CNS MODULE 2022

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Nerves System Terminology

1. **Neuron:** is a nerve cell body and its processes.

2. **Nucleus:** is a group of nerve cells **bodies** **inside** the CNS.

3. **Ganglia:** is a group of nerve cells **bodies** **outside** the CNS.

4. **Synapse:** is the site of contact of the axon of one neuron with the dendrites or cell body another neuron.

5. **Gray matter:** consists of **nerve cells bodies** and **unmyelinated** portion of axon in the CNS supported by **neuroglia+ Bl. Ves.**

6. **White matter:** consists of **nerve fibers (myelinated axons** of neurons in the CNS) supported by **neuroglia.**

8. Nerve fiber: is an axon + sheath .

9. P. Nerve: is **a bundle or group** of nerve fibers **in the PNS**.

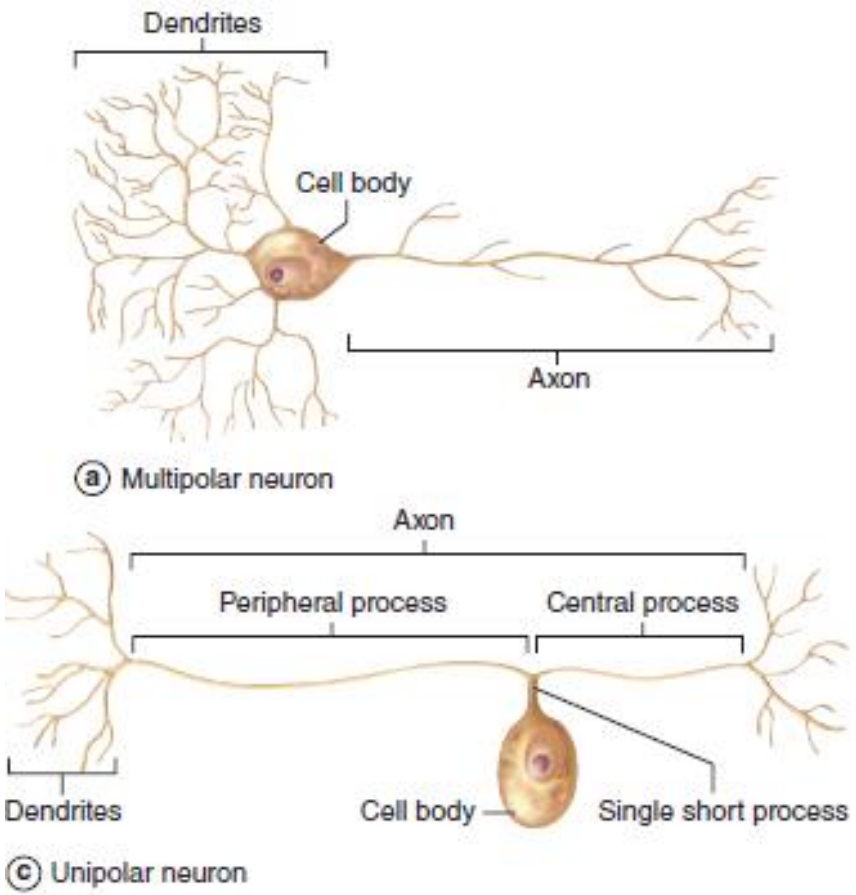
10. Tract: is a group of nerve fibers **inside CNS** which have the **same origin**, **termination** and **function**. The tract may be **ascending** (sensory or afferent) or **descending** (motor or efferent).

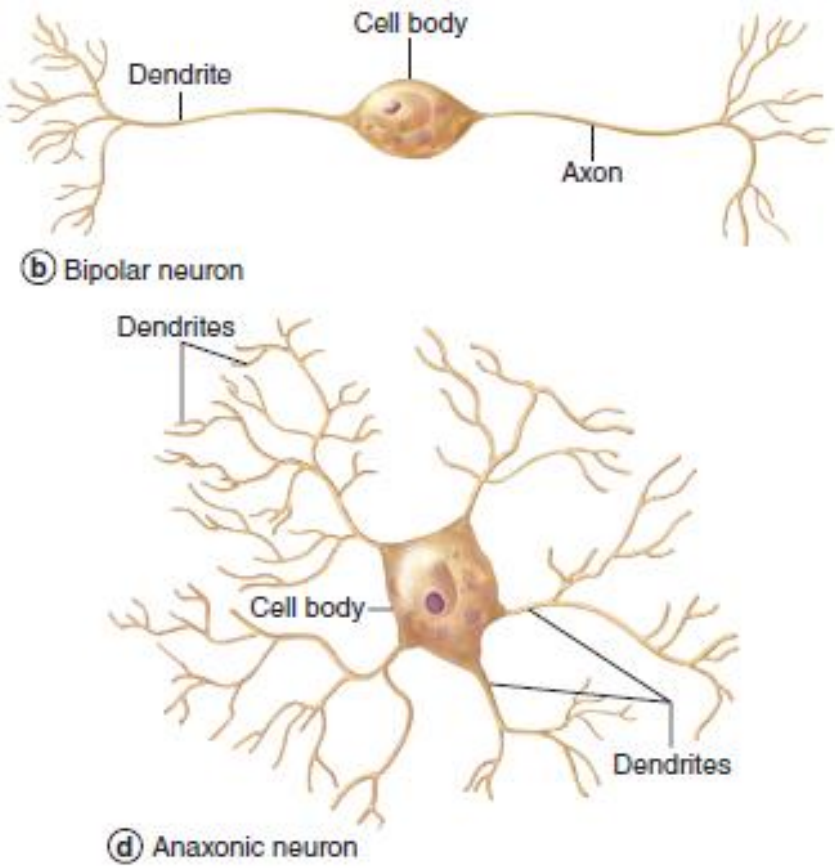
11. lemniscus: bundle of nerve fibers **inside CNS** which have **different origin , termination or function.**

7. Commissure: is a **group of nerve fibers** which connect **right** **and** **left** side of the brain or spinal cord

12. Association fibers: are **nerve fibers** which connect parts of the nervous system on the **same side**.

13. Peduncles: are **large nerve tracts** that emerge from certain region of the brain.





The main types of neurons:
(a) Most neurons, including all motor neurons and CNS interneurons, are multipolar. (b) Bipolar neurons include sensory neurons of the retina, olfactory mucosa, and inner ear. (c) All other sensory neurons are unipolar or pseudo unipolar

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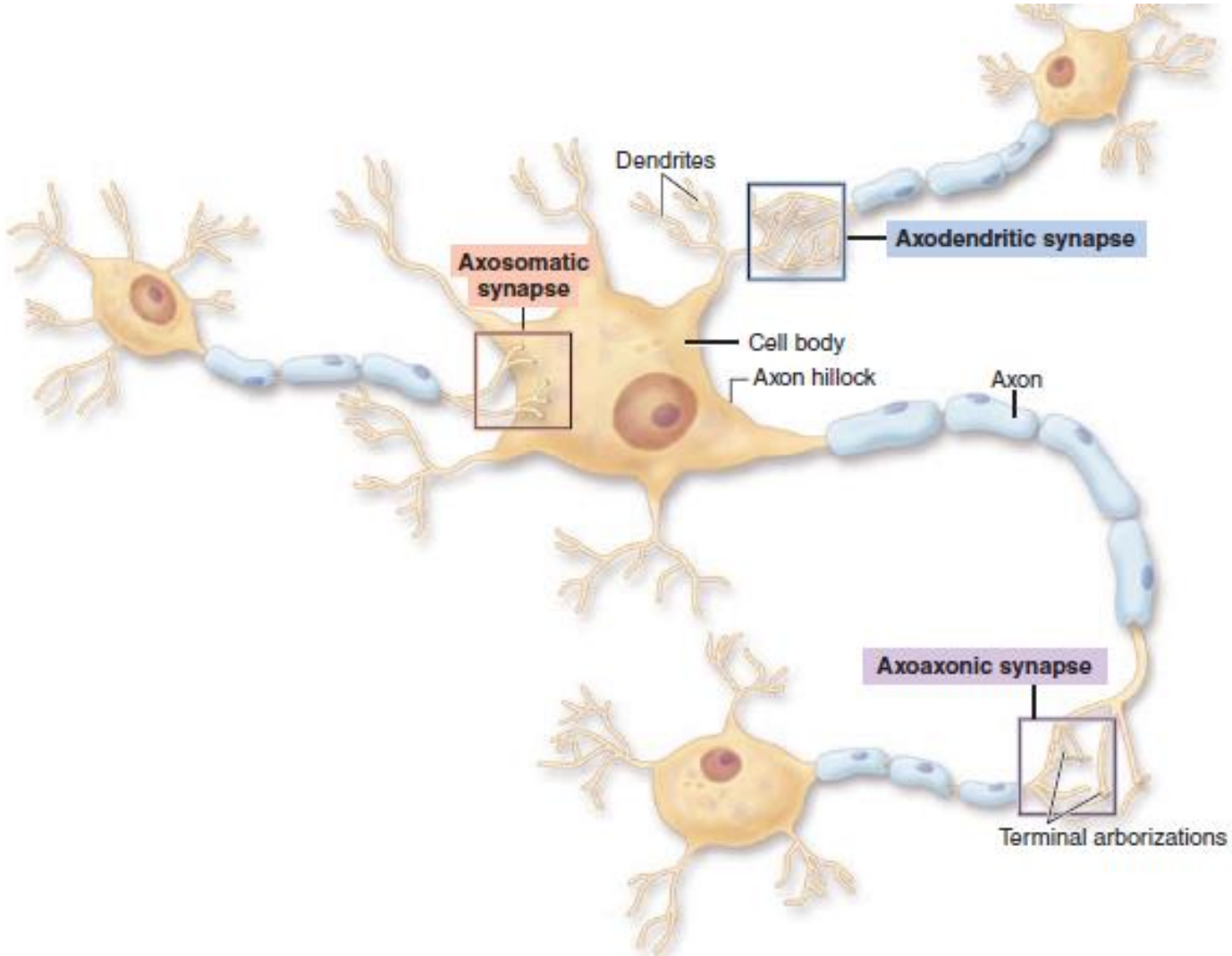
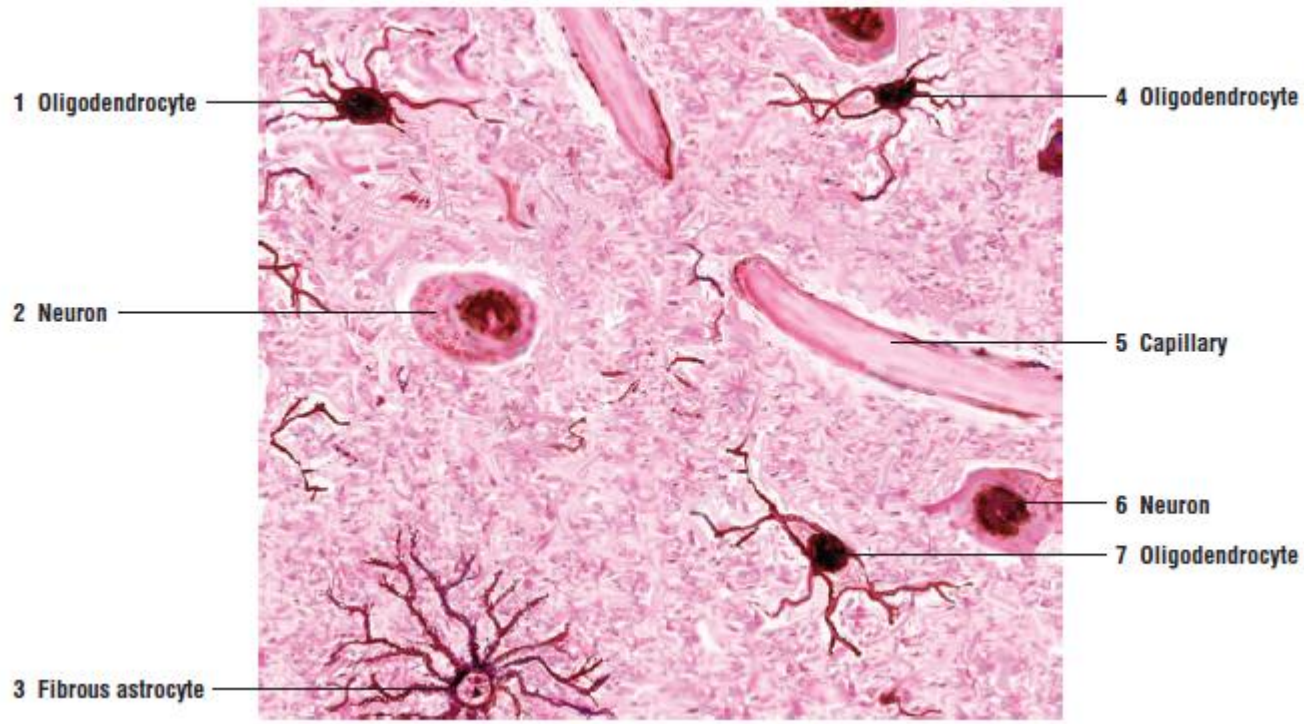
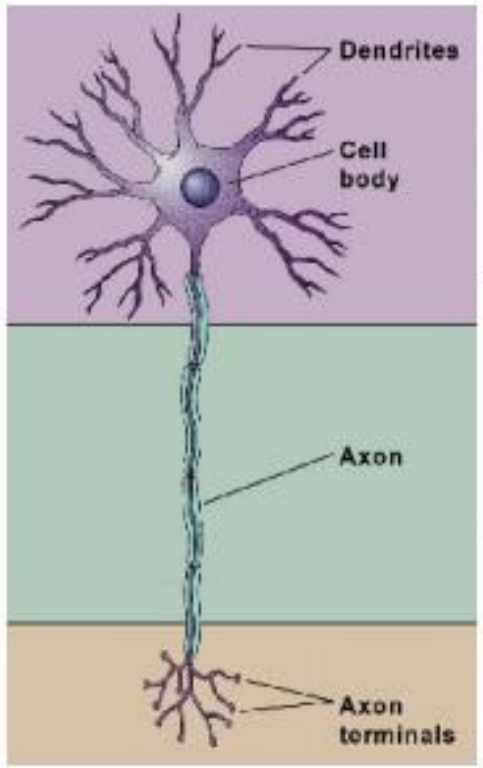
(d) Anaxonic neurons of the CNS lack true axons and do not produce action potentials, but regulate local electrical changes of adjacent neurons.

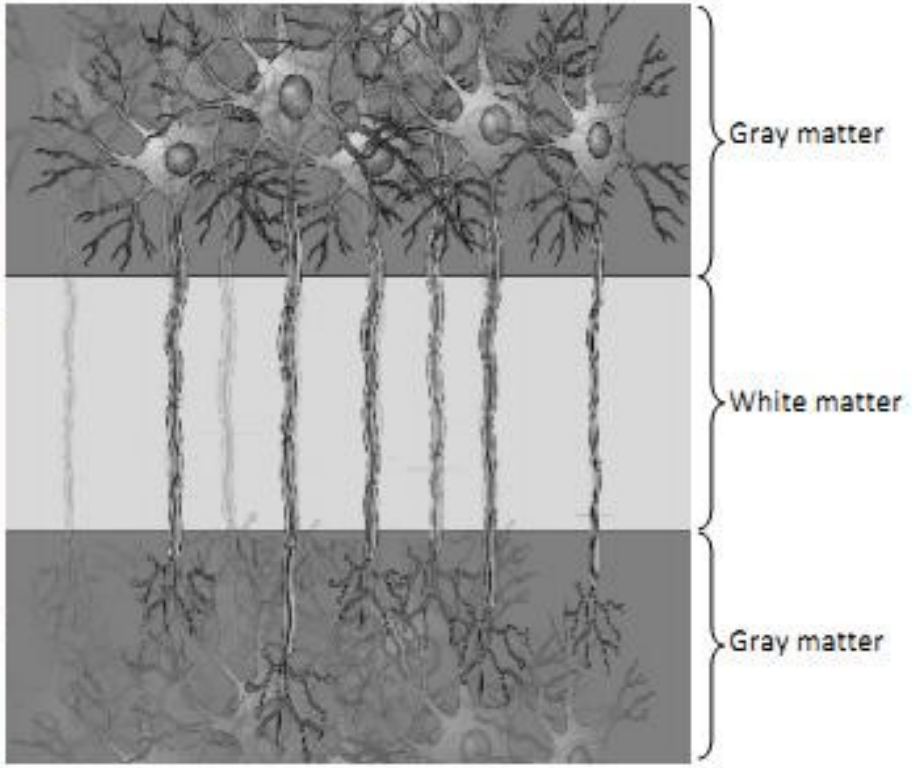


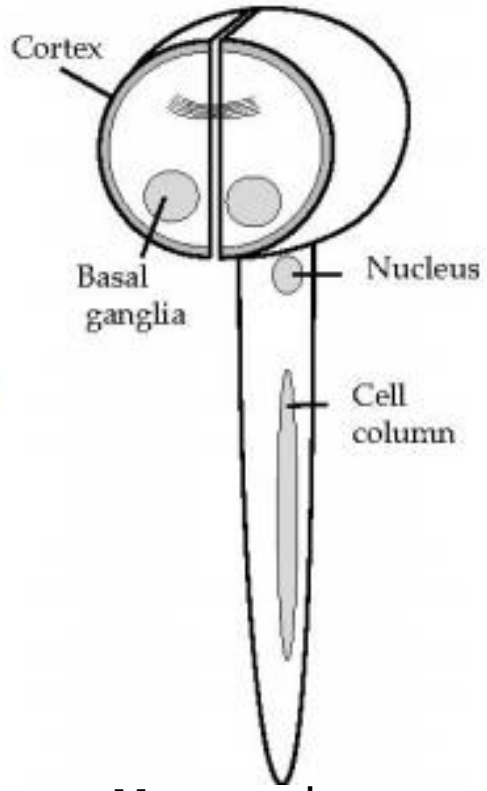
Axon terminals usually transmit the nerve impulse to another neuron's cell body (or soma) or to its dendrites (or a dendritic spine). Less frequently, axon terminals form synapses with another axon terminal, an arrangement that helps modulate synaptic activity. Features of these three common morphologic types of synapses are shown at the top of the figure.



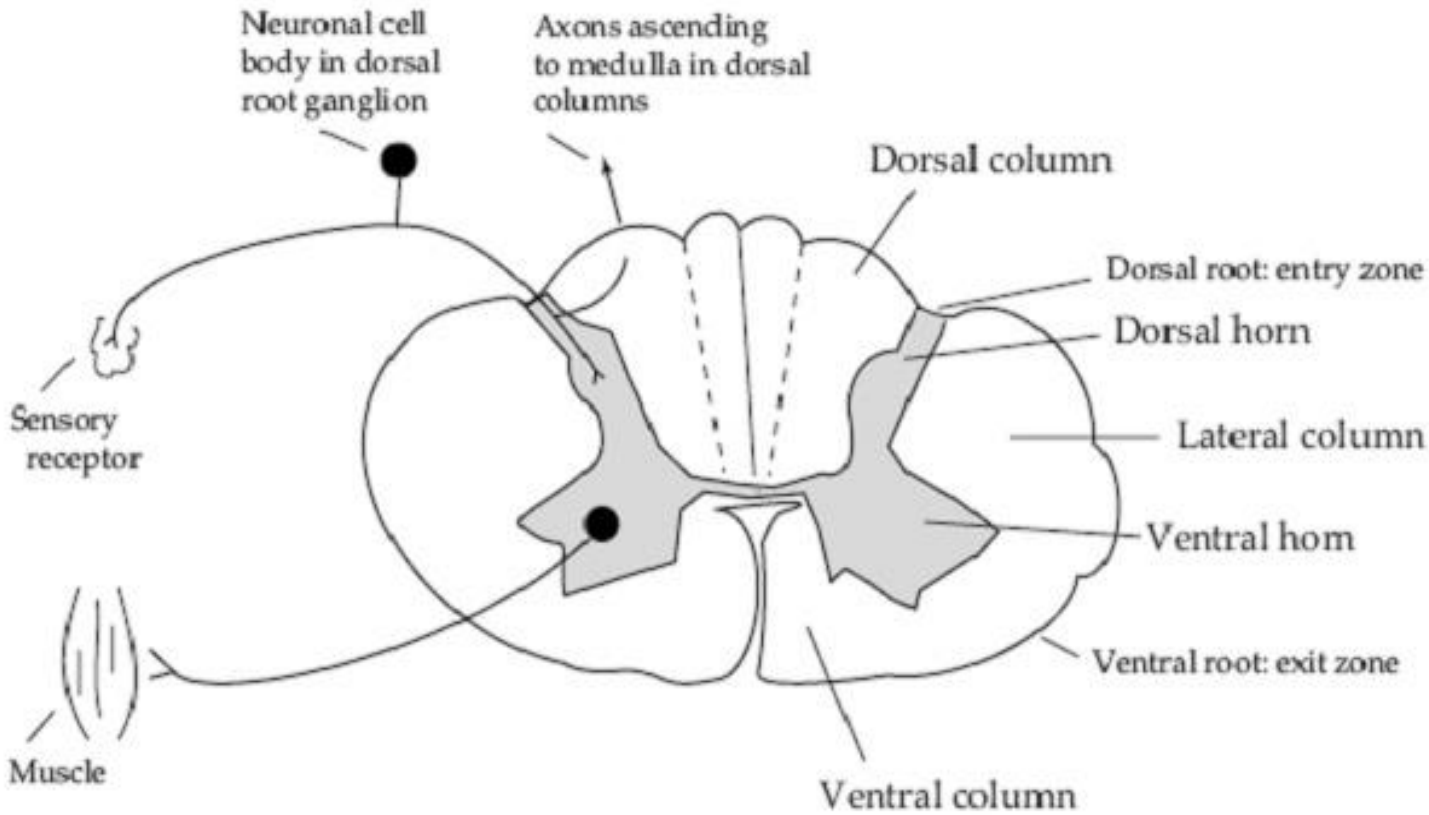
Glial Cell Type	Origin	Location	Main Functions
Oligodendrocyte	Neural tube	CNS	Myelin production, electrical insulation
Schwann cell (Neurolemmocyte)	Neural crest	Peripheral nerves	Myelin production, electrical insulation
Astrocyte	Neural tube	CNS	Structural and metabolic support of neurons; BBB; repair processes
Satellite cells (of ganglia)	Neural crest	Peripheral ganglia	Structural and metabolic support for neuronal cell bodies
Ependymal cell	Neural tube	Line ventricles and central canal of CNS	Aid production and movement of CSF
Microglia	Bone marrow (monocytes)	CNS	Defense and immune-related activities







- ✓ The simplest classification of central nervous tissue is **white matter** and **gray matter**
- ✓ The gray matter is made up of neuronal cell bodies, their dendrites, and the terminal arborizations of both local axons and those from distant sourcie.
- ✓ The white matter is made up of the axons that connect separated areas of gray matter.
- ✓ Note that an individual neuron can contribute to both gray and white matter.
- ✓ Axons projecting from one part of the brain to another usually group together in bundles. Likewise, neurons that serve similar functions often form clusters.


Neuronal cell body in dorsal root ganglion
Axons ascending to medulla in dorsal columns
Dorsal column
Dorsal root: entry zone
Dorsal horn
Lateral column
Ventral horn
Ventral root: exit zone
Ventral column
Sensory receptor
Muscle

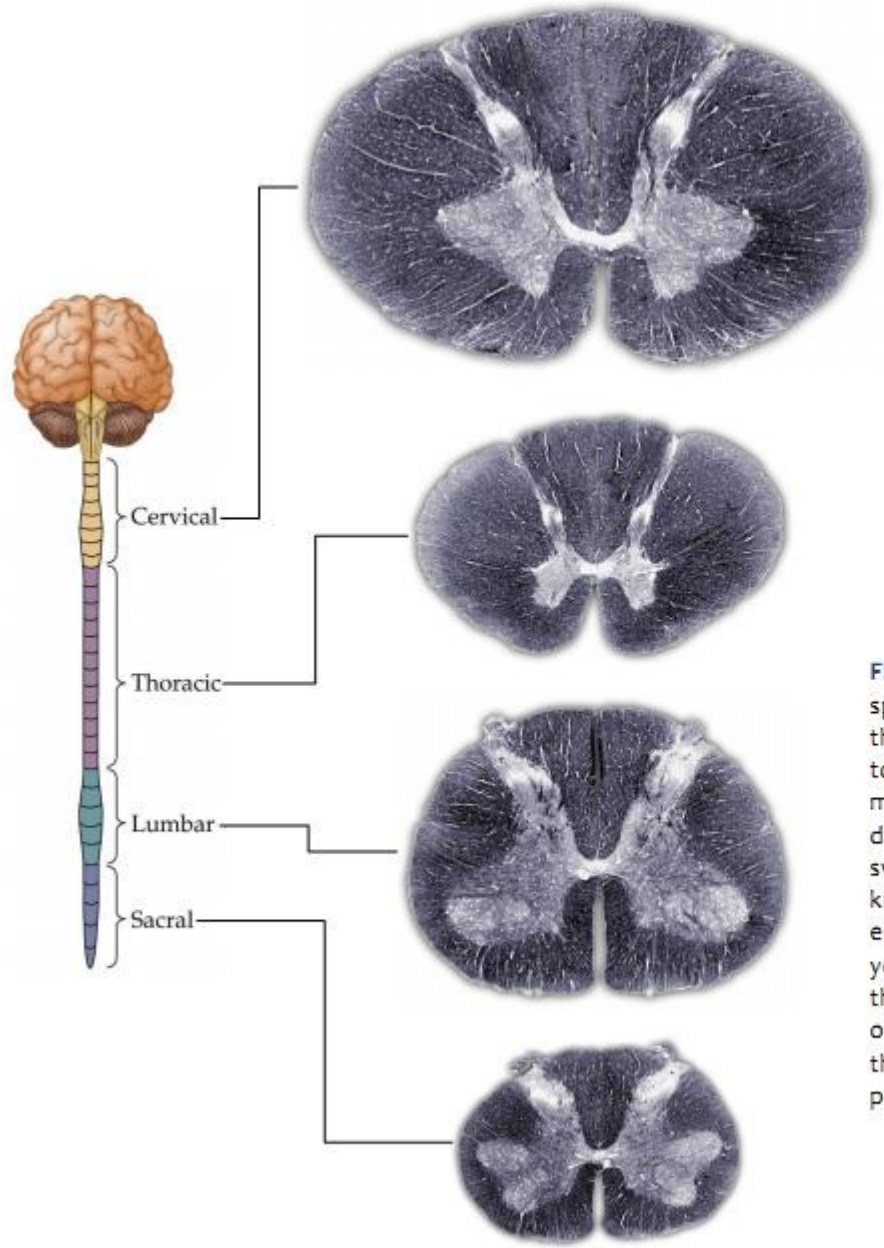


Figure 4.6. Cross-sections through the human spinal cord at four levels (shown at approximately the same magnification). Sections were prepared to emulate myelin staining (i.e., dark staining of myelin along axons). Thus, white matter appears dark and gray matter appears lighter. Note the swellings in cervical and lumbar cord segments, known as the cervical and lumbosacral enlargements of the spinal cord, respectively. As you might expect, these swellings accommodate the added neural circuitry related to the structure of the limbs that receive central innervation from the dorsal root ganglia and spinal cord. (Illustration provided courtesy of Pyramis Studios, Durham NC)

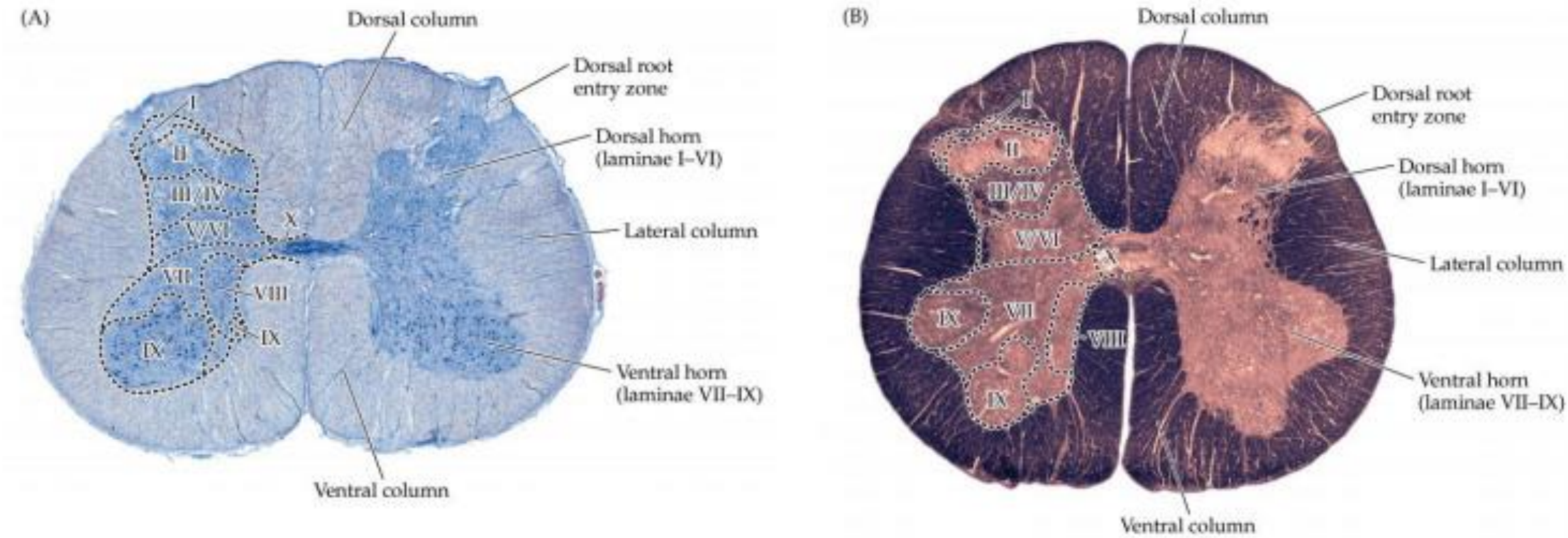
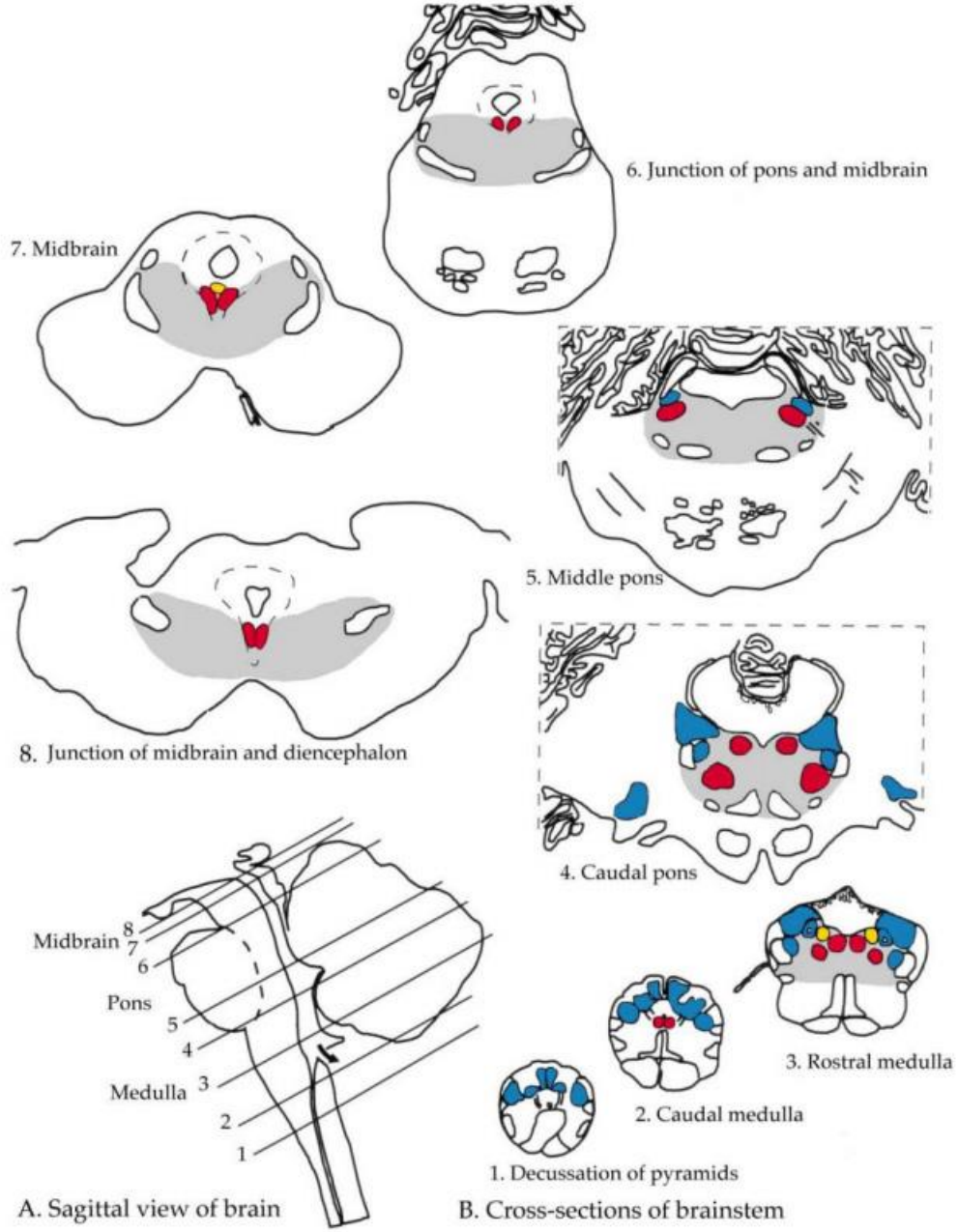


Figure 4.7. Cross-sections through a lumbar segment of the human spinal cord. (A) Nissl stain highlighting cell bodies. (B) Facsimile of a myelin stain highlighting (in dark tones) white matter. (Figure A6 in *Neuroscience*, 5th *Ed.*, Sinauer Assoc., Inc.)

Chart 2-1	Internal features								
Spinal cord segment	Dorsal horn	Lateral horn	Ventral horn	White matter	Gracile tract	Cuneate tract	Lateral corticospinal tract	Ventral corticospinal tract	Anterolateral system
Cervical segments (8)		--		+++++					
Thoracic segments (12)				++++					
Lumbar segments (5)		--		+++		--			
Sacral segments (5)		--		++		--			
Coccygeal segment (1)		--		+		--	--		



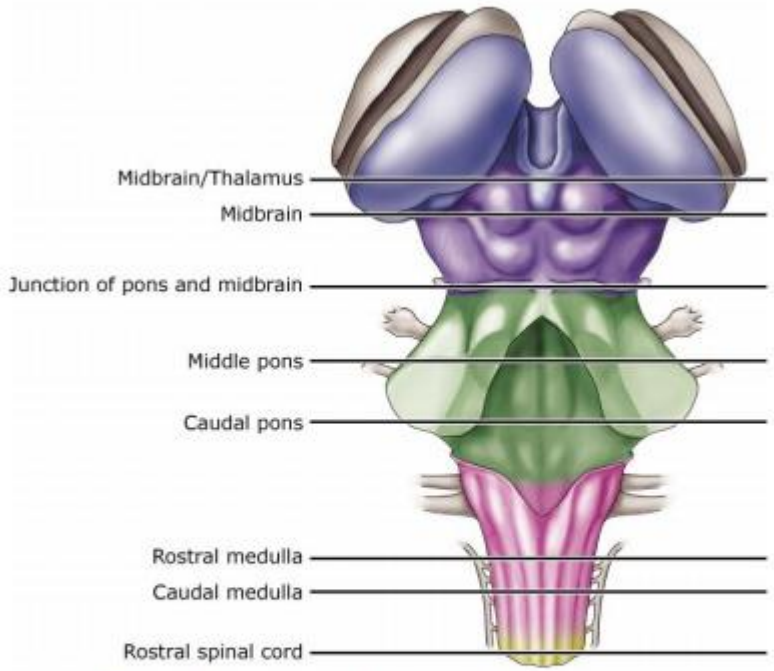
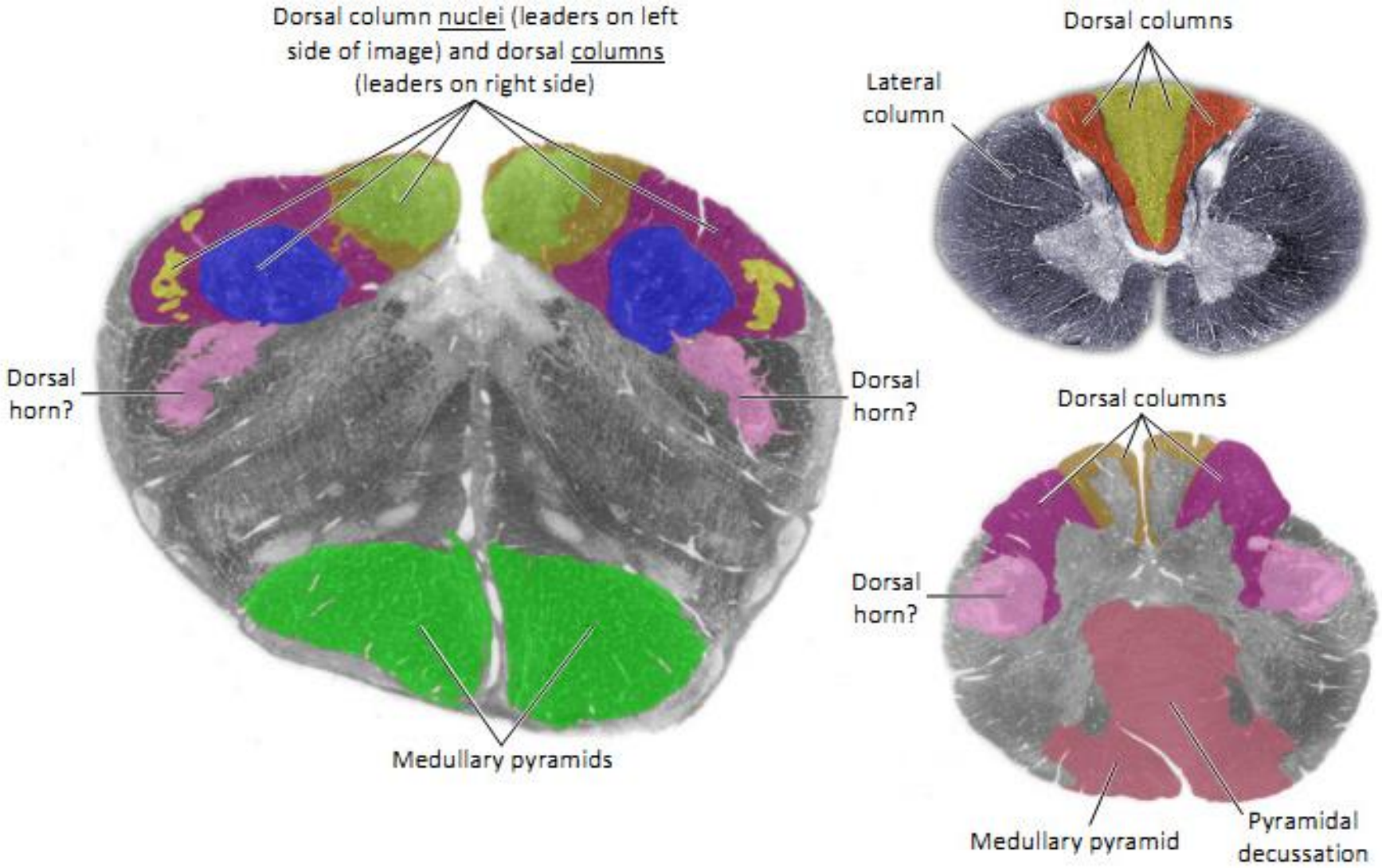


Figure 4.8. Drawing of the dorsal surface of the brainstem with lines to indicate the seven levels that will be illustrated in the following pages. These same sections are also annotated in the **Brainstem Cross Sectional Atlas** in ***Sylvius4 Online.*** (Illustration courtesy of Pyramis Studios, Durham NC)


Dorsal column nuclei (leaders on left side of image) and dorsal columns (leaders on right side)
Dorsal horn?
Dorsal horn?
Medullary pyramids
Dorsal columns
Lateral column
Dorsal columns
Dorsal horn?
Medullary pyramid
Pyramidal decussation

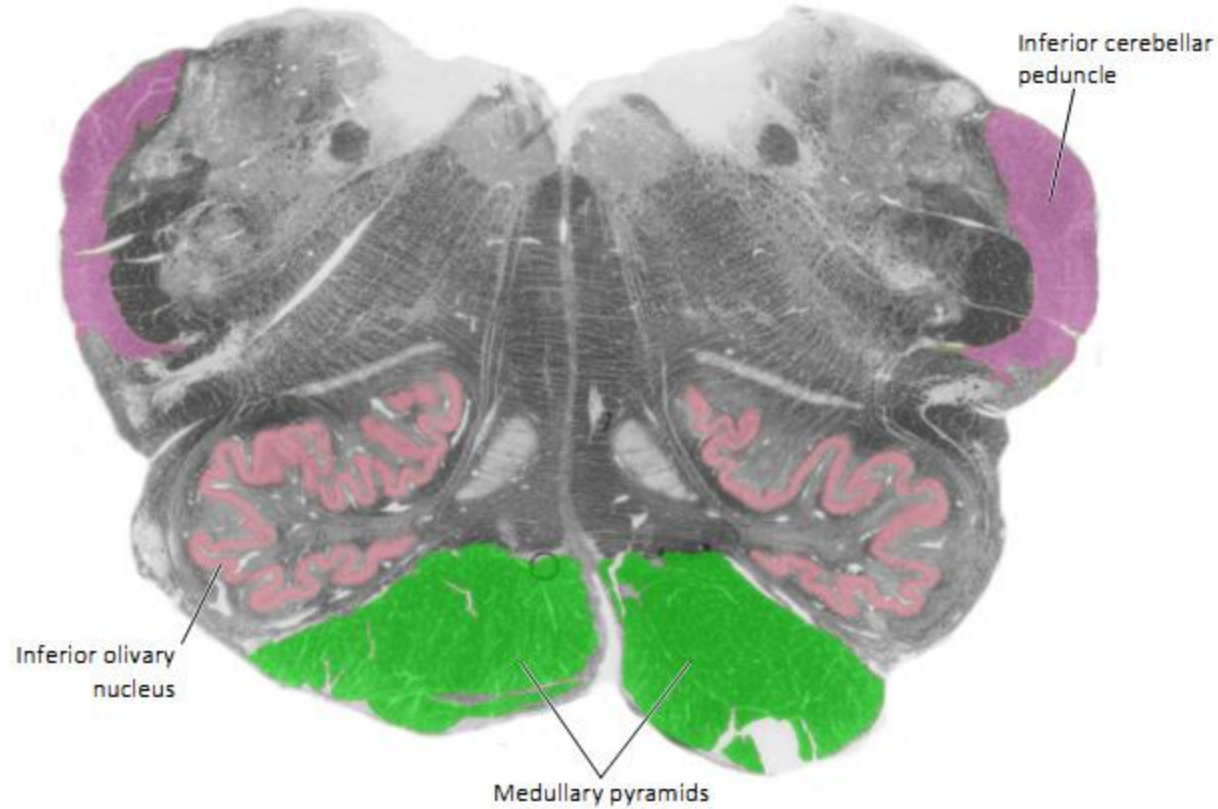


Figure 4.11. The rostral medulla is easy to identify and is not likely to be confused with any other part of the brain (section shown is "9-medulla" in ***Sylvius4 Online***). It features the large nuclei known as the paired **inferior olivary nucleus** (this is what accounts for the outward bulging seen superficially as the inferior olive). This nucleus is part of an extensive group of brainstem nuclei that project to the cerebellum. Together with the medullary pyramids, they form the ventral base of the rostral medulla. A prominent fiber bundle on the lateral surface of the medulla is the incipient **inferior cerebellar peduncle** (not yet attached to the cerebellum at this point). The thin roof of the fourth ventricle (IV) has been torn off of this specimen. It is made up of pia, ependyma, and blood vessels. You can see that the tegmentum of the medulla contains many different cell groups. They will be discussed later.

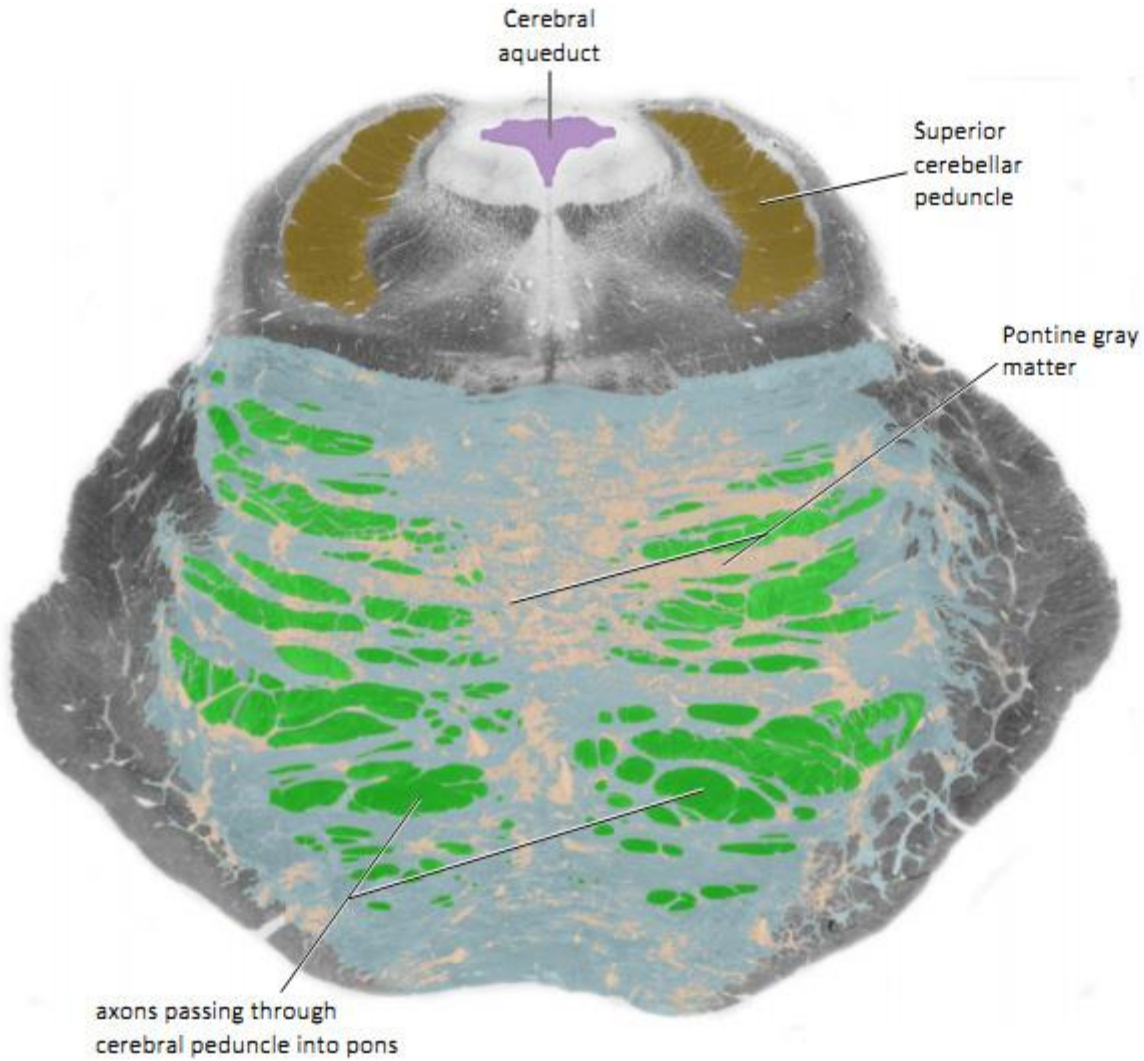


Figure 5.11. At the junction of the pons and midbrain, the brainstem looks relatively simple. The massive pontine base is about to give way to the cerebral peduncles. Dorsal to the base, the brainstem is reduced to the tegmentum. The fourth ventricle, which you saw in the sections through the pons, is disappearing to be replaced by the cerebral aqueduct. (Section is "4-pons" in ***Sylvius4***)

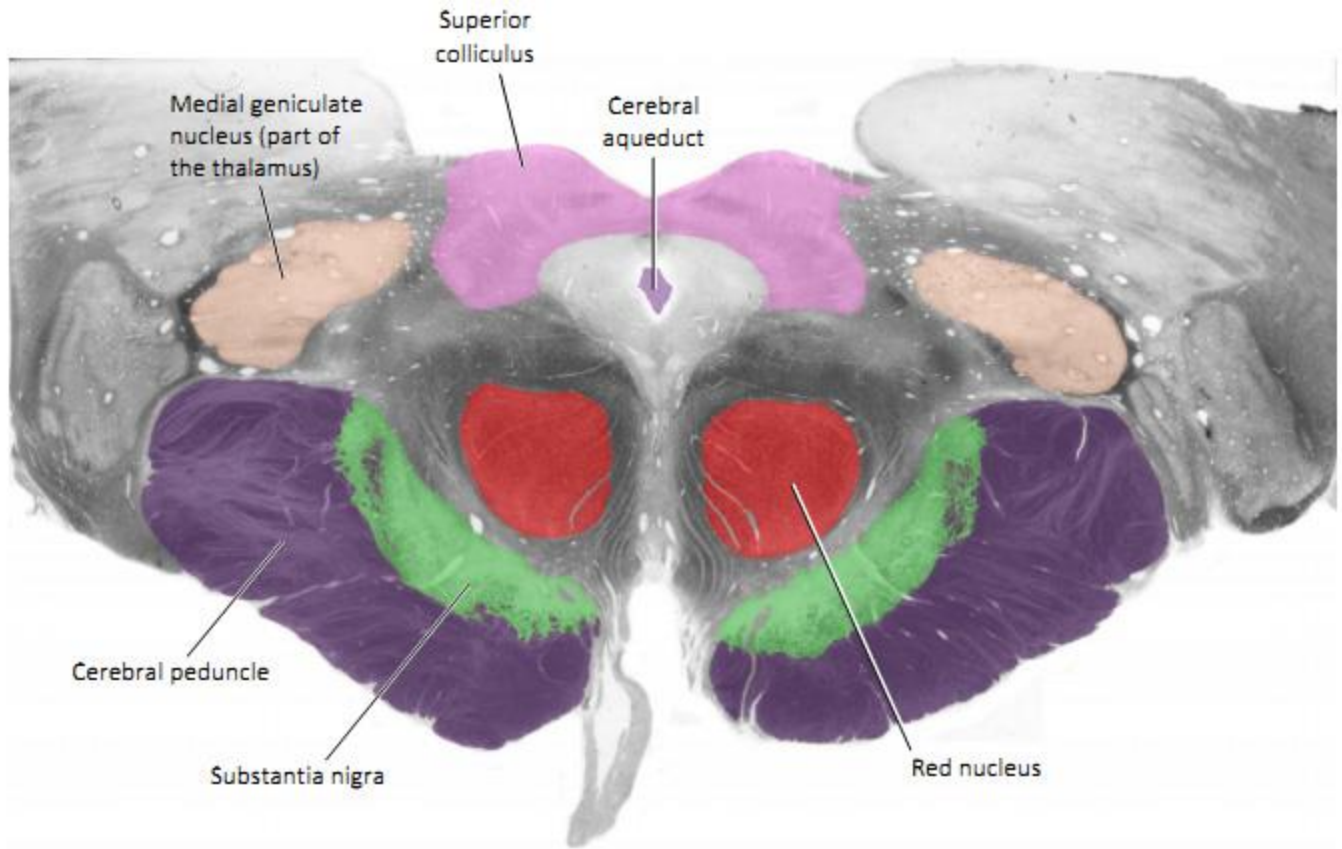


Figure 5.12. This section is through the rostral midbrain and so it cuts through the **superior colliculus**. The space between the colliculi is the **cerebral aqueduct**. The **cerebral peduncles** form the base of the midbrain. Two very large nuclei lie dorsal to them. These are the **substantia nigra** and the **red nucleus**; they are discussed in a later session. (A small part of the dorsal thalamus—the medial geniculate nucleus—is also included in this section. Refer to Figure 5.6 if it is not clear why you see it here.) (Section is "2-midbrain" in ***Sylvius4***)

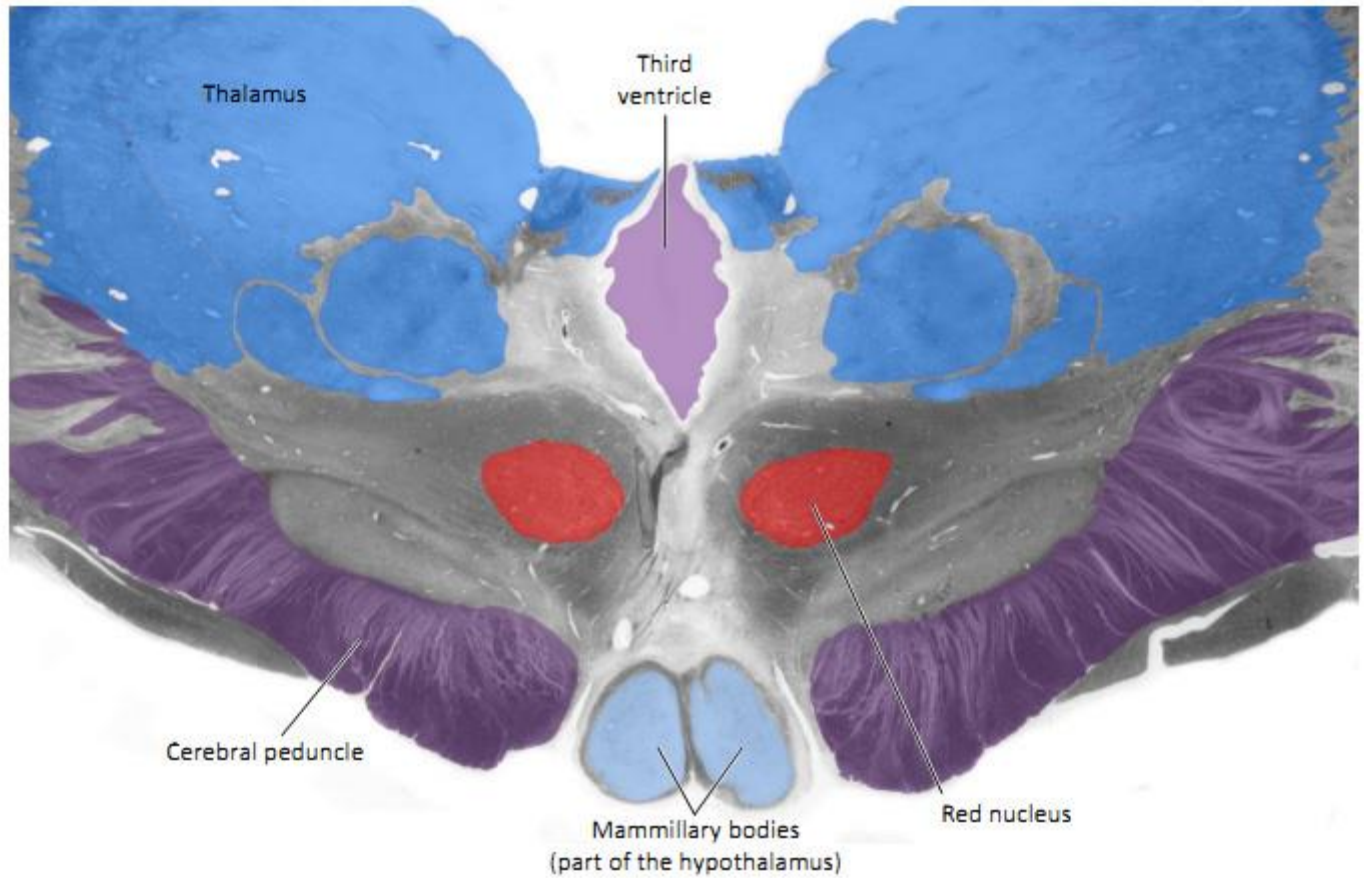
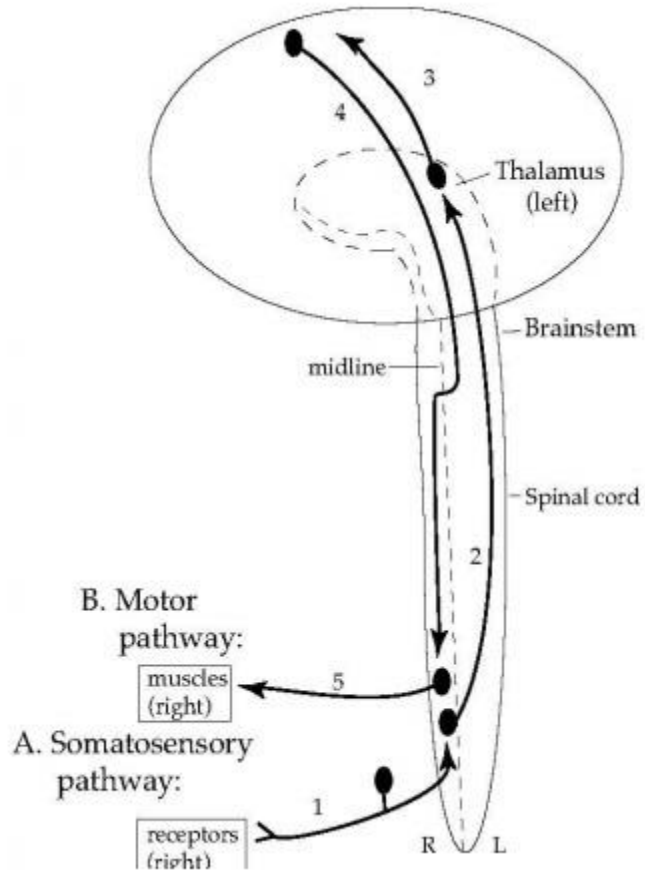


Figure 5.13. The last section in the series through the brainstem is cut through the junction of the midbrain and diencephalon. Structures of the midbrain are seen medially, but laterally the diencephalon has appeared. The cerebral peduncles will become continuous with the **internal capsule** a little rostral to this level. Likewise, the cerebral aqueduct will become continuous with the **third ventricle**. (Section is "1-midbrain-diencephalon junction" in *Sylvius4*)

Figure 4.4. Simplified view of components of two systems that will be covered in detail in later sessions. A. One pathway carrying somatic sensory information (the 'pain' pathway) includes a primary sensory neuron that forms synapses in the spinal cord (1); a spinal cord neuron whose axon crosses the midline and ascends to the thalamus (2), and a thalamic neuron whose axon projects to the somatic sensory cortex (in the postcentral gyrus) (3). A pathway that carries information toward the cortex is called an 'ascending' pathway. B. A pathway that is important in control of motor function (the corticospinal pathway) includes a neuron in the motor cortex (in the precentral gyrus) whose axon crosses the midline in the medulla and descends to the spinal cord (4) and a motor neuron whose axon travels out to innervate striated muscle fibers (5). A pathway carrying information toward motor effectors is called a 'descending' pathway. (Illustration by N.B. Cant)



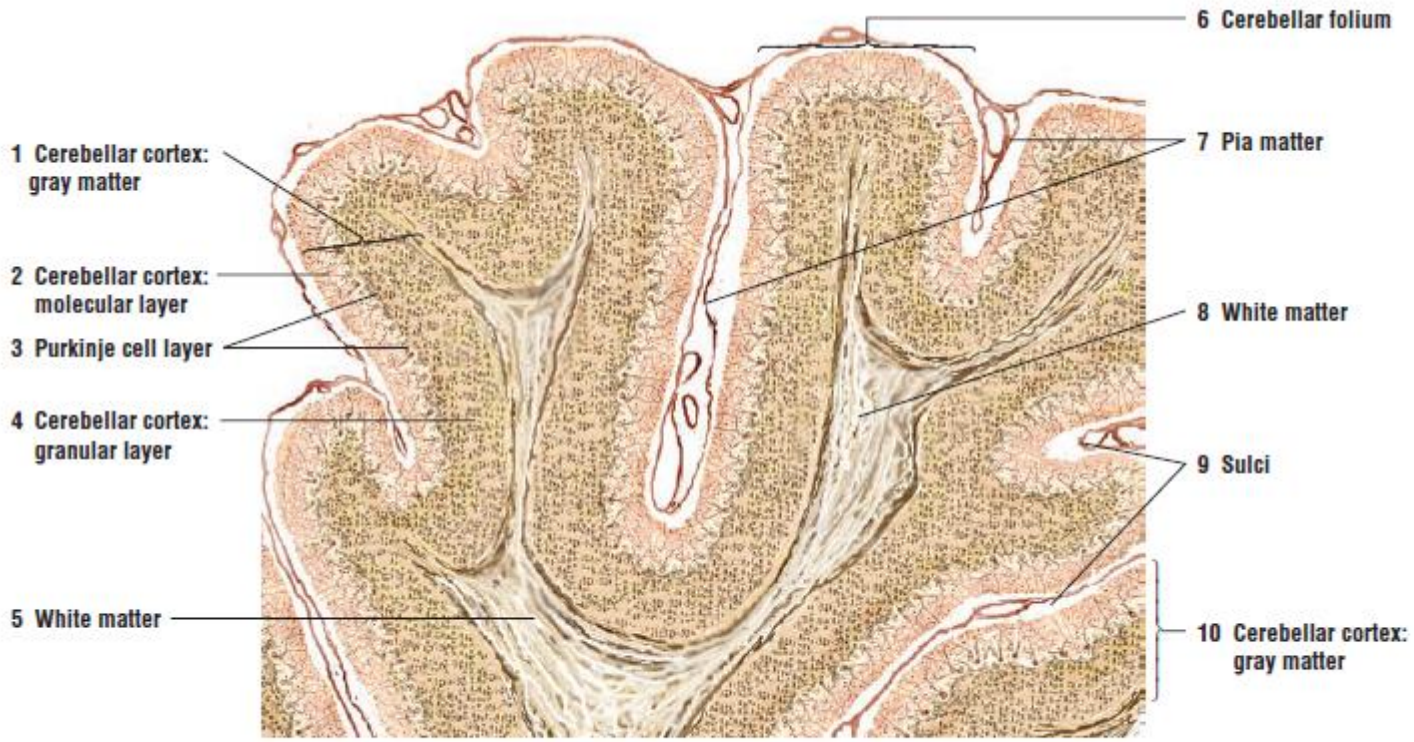
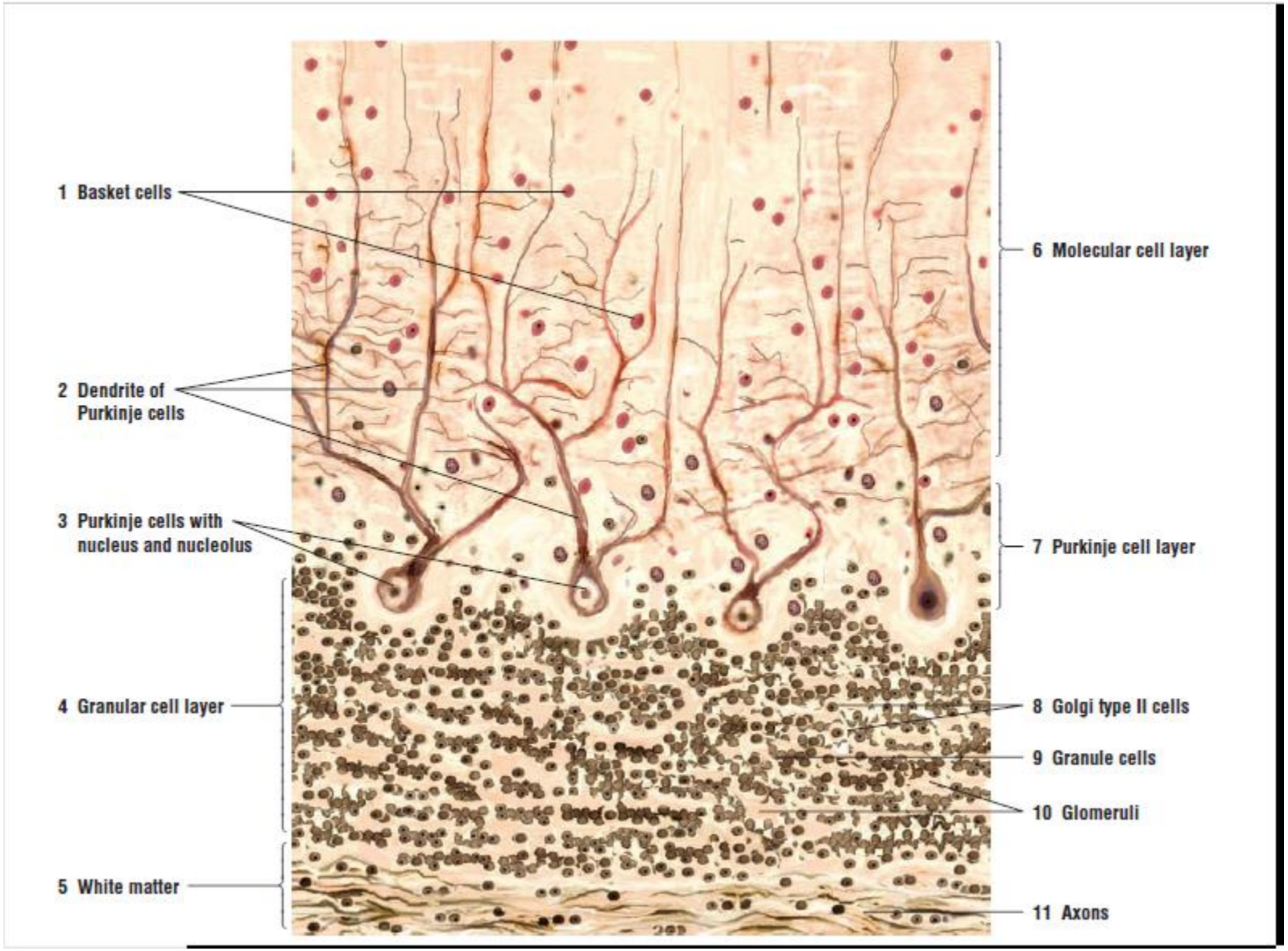


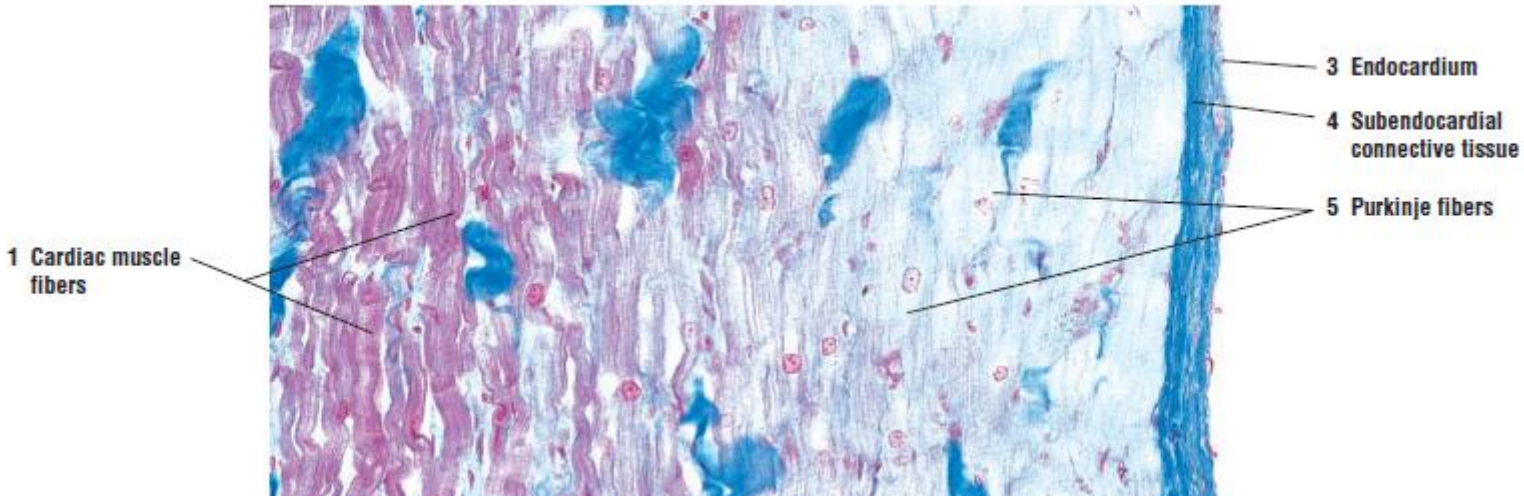
FIGURE 7.10 ■ Cerebellum (transverse section). Stain: silver impregnation (Cajal's method). Low magnification.

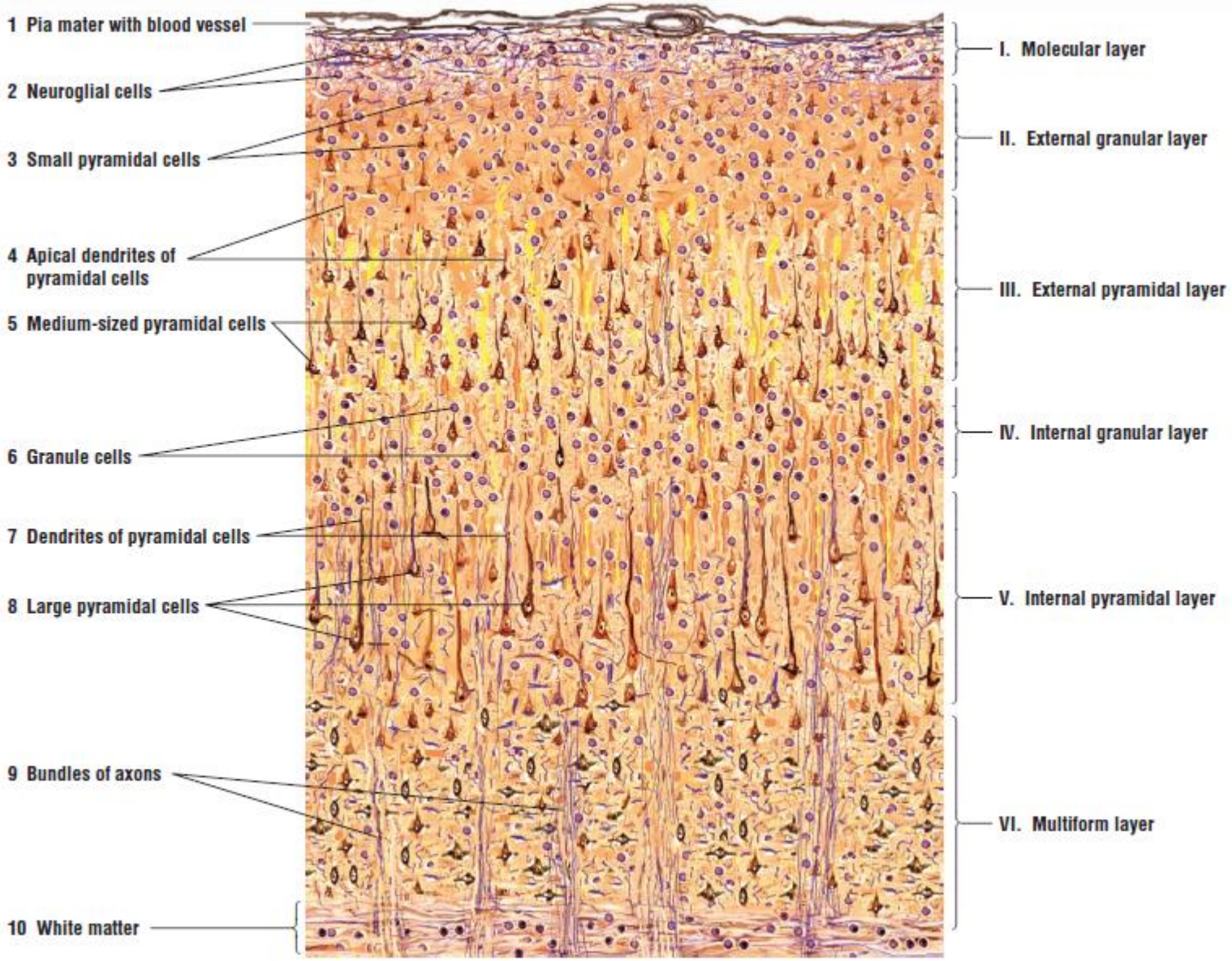
Cerebellar Cortex

- Deep folds in cortex called cerebellar folia separated by sulci
- Outer molecular layer contains small neurons and fibers
- Middle Purkinje layer contains large Purkinje cells whose dendrites branch in molecular layer
- Granule cell layer contains small granule cells, Golgi type II cells, and empty spaces called glomeruli


1 Basket cells
2 Dendrite of Purkinje cells
3 Purkinje cells with nucleus and nucleolus
4 Granular cell layer
5 White matter
6 Molecular cell layer
7 Purkinje cell layer
8 Golgi type II cells
9 Granule cells
10 Glomeruli
11 Axons

Purkinje fibers are thicker and larger than cardiac muscle fibers and contain a greater amount of glycogen. They also contain fewer contractile filaments. Purkinje fibers are part of the conduction
system of the heart. These fibers are located beneath the endocardium on either side of the interventricular septum and are recognized as separate tracts. Because Purkinje fibers branch throughout the myocardium, they deliver continuous waves of stimulation from the atrial nodes to the rest of the heart musculature via the gap junctions. This produces ventricular contractions (systole) and ejection of blood from both ventricular chambers.





Cerebral Cortex: Gray Matter (Layers I to IV)

- Molecular layer (I): most superficial and covered by pia mater; contains neuroglial cells and horizontal cells of Cajal
- External granular layer (II): contains neuroglial cells and small pyramidal cells
- External pyramidal layer (III): medium-sized pyramidal cells predominant type
- Internal granular layer (IV): thin layer with small granule, pyramidal cells, and neuroglia
- Internal pyramidal layer (V): contains neuroglial cells and largest pyramidal cells
- Multiform layer (VI): deepest layer, adjacent to white matter with various cell types