." The ependymal cells form a simple layer of specialized, ciliated, cuboidal epithelium that covers the surfaces of the brain ventricles and spinal cord central canal. These cells differentiate from germinal cells of the embryonic neural tube. Occasionally, undifferentiated germinal cells fail to migrate and are found as clusters or "rests" (neural tube remnants) located near the ependyma of ventricles. (A) Rostral extension of the lateral ventricle with adjacent germ cell rest. (B) Rests contain small, dark, round cells with minimal cytoplasm. These cell clusters also occurs in humans, in whom the most common site is the floor of the fourth ventricle and the second most common location is the lateral ventricle.



13.13 TS choroid plexus in the fourth ventricle (cat). (1) Ependyma. (2) Capillaries. H & E. ×160.

Peripheral nerves

FIGURE 7.15 ■ Peripheral nerves and blood vessels (transverse section). Stain: hematoxylin and eosin. Medium magnification.


EPINÊURIO
EPINÊURIO
PERINÊURIO
ENDONÊURIO

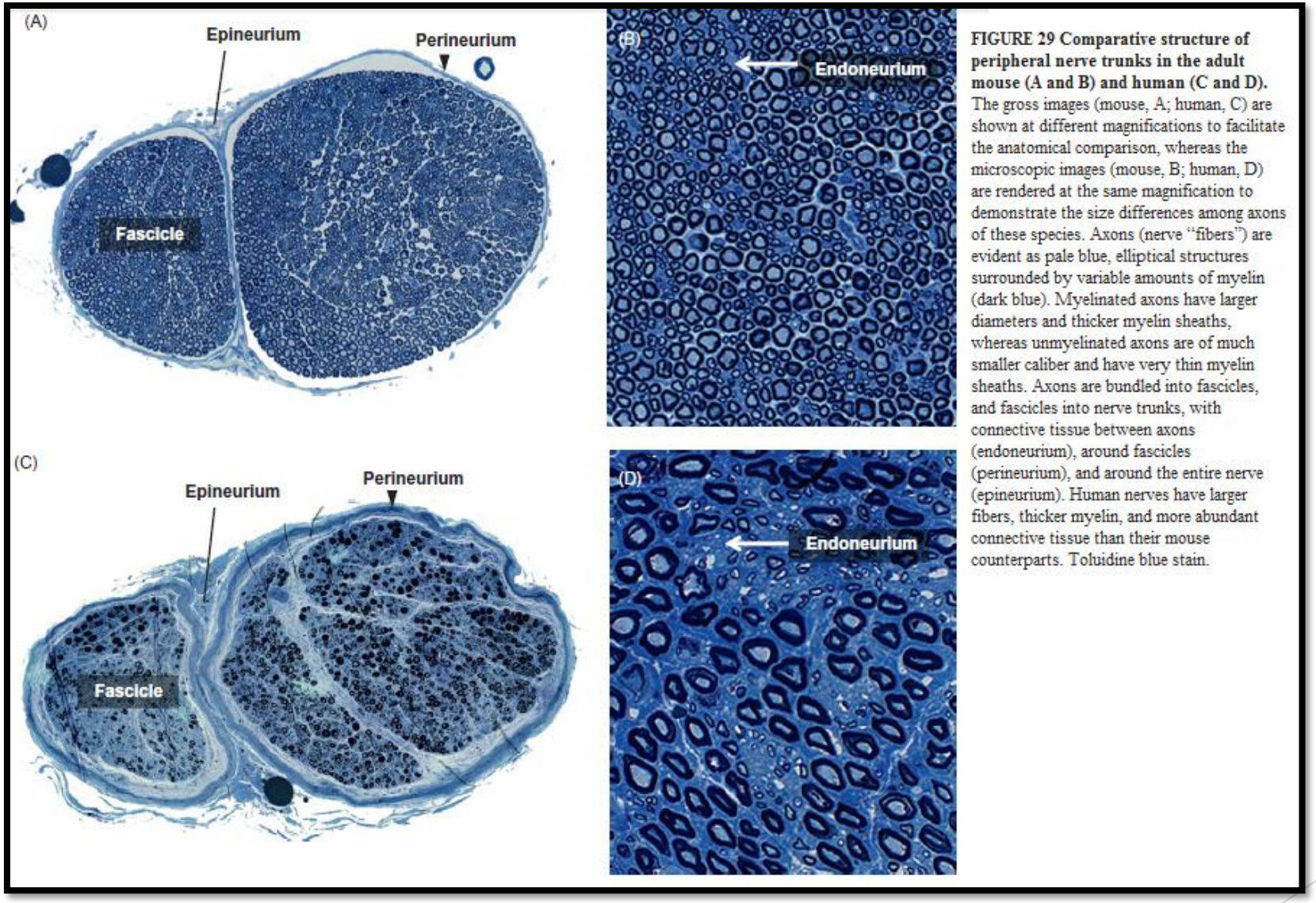
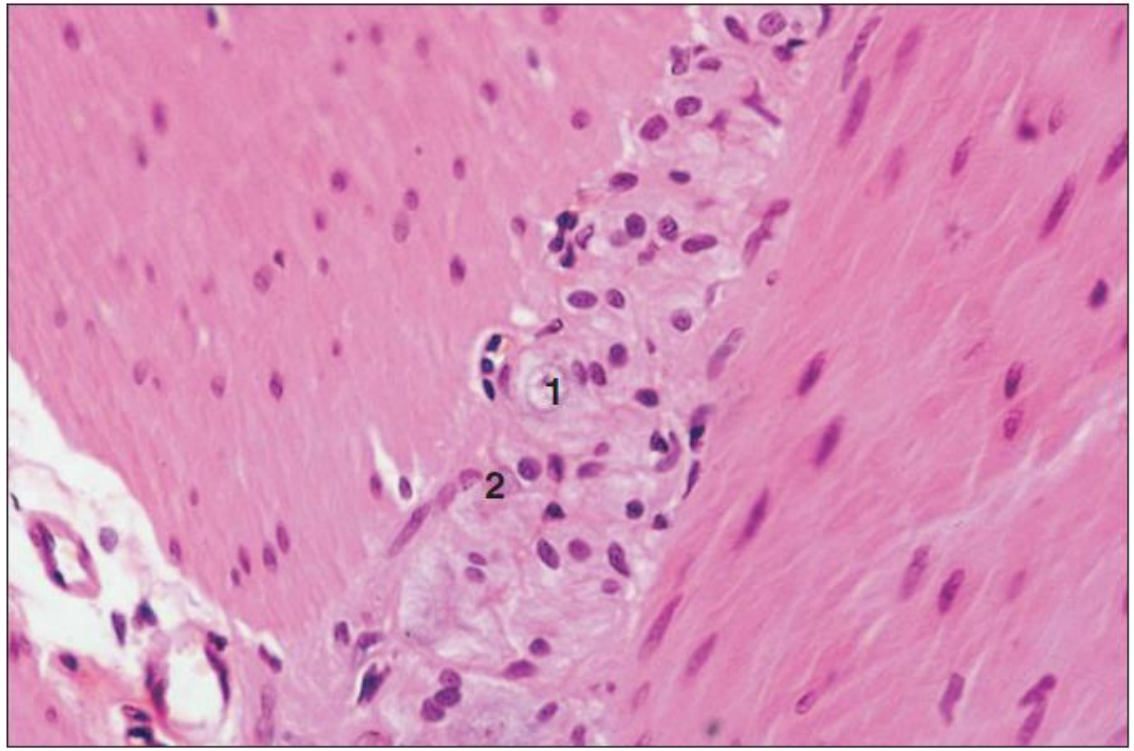


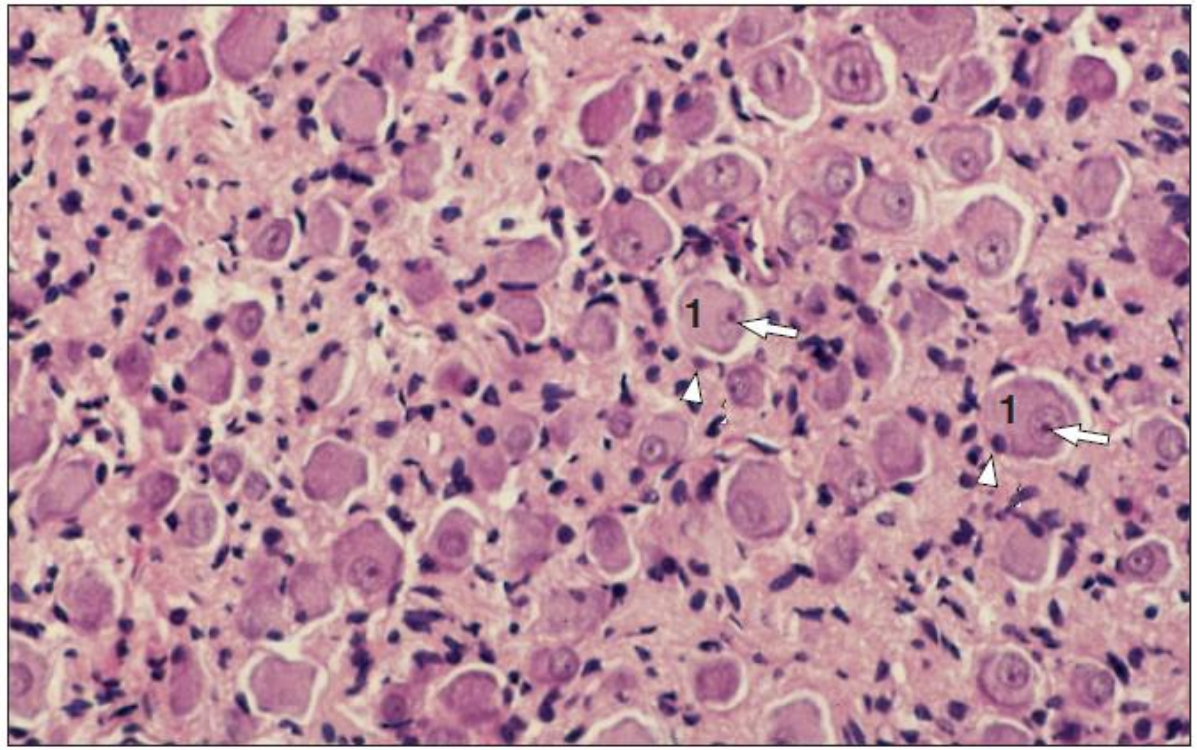
FIGURE 29 Comparative structure of peripheral nerve trunks in the adult mouse (A and B) and human (C and D). The gross images (mouse, A; human, C) are shown at different magnifications to facilitate the anatomical comparison, whereas the microscopic images (mouse, B; human, D) are rendered at the same magnification to demonstrate the size differences among axons of these species. Axons (nerve "fibers") are evident as pale blue, elliptical structures surrounded by variable amounts of myelin (dark blue). Myelinated axons have larger diameters and thicker myelin sheaths, whereas unmyelinated axons are of much smaller caliber and have very thin myelin sheaths. Axons are bundled into fascicles, and fascicles into nerve trunks, with connective tissue between axons (endoneurium), around fascicles (perineurium), and around the entire nerve (epineurium). Human nerves have larger fibers, thicker myelin, and more abundant connective tissue than their mouse counterparts. Toluidine blue stain.

Ganglia

13.11 Parasympathetic ganglion. Stomach (pig). (1) Neuron body. (2) Nerve fibres and supporting neuroglial cells. H & E. ×250.



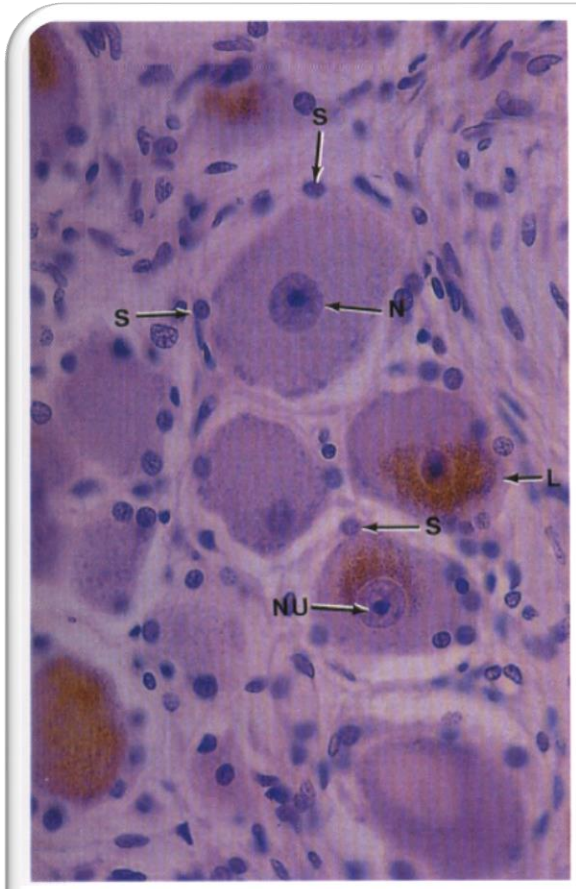
13.10



13.10 Sympathetic ganglion (dog). (1) Neuron body with eccentric nucleus (arrow) and satellite cells (arrowhead). H & E. ×125.

FIGURE 7.22 ■ Cells and unipolar neurons of a dorsal root ganglion. Stain: hematoxylin and eosin. High magnification.

FIGURE 7.23 ■ Multipolar neurons, surrounding cells, and nerve fibers of sympathetic ganglion. Stain: hematoxylin and eosin. High magnification.



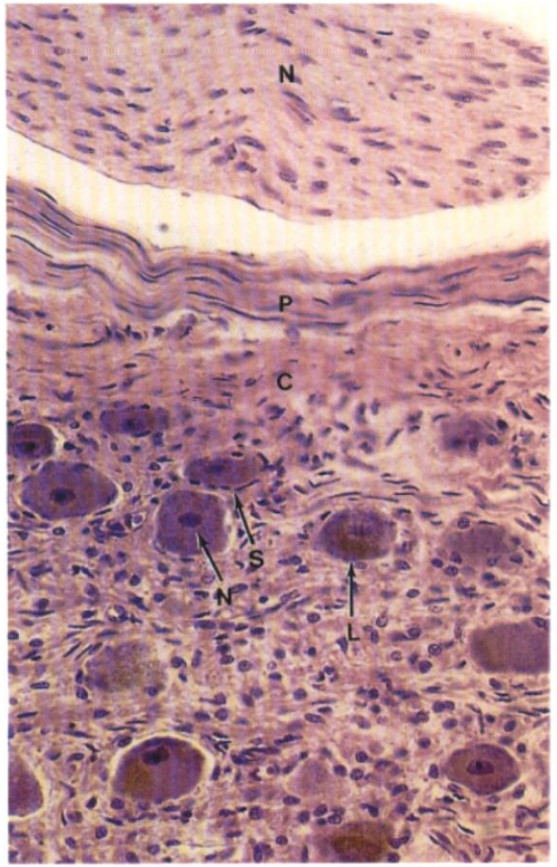
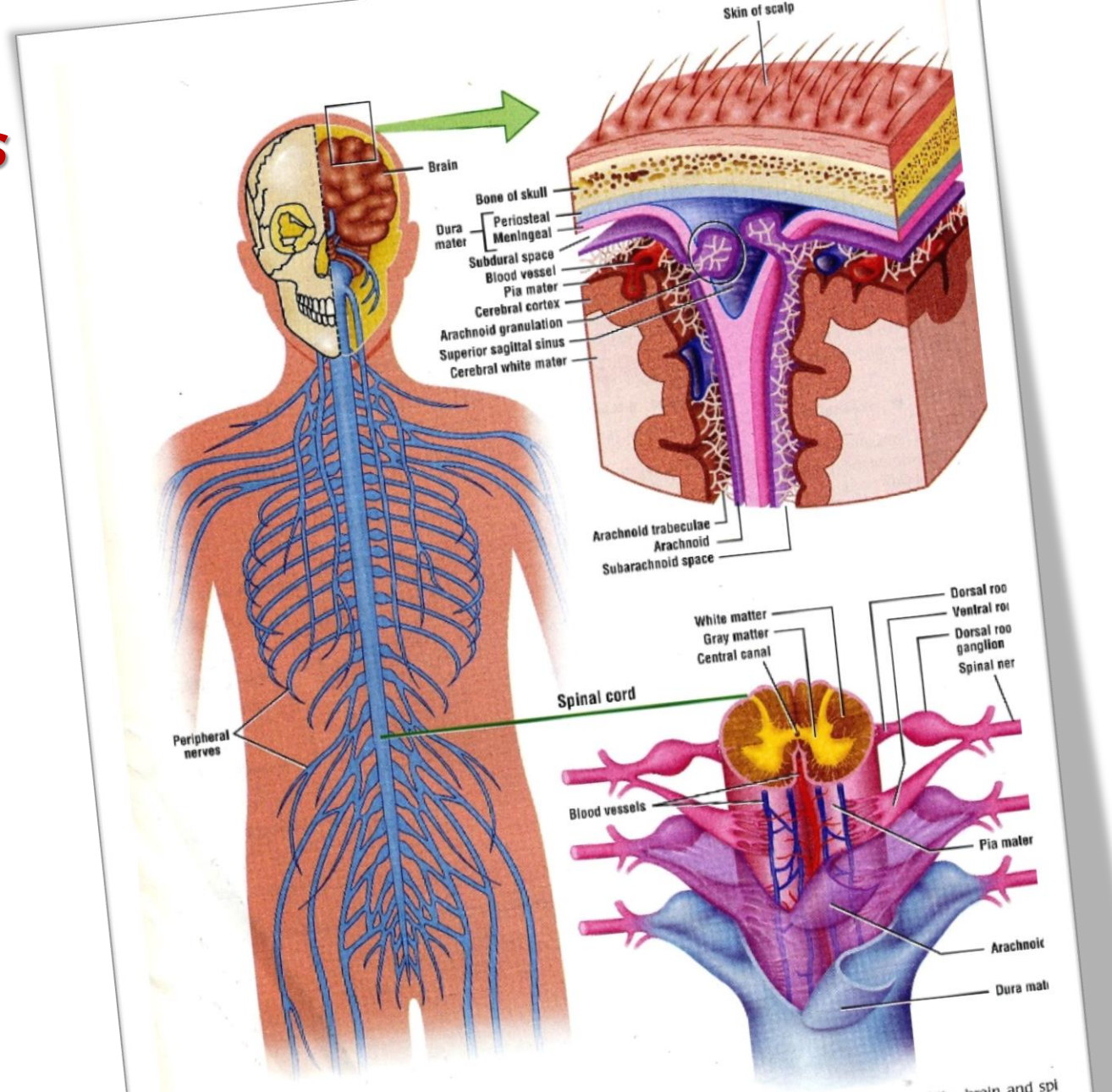


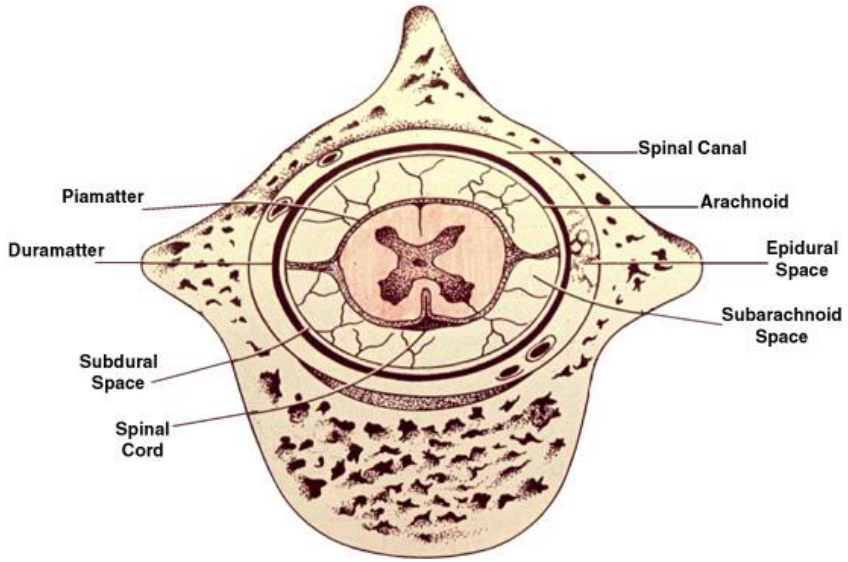
FIGURE 6-11
Photomicrograph of dorsal root (sensory) ganglion cells. Apparent are the nucleus (N) and nucleolus (NU) of the ganglion cells, satellite cells (S), and lipofuscin (L). × 560.

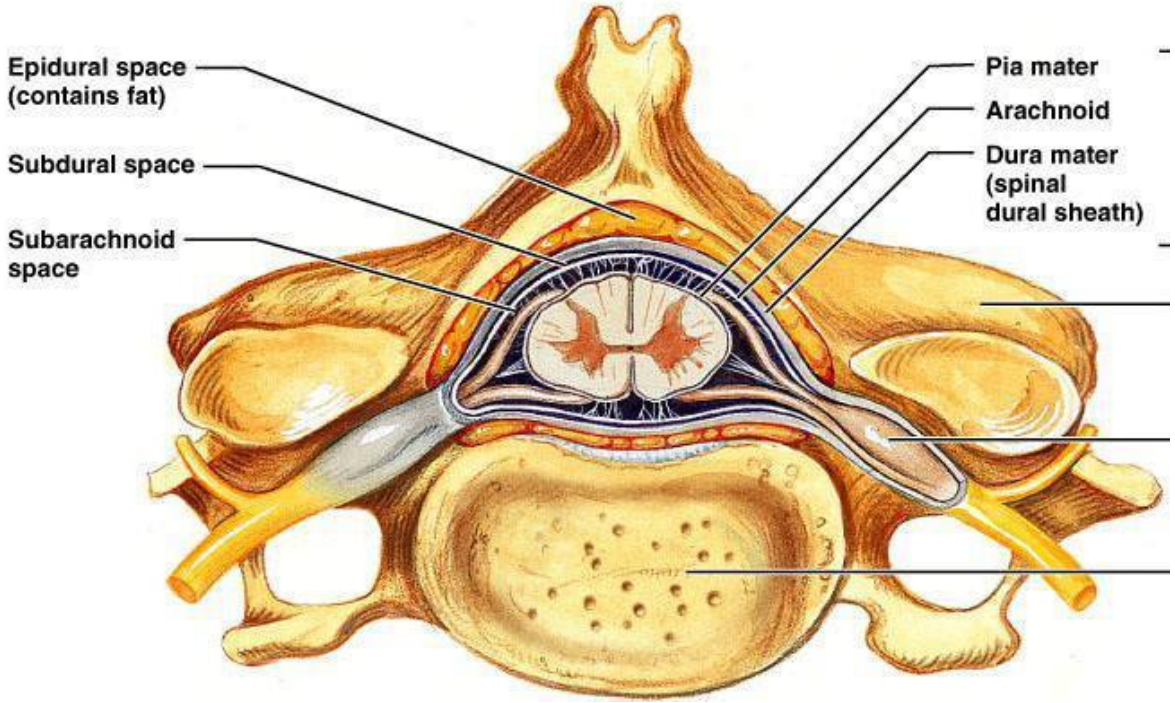
FIGURE 6-12
Photomicrograph of sympathetic ganglion cells in the peripheral nervous system showing the nucleus (N) of a ganglion cell, satellite cells (S), and the capsule (C) of the ganglion. The space between a part of the nerve fascicle (N) and its perineurium (P) is an artifact of slide preparation. L, lipofuscin. × 344.

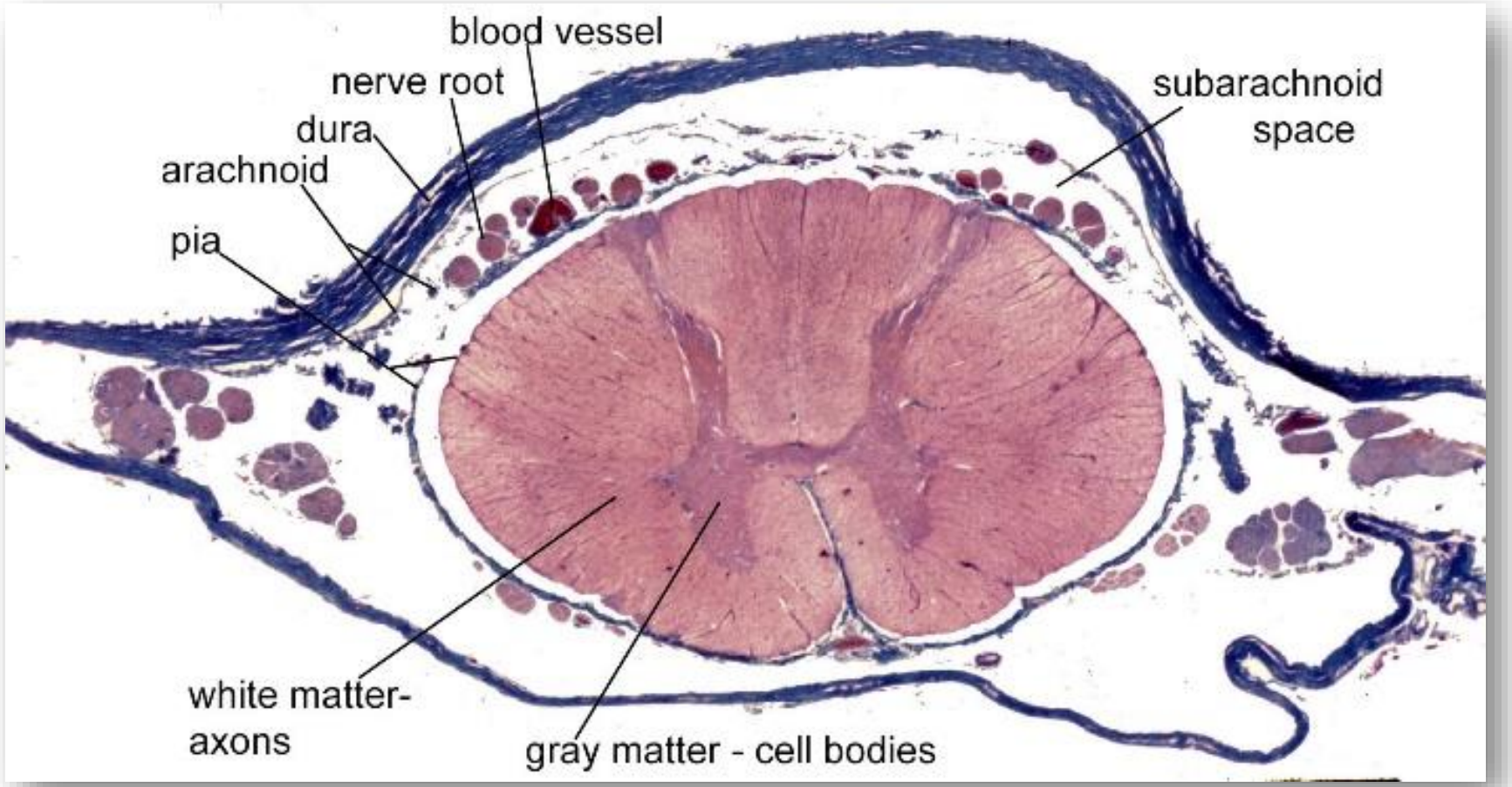
CNS
Meninges

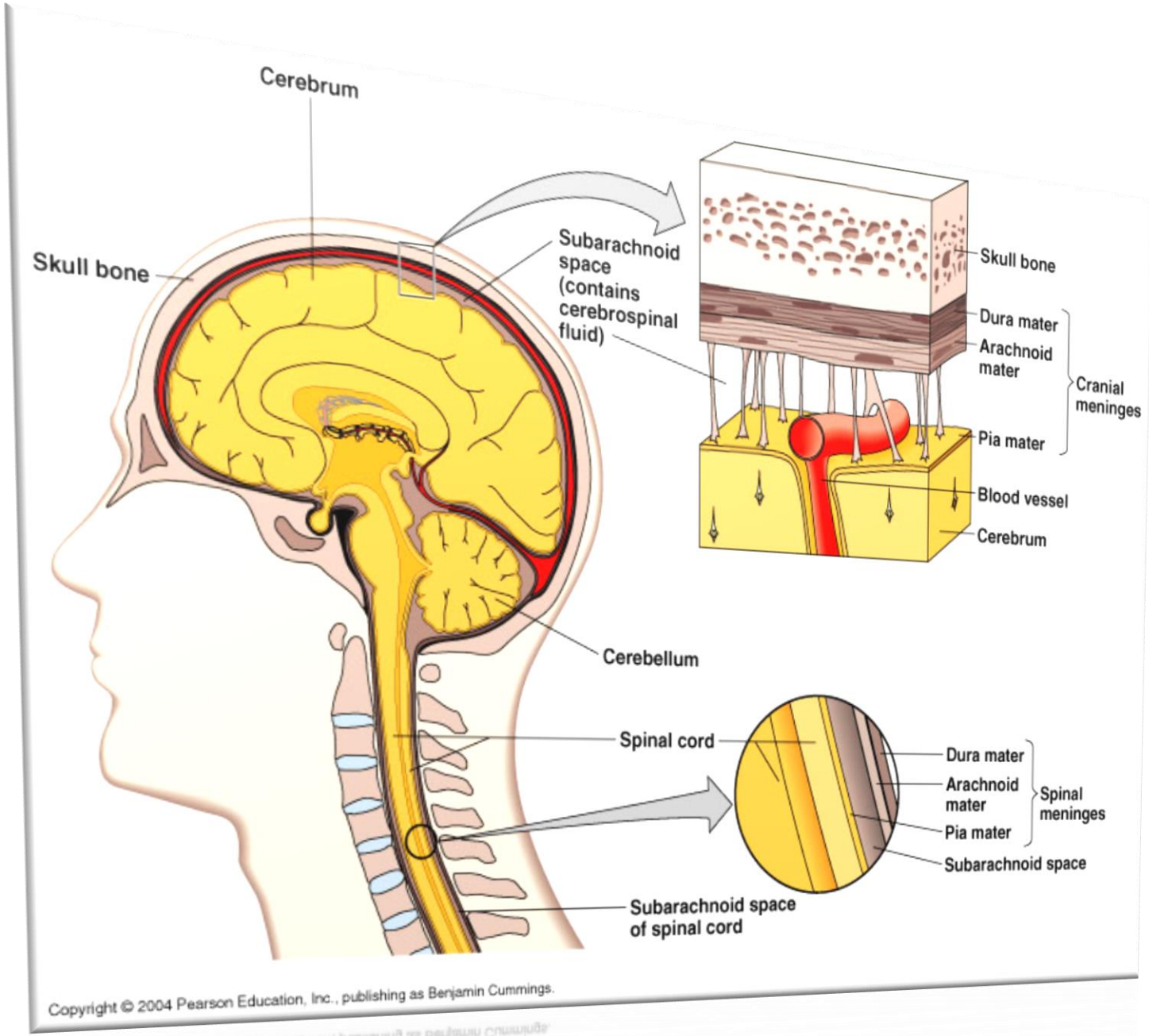


OVERVIEW FIGURE–CENTRAL NERVOUS SYSTEM ■ The central nervous system is composed of the brain and spi
cord. A section of the brain and spinal cord is illustrated here with their protective connective tissue layers called menin
(dura mater, arachoid, and pia mater).

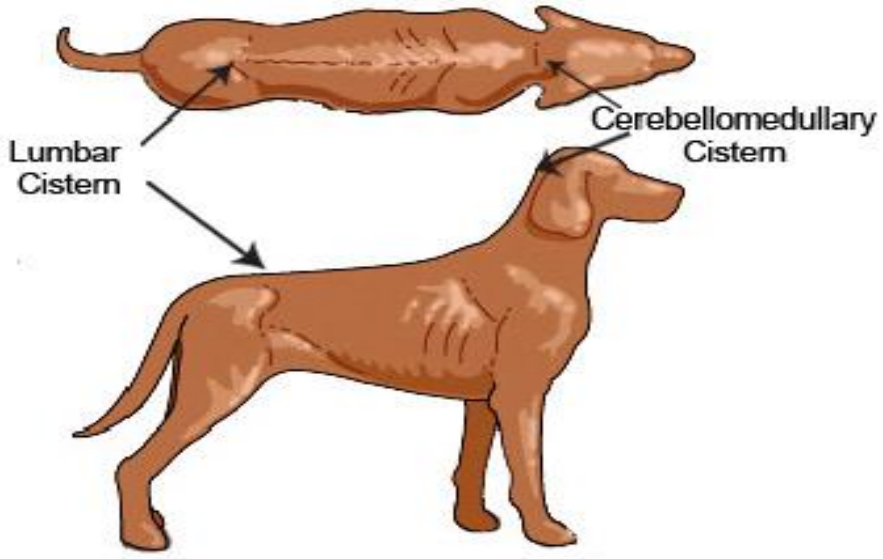

Spinal Canal
Piamatter
Arachnoid
Duramatter
Epidural Space
Subarachnoid Space
Subdural Space
Spinal Cord

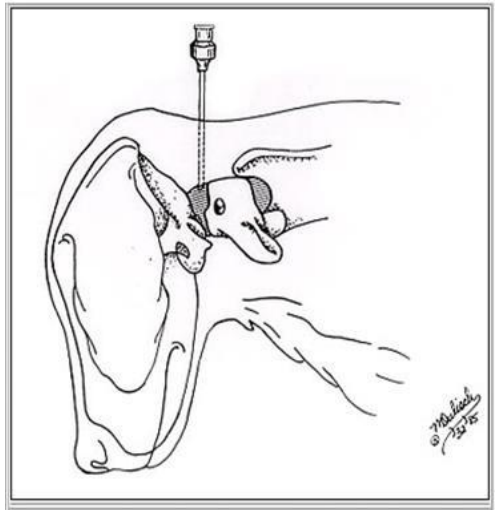

Epidural space (contains fat)
Subdural space
Subarachnoid space
Pia mater
Arachnoid
Dura mater (spinal dural sheath)


blood vessel
nerve root
dura
arachnoid
pia
subarachnoid space
white matter- axons
gray matter - cell bodies

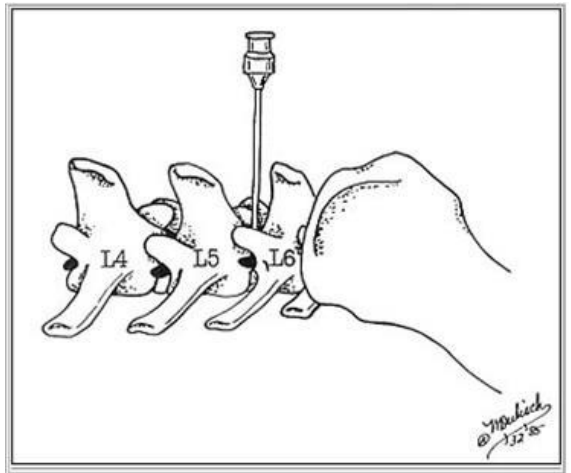

Cerebrum
Skull bone
Subarachnoid space (contains cerebrospinal fluid)
Cerebellum
Spinal cord
Subarachnoid space of spinal cord
Skull bone
Dura mater
Arachnoid mater
Pia mater
Cranial meninges
Blood vessel
Cerebrum
Dura mater
Arachnoid mater
Pia mater
Spinal meninges
Subarachnoid space
Copyright © 2004 Pearson Education, Inc., publishing as Benjamin Cummings.

CSF





Site of cisternal puncture for spinal fluid collection and/or insertion of contrast medium for myelography. (From Morgan RV: Selected diagnostic and therapeutic procedures. P. 17. In Morgan RV (ed): Handbook of Small Animal Practice. 3rd Ed. WB Saunders, Philadelphia, 1997, with permission.)



A lumbar spinal tap is demonstrated at the interarcual space between lumber vertebrae 5 and 6. (From Morgan RV: Selected diagnostic and therapeutic procedures. P. 17. In Morgan RV (ed): Handbook of Small Animal Practice. 3rd Ed. WB Saunders, Philadelphia, 1997, with permission.)

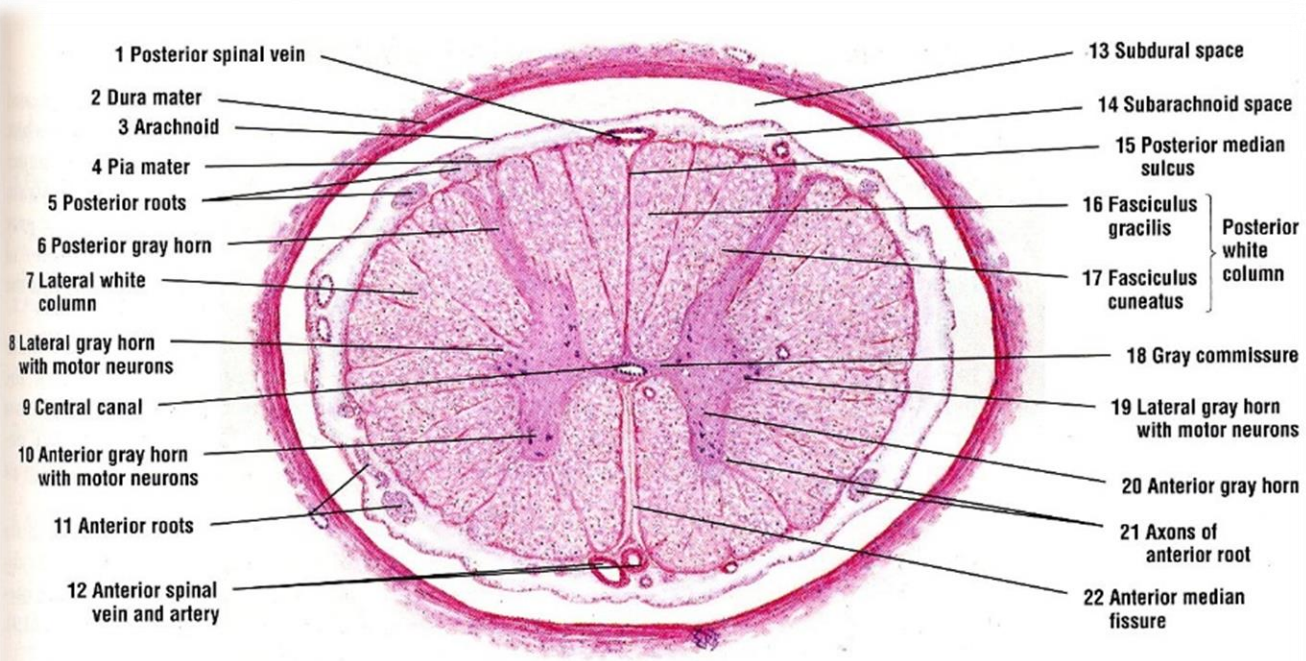


FIGURE 7.1 ■ Spinal cord: midthoracic region (transverse section). Stain: hematoxylin and eosin. Low magnification.

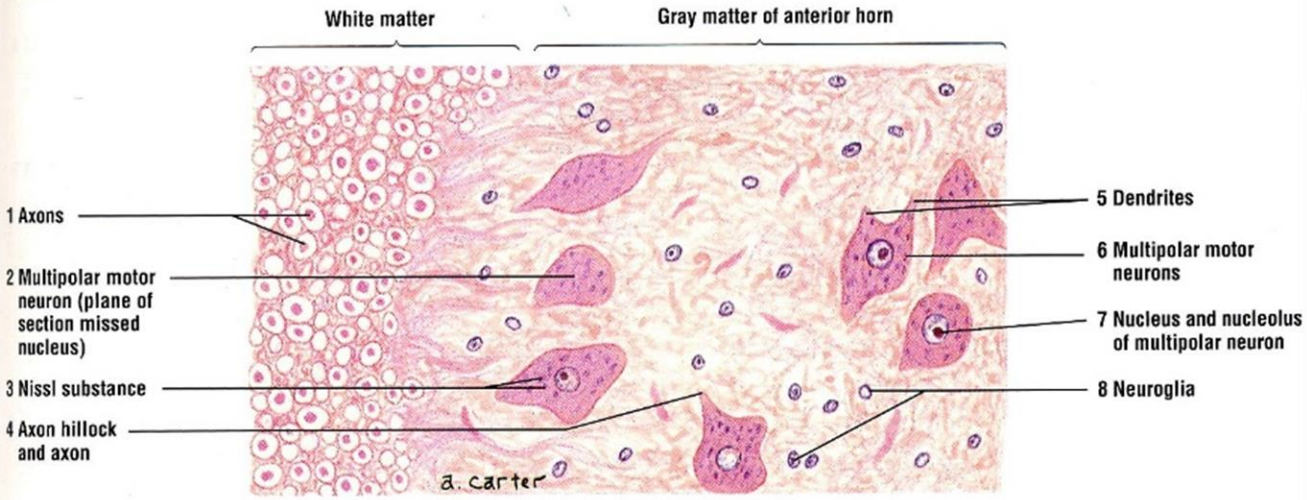


FIGURE 7.2 ■ Spinal cord: anterior gray horn, motor neurons, and adjacent white matter. Stain: hematoxylin and eosin. Medium magnification.

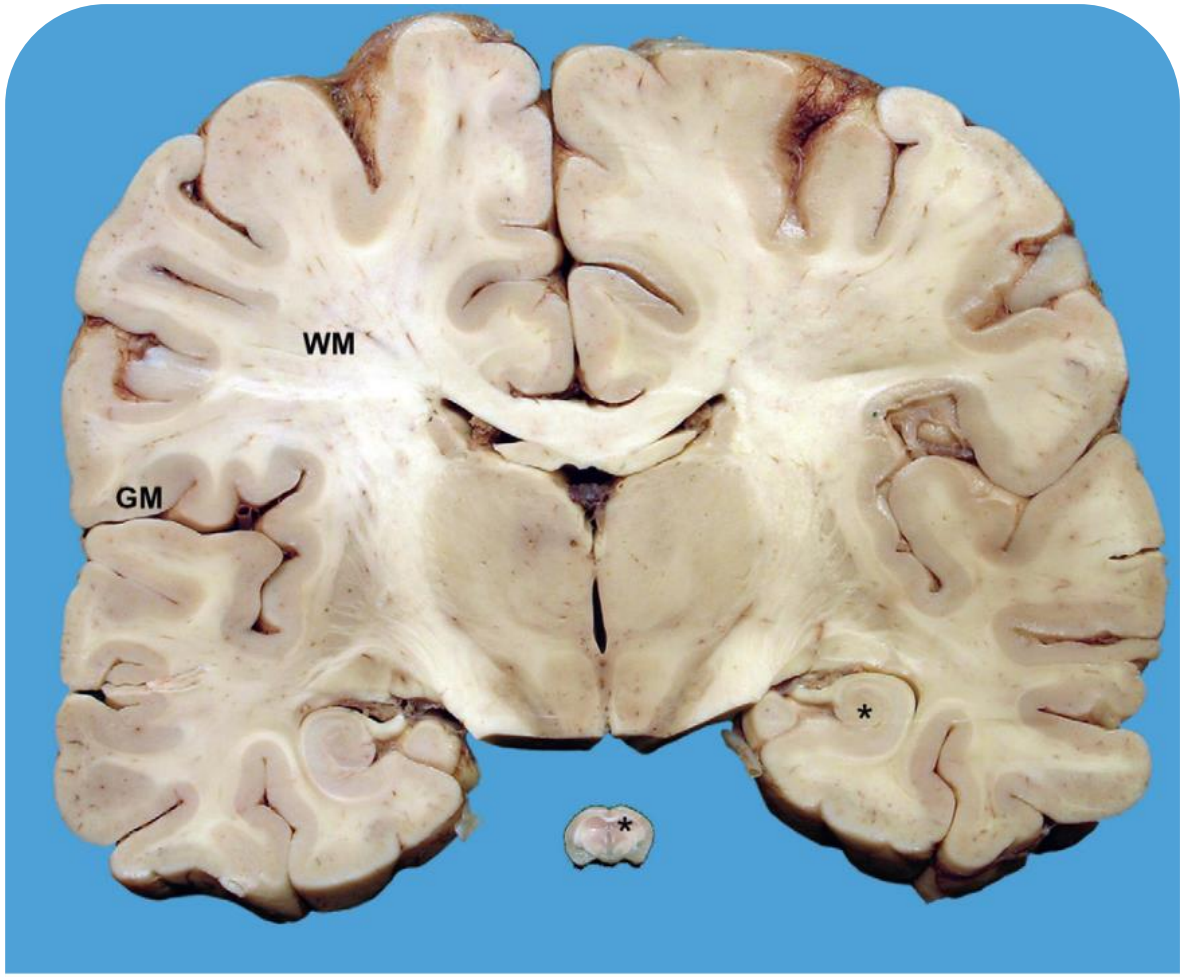


FIGURE 1 Coronal brain slices from an adult human and adult mouse demonstrating the marked differences in organ size and organization. Gray matter (GM) includes neuron cell bodies, glia, and blood vessels. White matter (WM) consists of myelinated axons and myelinating cells. The hippocampal formation on the right side of each slice is marked with an asterisk. Many of the photos and diagrams in this chapter have been adjusted in size to provide optimal anatomical and cellular comparisons.

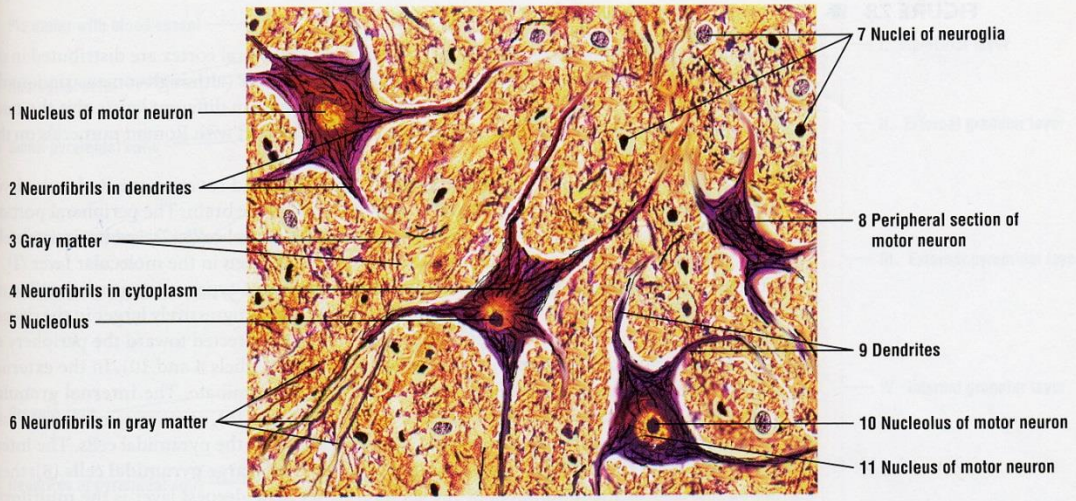


FIGURE 7.6 ■ Neurofibrils and motor neurons in the gray matter of the anterior horn of the spinal cord. Stain: silver impregnation (Cajal's method). High magnification.

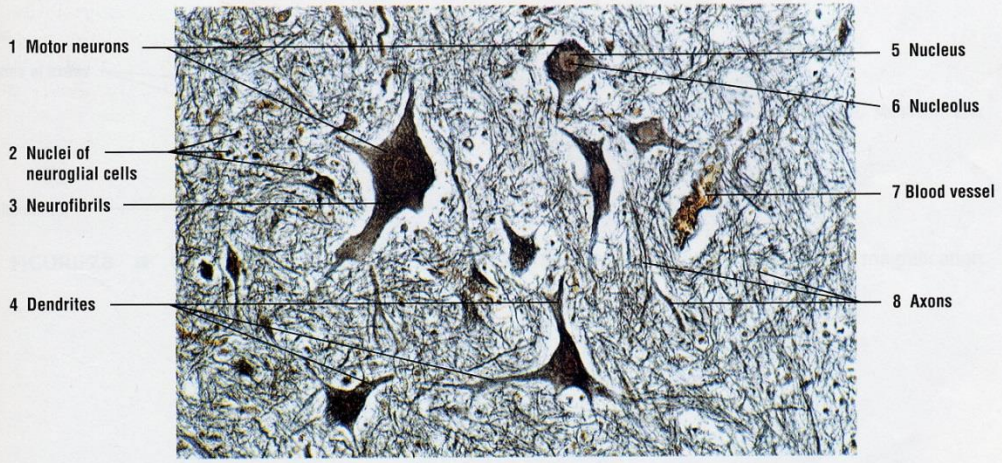
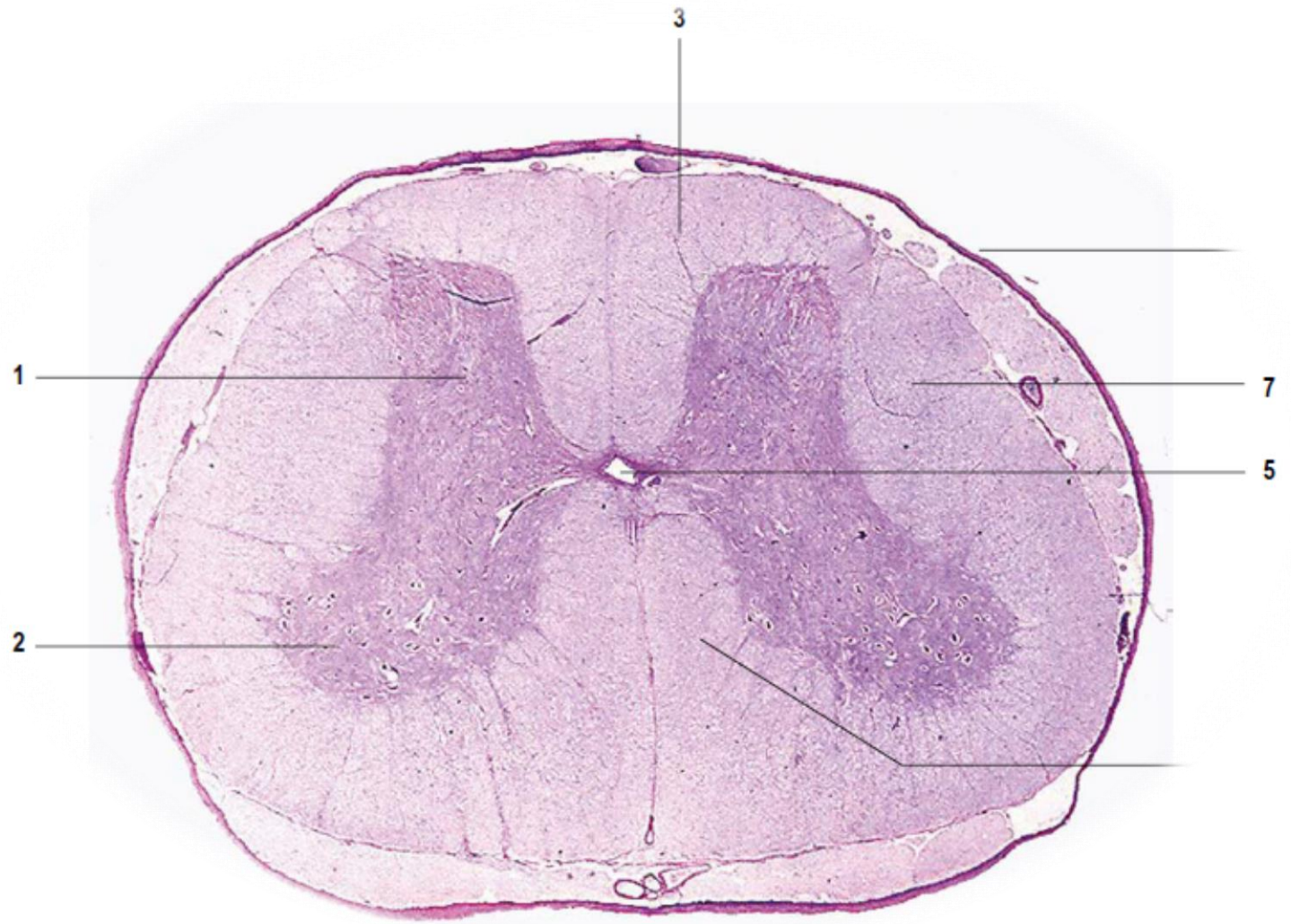
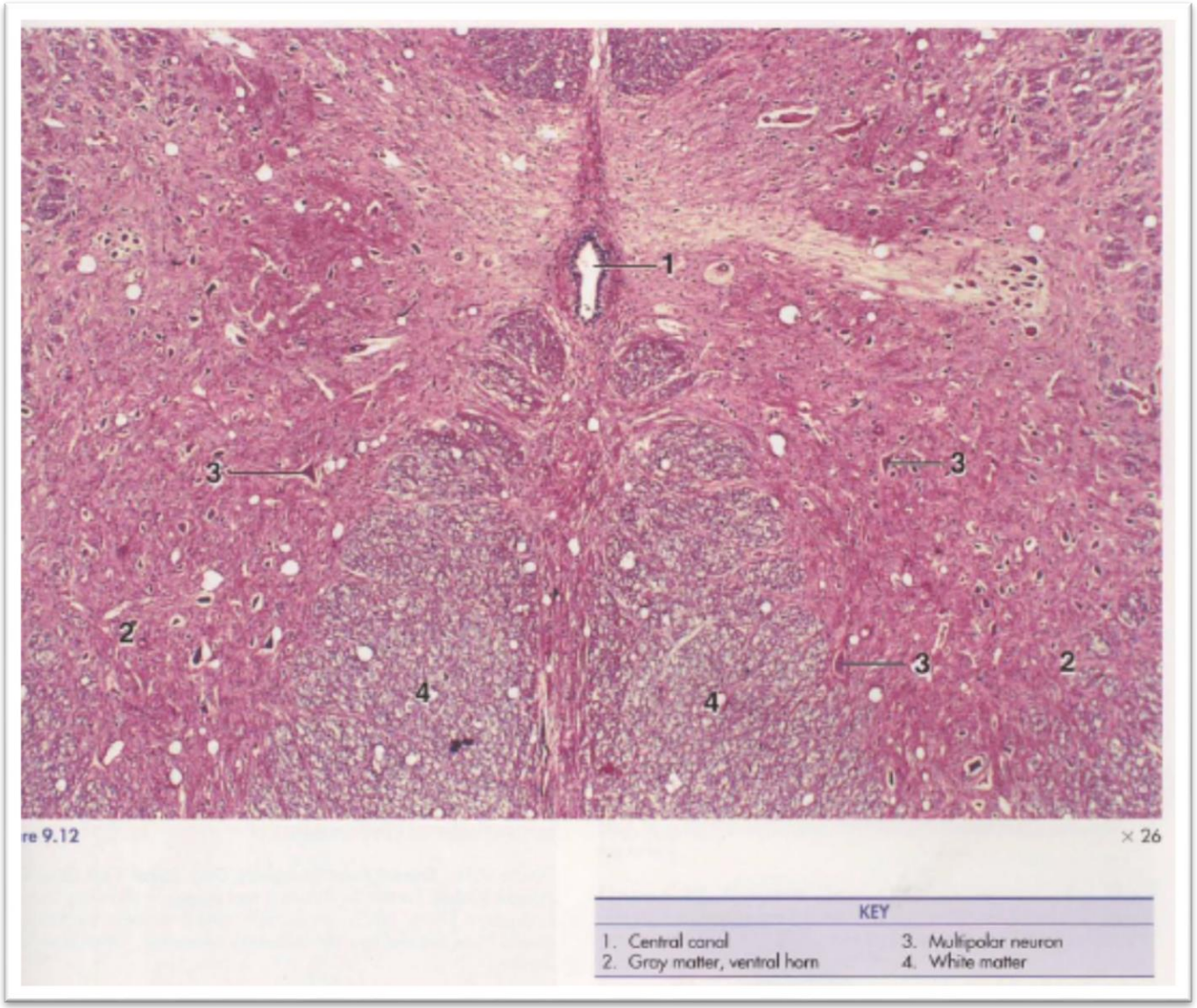


FIGURE 7.7 ■ Anterior gray horn of the spinal cord: multipolar motor neurons, axons, and neuroglial cells. Stain: silver impregnation (Cajal's method). 80×

Spinal cord

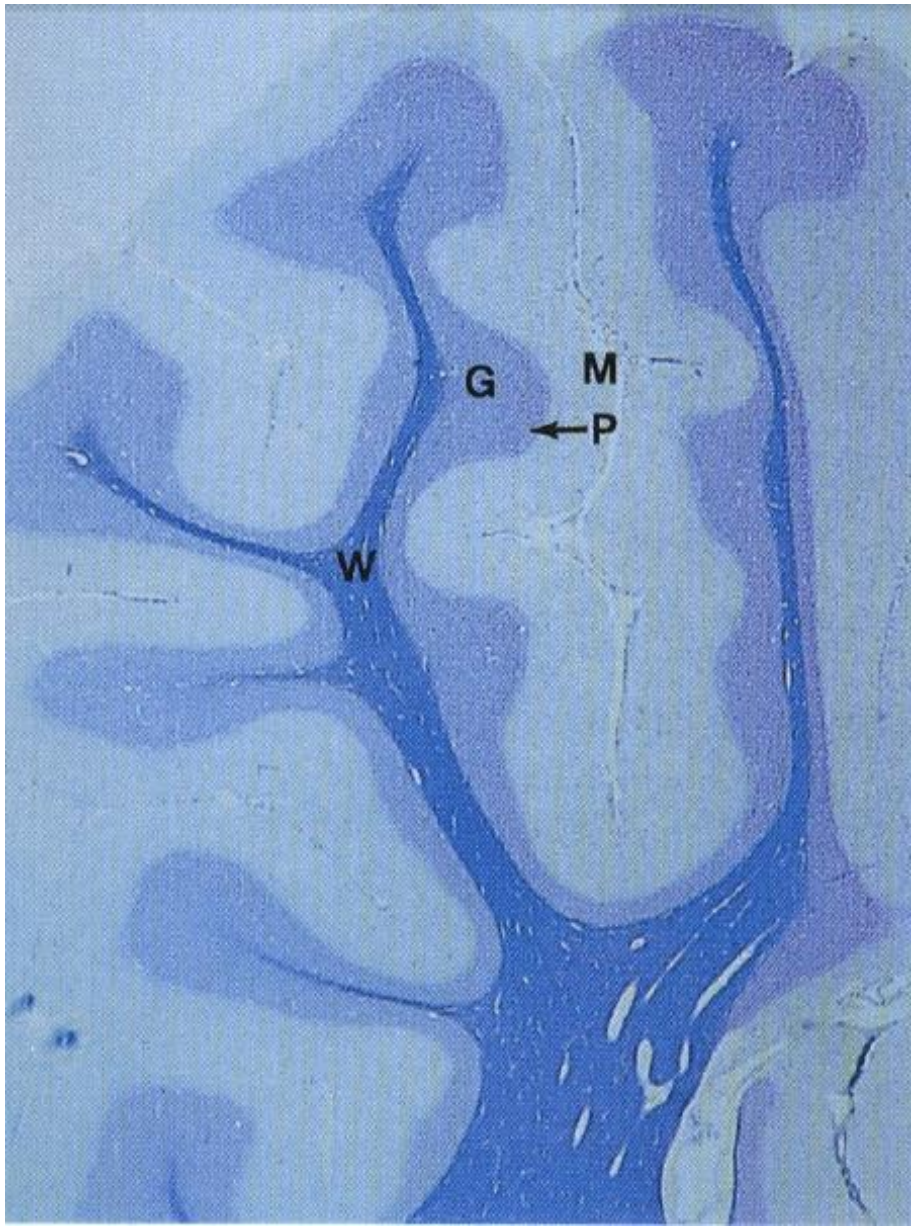




re 9.12 × 26

KEY	
1. Central canal	3. Multipolar neuron
2. Gray matter, ventral horn	4. White matter

Cerebellum



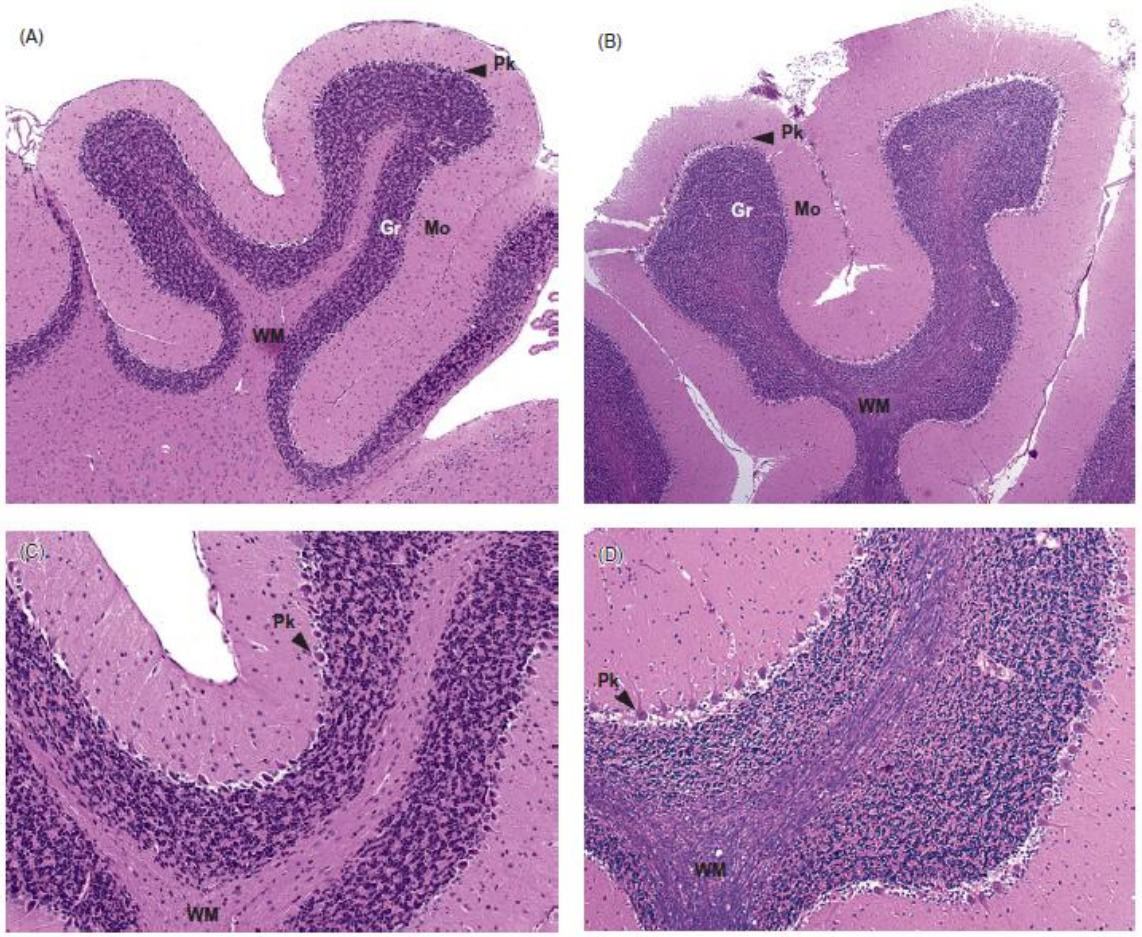


FIGURE 17 Cerebellum of the adult mouse (A, C, and E; H&E) and human (B, D, and F; H&E with LFB). The region is uniformly organized in three layers, which are (from outside to in) the molecular layer (Mo), Purkinje cell layer (Pk, with arrowheads), and the granular layer (Gr). The molecular layer is a broad expanse of densely packed neuronal processes with few neuronal bodies. The Purkinje cell layer is a single layer of large, torpedo-shaped cells with prominent apical processes extending into the molecular layer; the cells in the mouse are smaller and have less cytoplasm (E) relative to human cells (F). The granular layer is packed with small, dark, round granule cells, and it is more cellular in the human than in the mouse. The white matter (WM) core of each cerebellar folium (meaning "leaf") is visible in both species. Mouse and human micrographs are shown at different magnifications to better illustrate the cytoarchitectural features of each species.

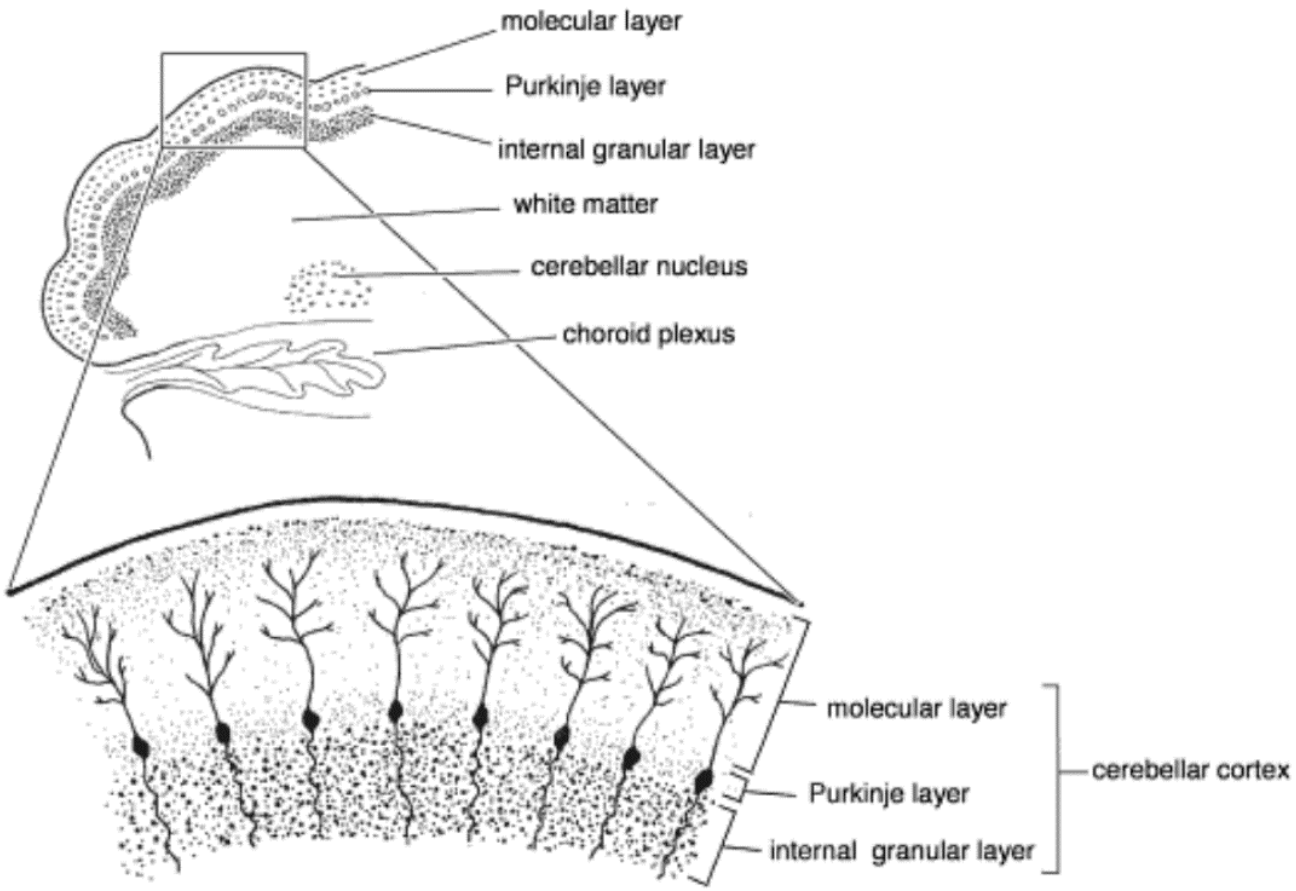


Figure 13.18 Section through the cerebellar cortex. Enlarged view shows the three definitive cellular layers of the cerebellar cortex.

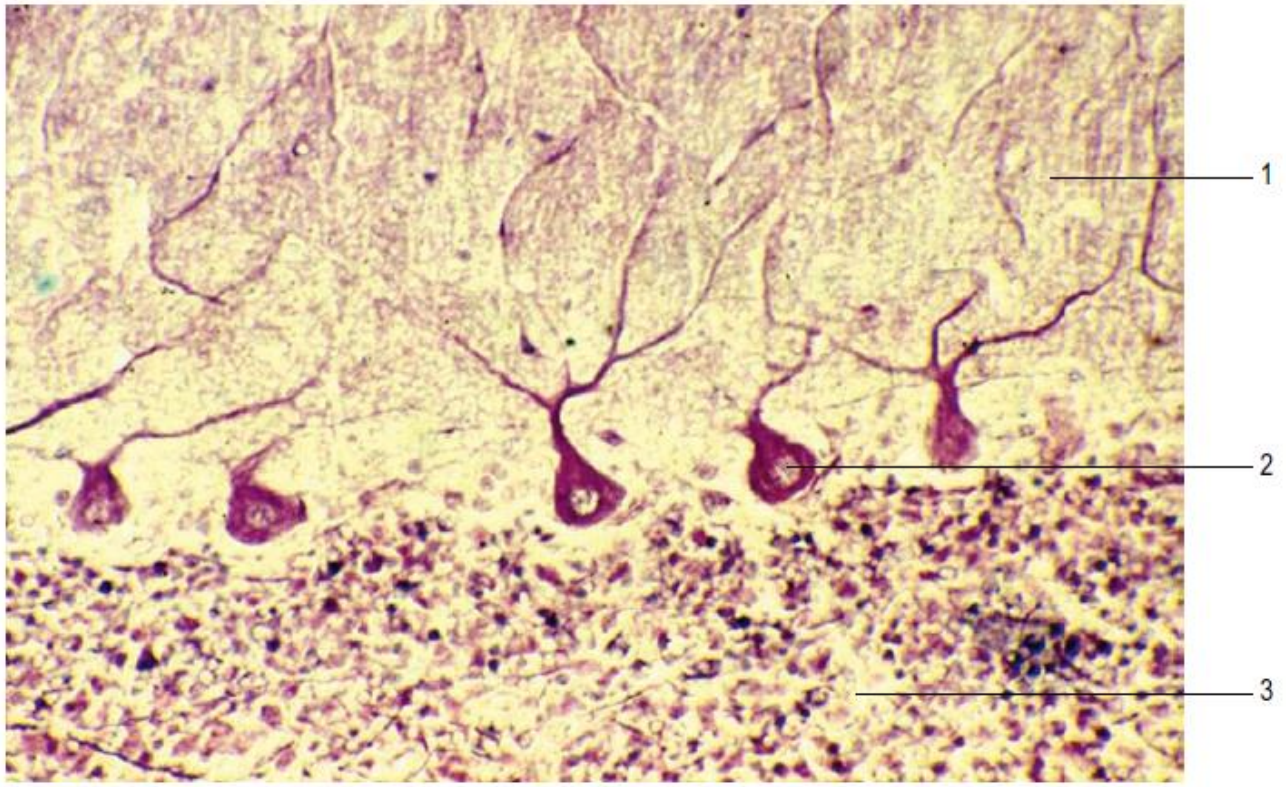


Fig. 10-20: Histological section through the differentiated cerebellar cortex of an adult dog. 1: Molecular layer; 2: Purkinje cell layer; 3: Granular layer.

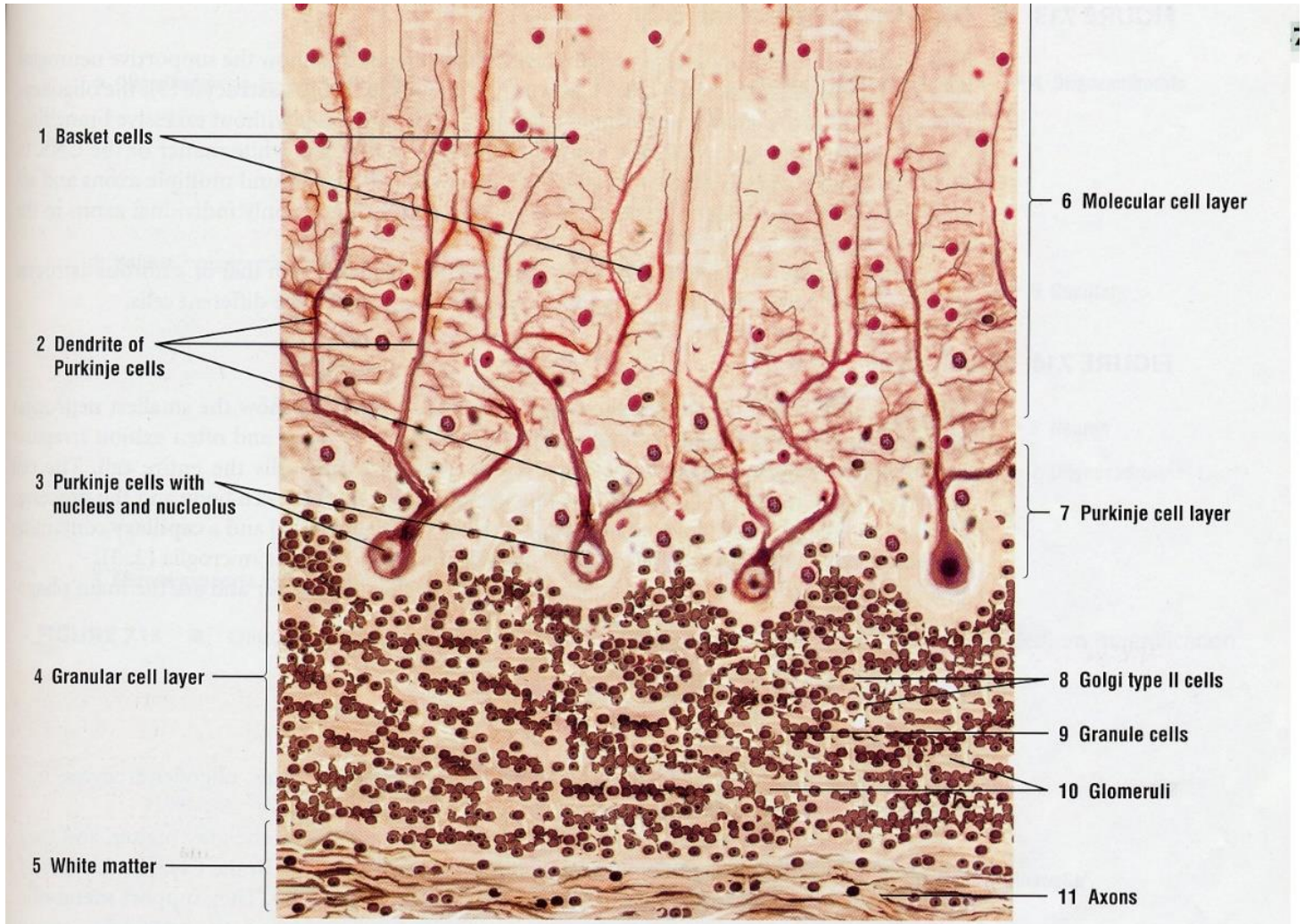


FIGURE 7.11 ■ Cerebellar cortex: molecular layer, Purkinje cell layer, and granular cell layer. Stain: silver impregnation (Cajal's method). High magnification.

Cerebrum

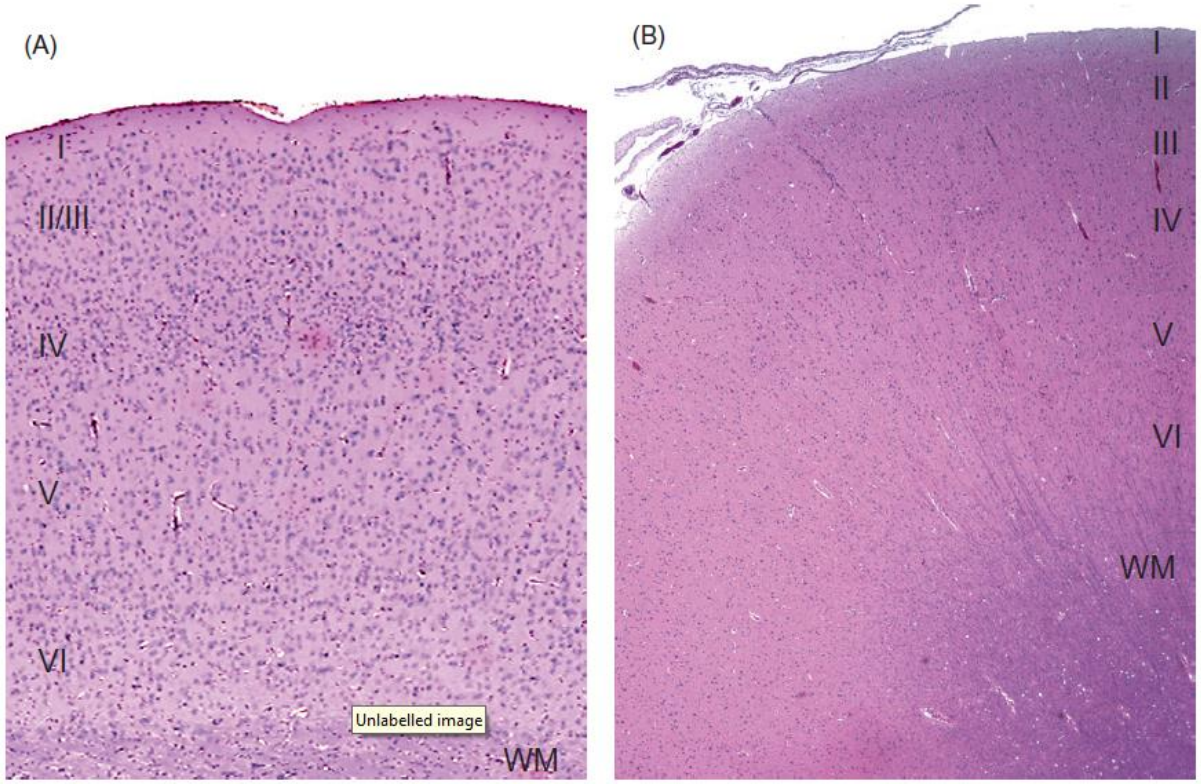


FIGURE 12 Neuronal organization in the cerebral cortex of an adult mouse (A) and human (B). The cortex contains six layers, although in the mouse, layers II and III are merged together as layer II/III. Layer I (molecular layer) lies beneath the meninges and contains neuropil and few neuron cell bodies. The remaining strata are layers II (external granular cell layer), III (external pyramidal cell layer, composed of small pyramidal cells), IV (internal granular cell layer), V (internal pyramidal cell layer, containing large pyramidal cells), and VI (multiforme layer, with elongate fusiform neurons). To highlight cellular detail of each species, the mouse image is presented at a higher magnification. WM, white matter.

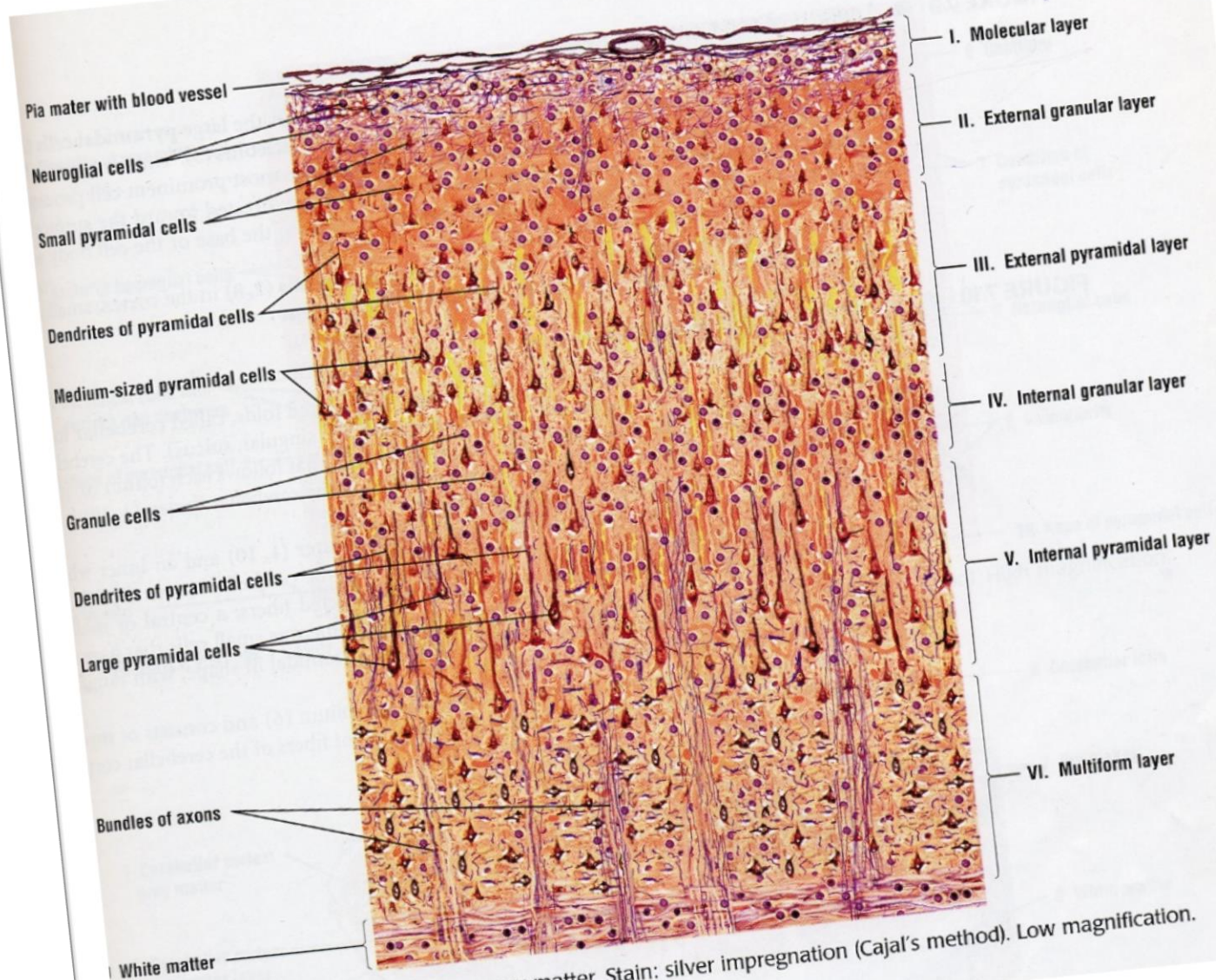


FIGURE 7.8 ■ Cerebral cortex: gray matter. Stain: silver impregnation (Cajal's method). Low magnification.