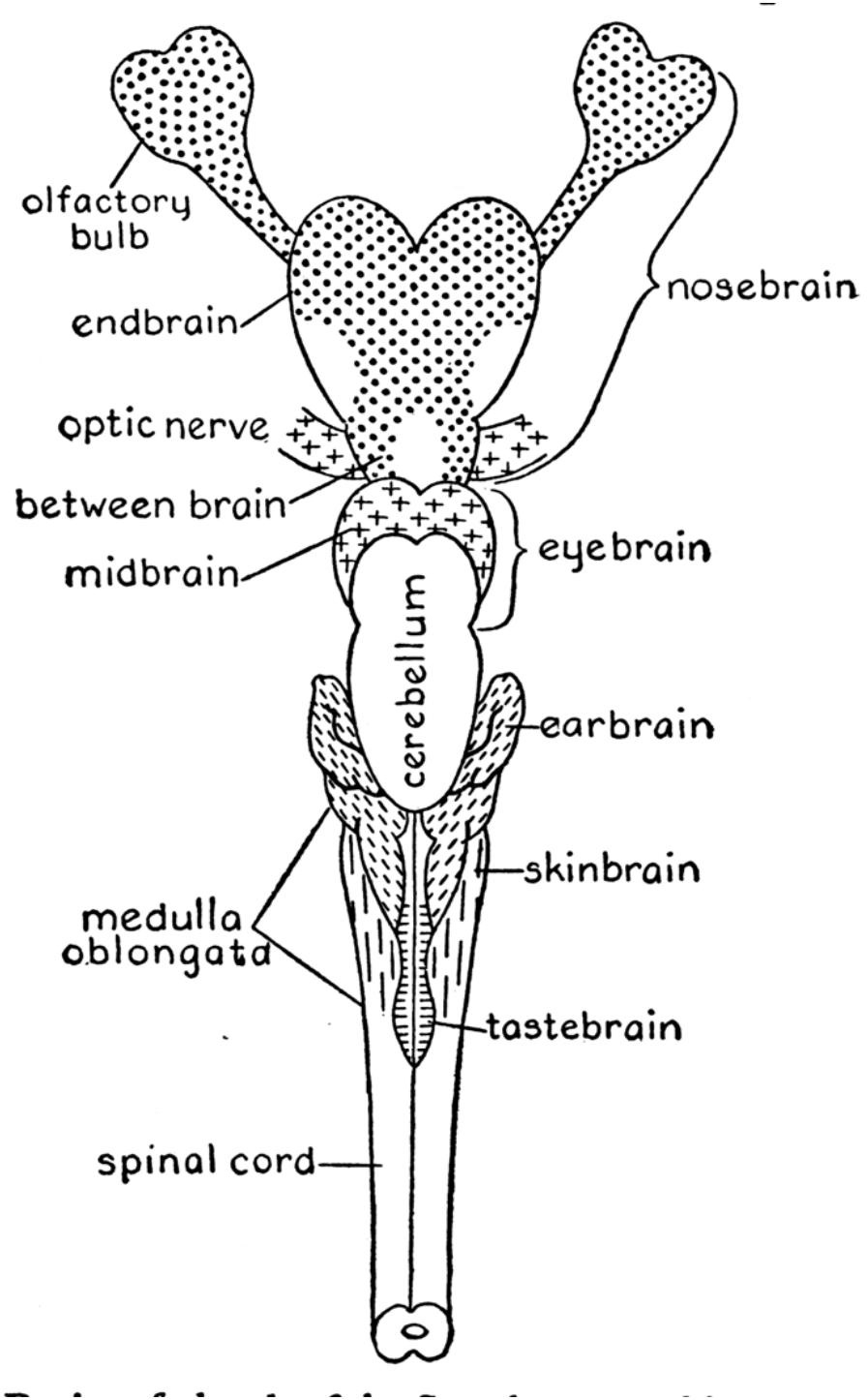
MEDS 5384 - 2014

Douglas Oliver

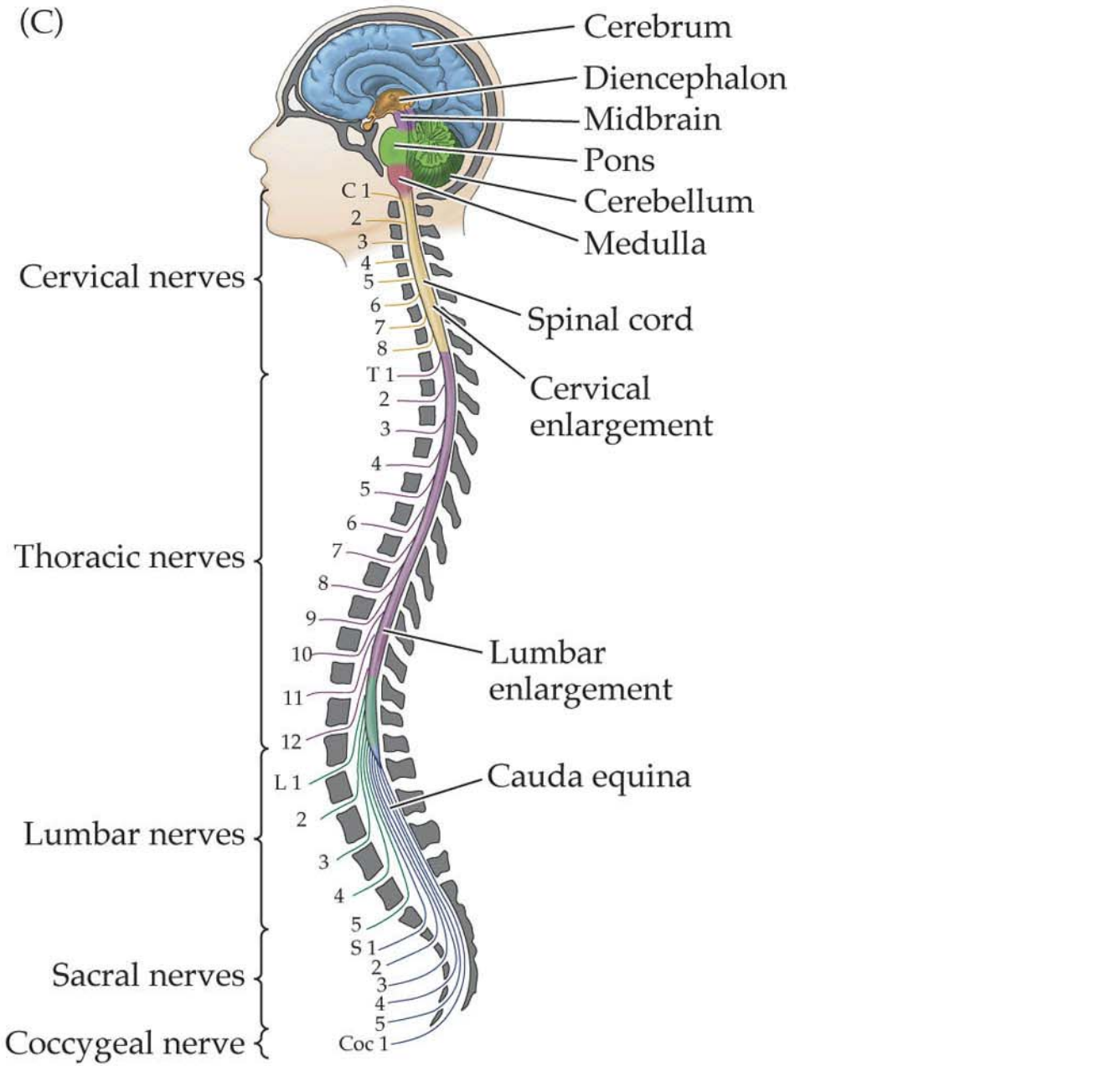
INTRODUCTION NEURAL CIRCUITRY

The Five Parts of the Brain in the Shark

- Telencephalon
- Thalamus (Diencephalon)
- Midbrain (Mesencephalon)
- Pons (Metencephalon)
- Medulla (Myelencephalon)
- Spinal cord

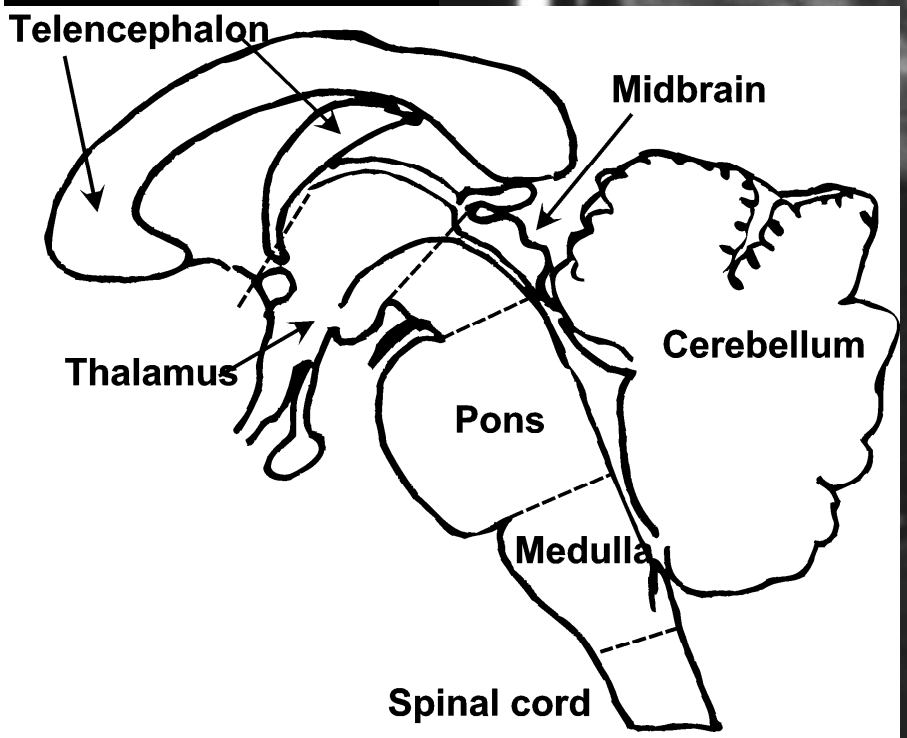


Parts of CNS



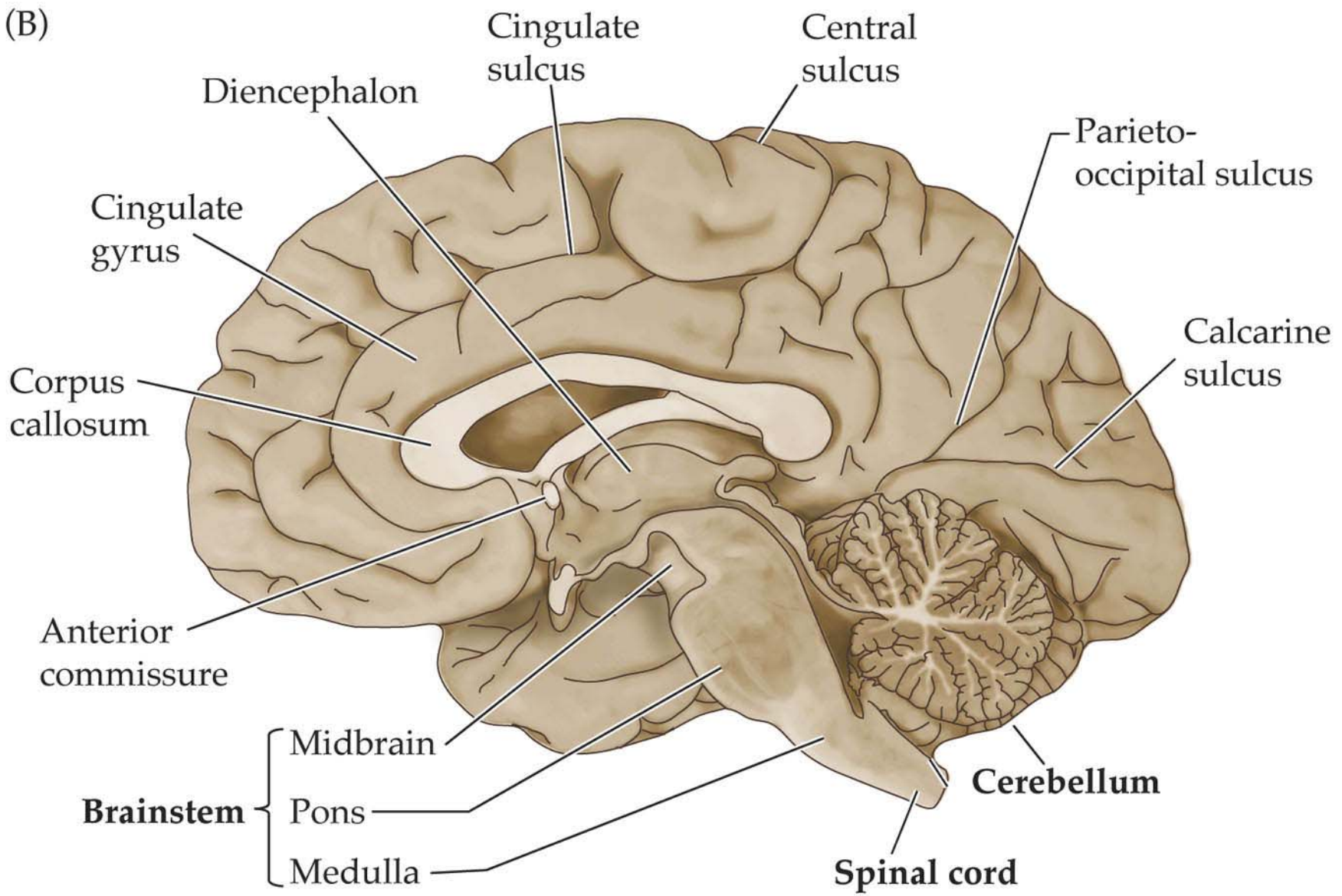
NEUROSCIENCE, Third Edition, **Figure 1.11 (Part 3)**

Midline MRI



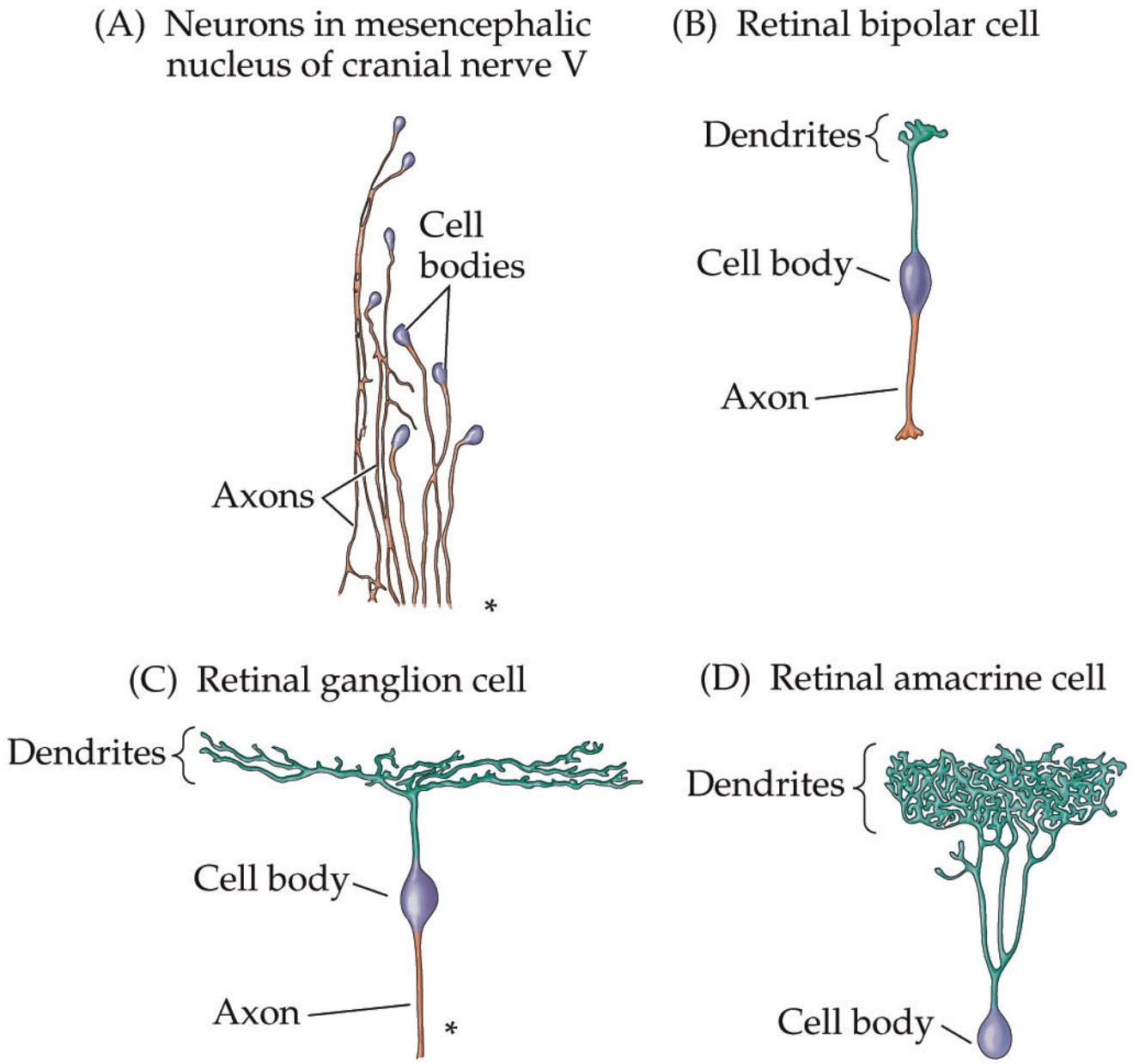
MAIN REGIONS OF CNS

1.12 Gross anatomy of the forebrain. (Part 2)



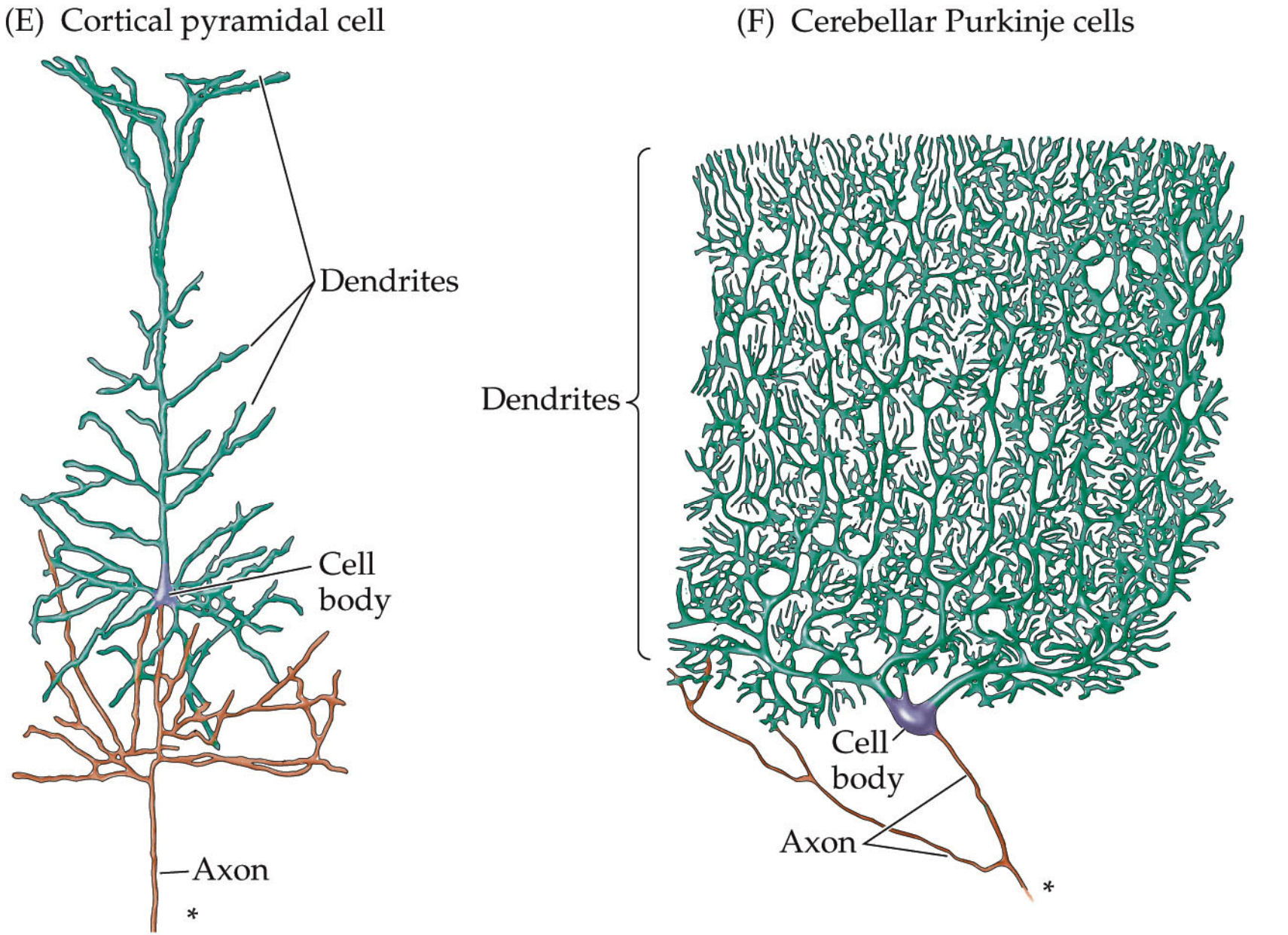
NEUROSCIENCE, Third Edition, **Figure 1.12 (Part 2)**

Figure 1.2 Some nerve cell morphologies found in the human nervous system (Part 1)



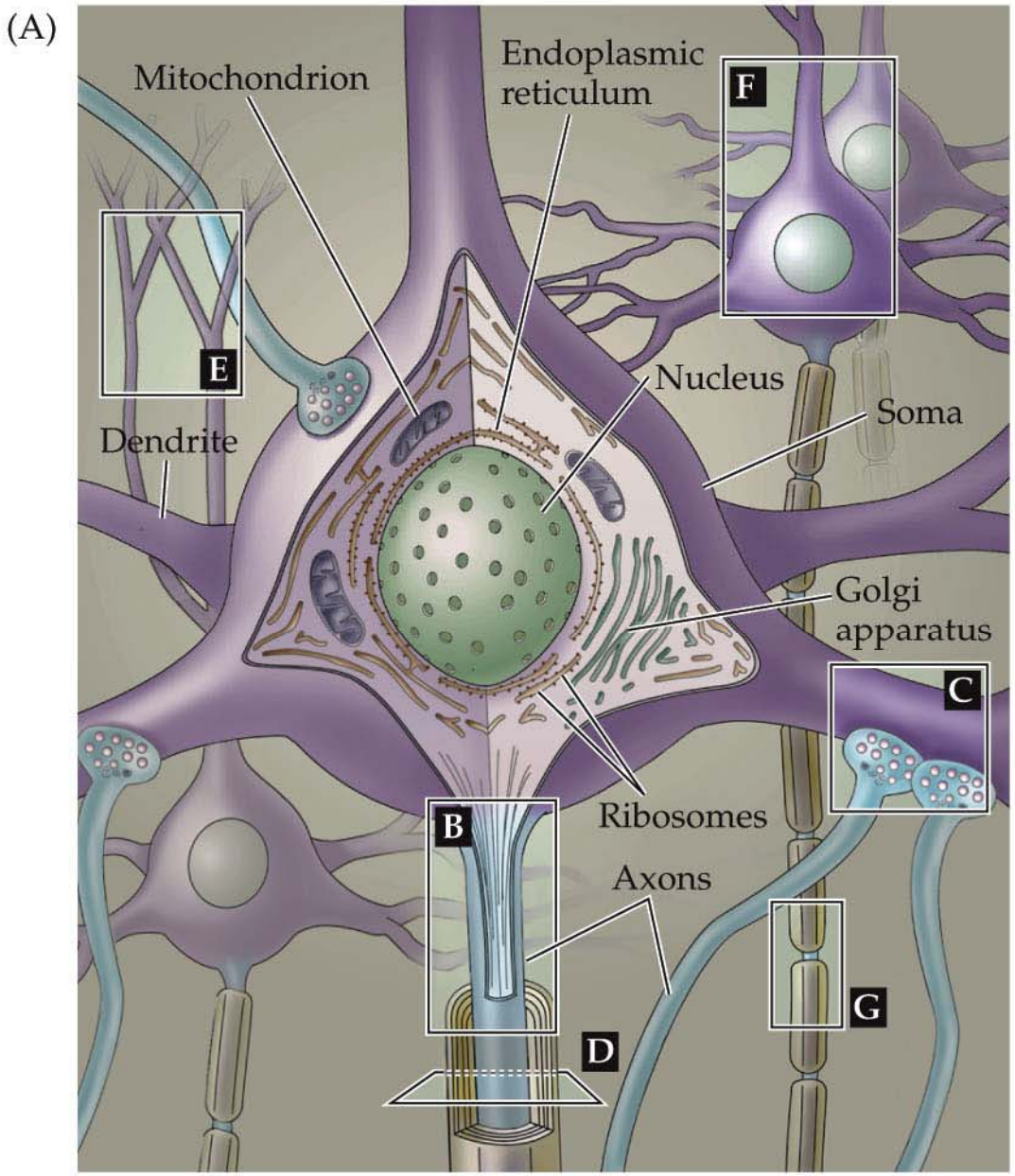
***NEUROSCIENCE, Fourth Edition,* Figure 1.2 (Part 1)**

Figure 1.2 Some nerve cell morphologies found in the human nervous system (Part 2)



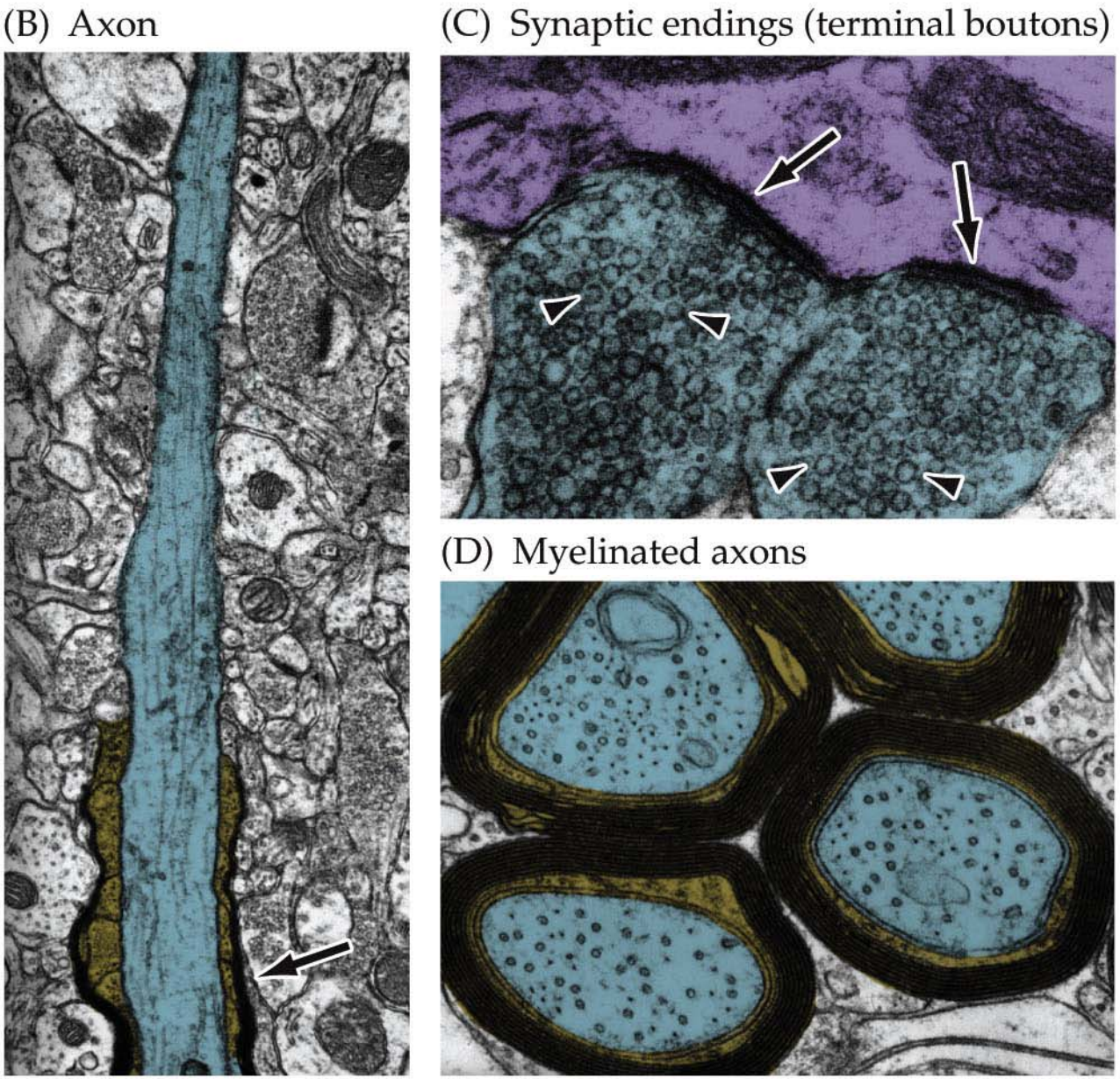
***NEUROSCIENCE, Fourth Edition,* Figure 1.2 (Part 2)**

Figure 1.3 The major light and electron microscopical features of neurons (Part 1)



NEUROSCIENCE, Fourth Edition, Figure 1.3 (Part 1)

Figure 1.3 The major light and electron microscopical features of neurons (Part 2)

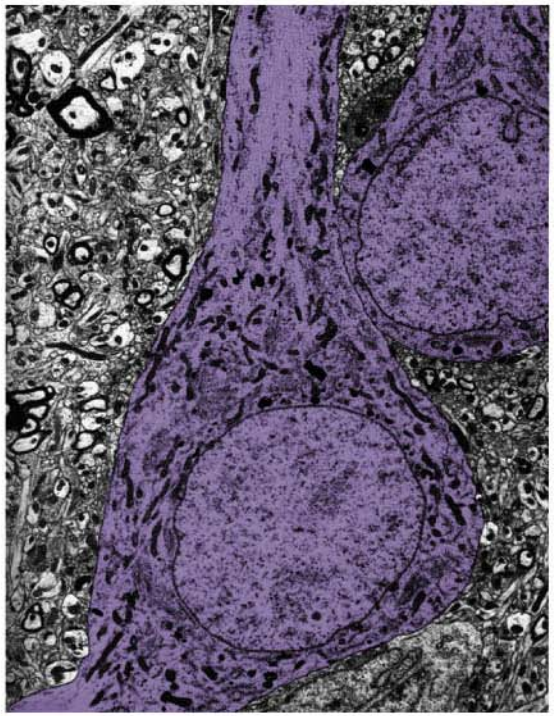


***NEUROSCIENCE, Fourth Edition,* Figure 1.3 (Part 2)**

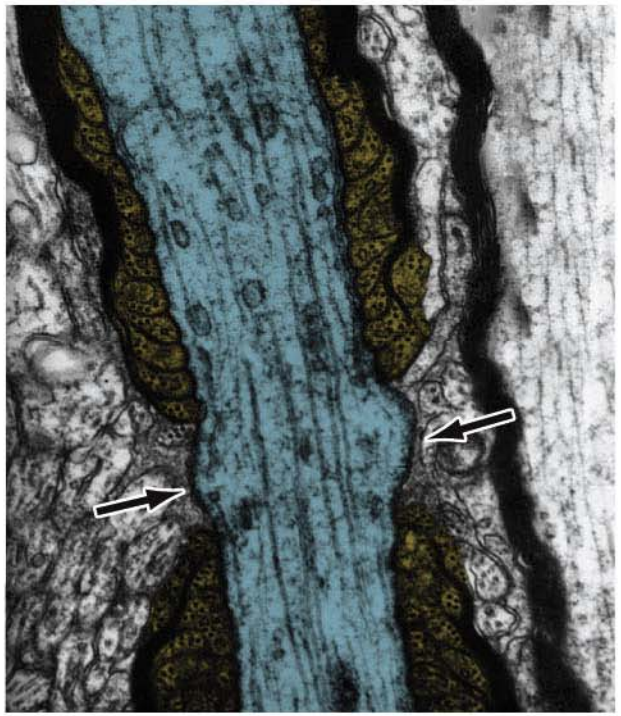
Figure 1.3 The major light and electron microscopical features of neurons (Part 3)

(E) Dendrites

(F) Neuronal cell body (soma)

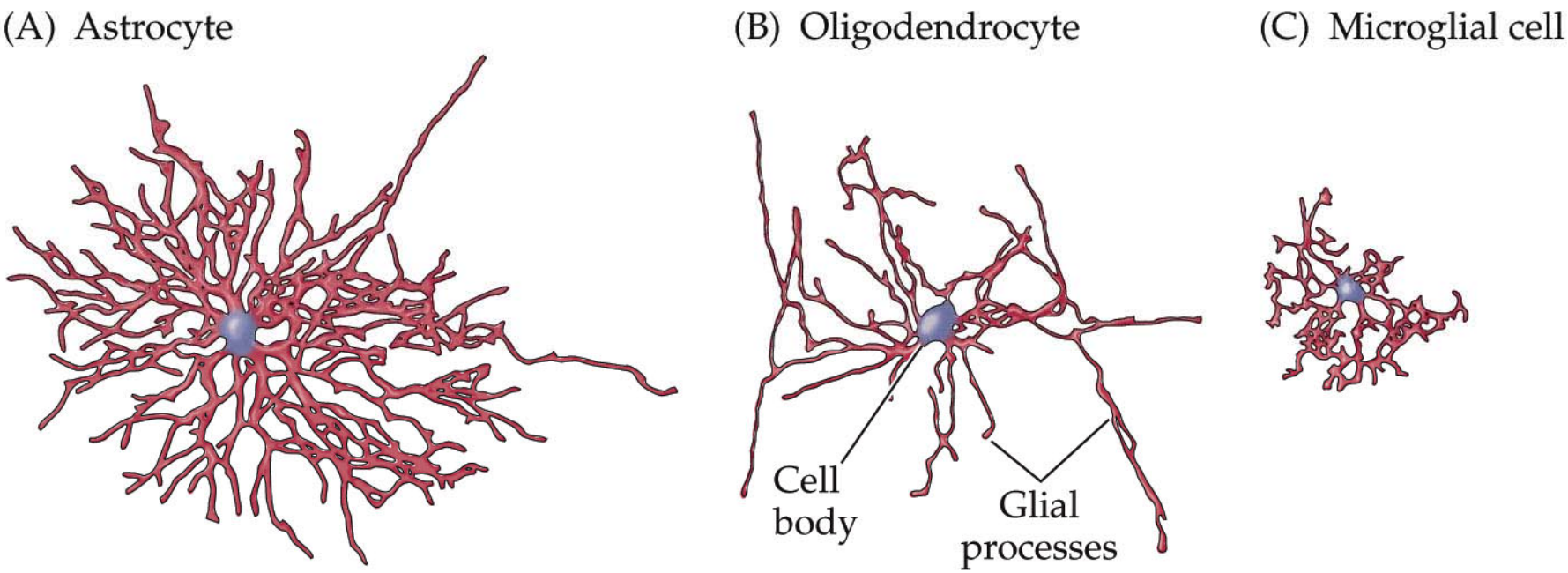


(G) Myelinated axon and node of Ranvier



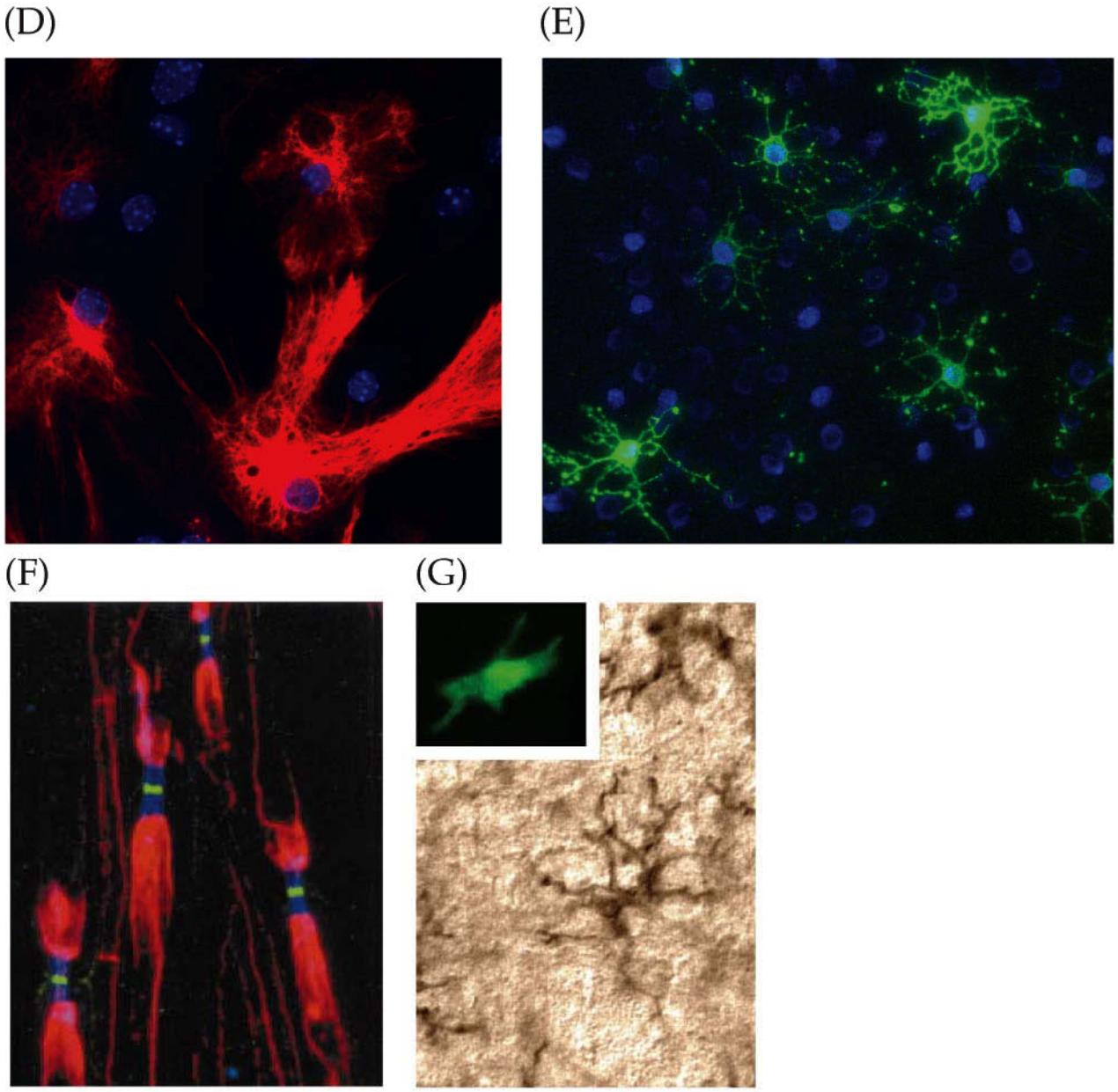
***NEUROSCIENCE, Fourth Edition,* Figure 1.3 (Part 3)**

Figure 1.5 Varieties of neuroglial cells (Part 1)



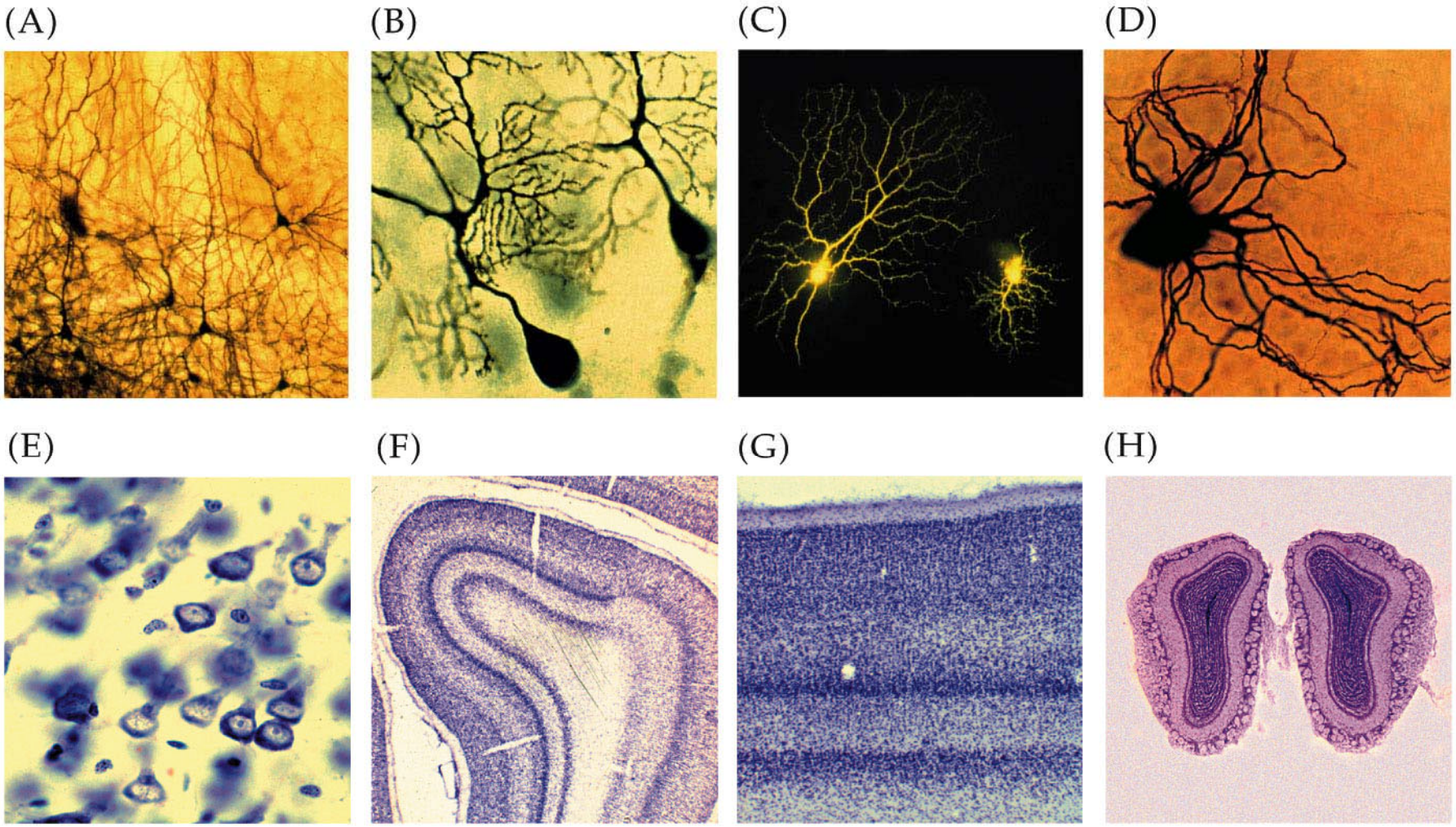
***NEUROSCIENCE, Fourth Edition,* Figure 1.5 (Part 1)**

Figure 1.5 Varieties of neuroglial cells (Part 2)



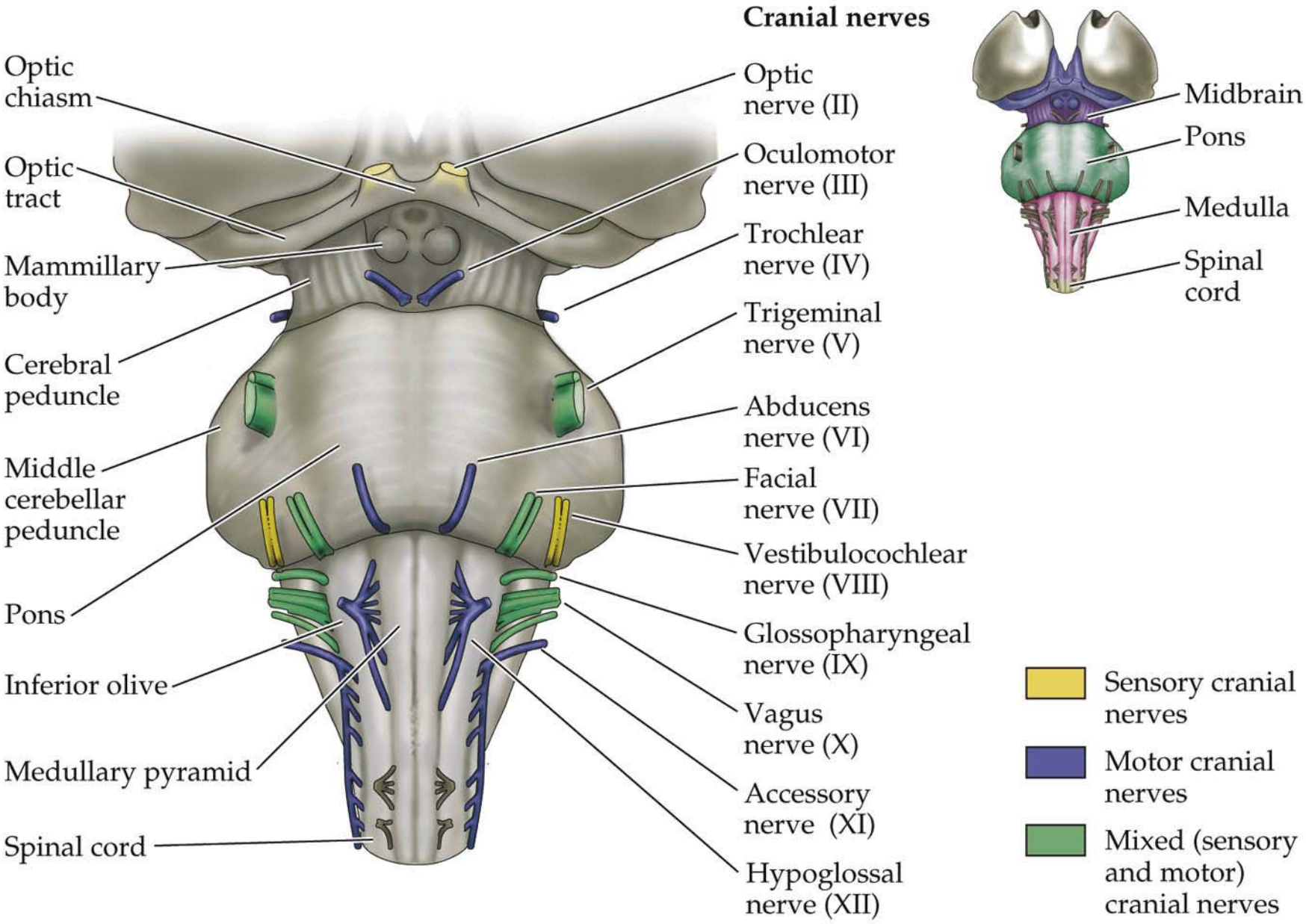
***NEUROSCIENCE, Fourth Edition,* Figure 1.5 (Part 2)**

Figure 1.6 Visualizing nerve cells and their connections

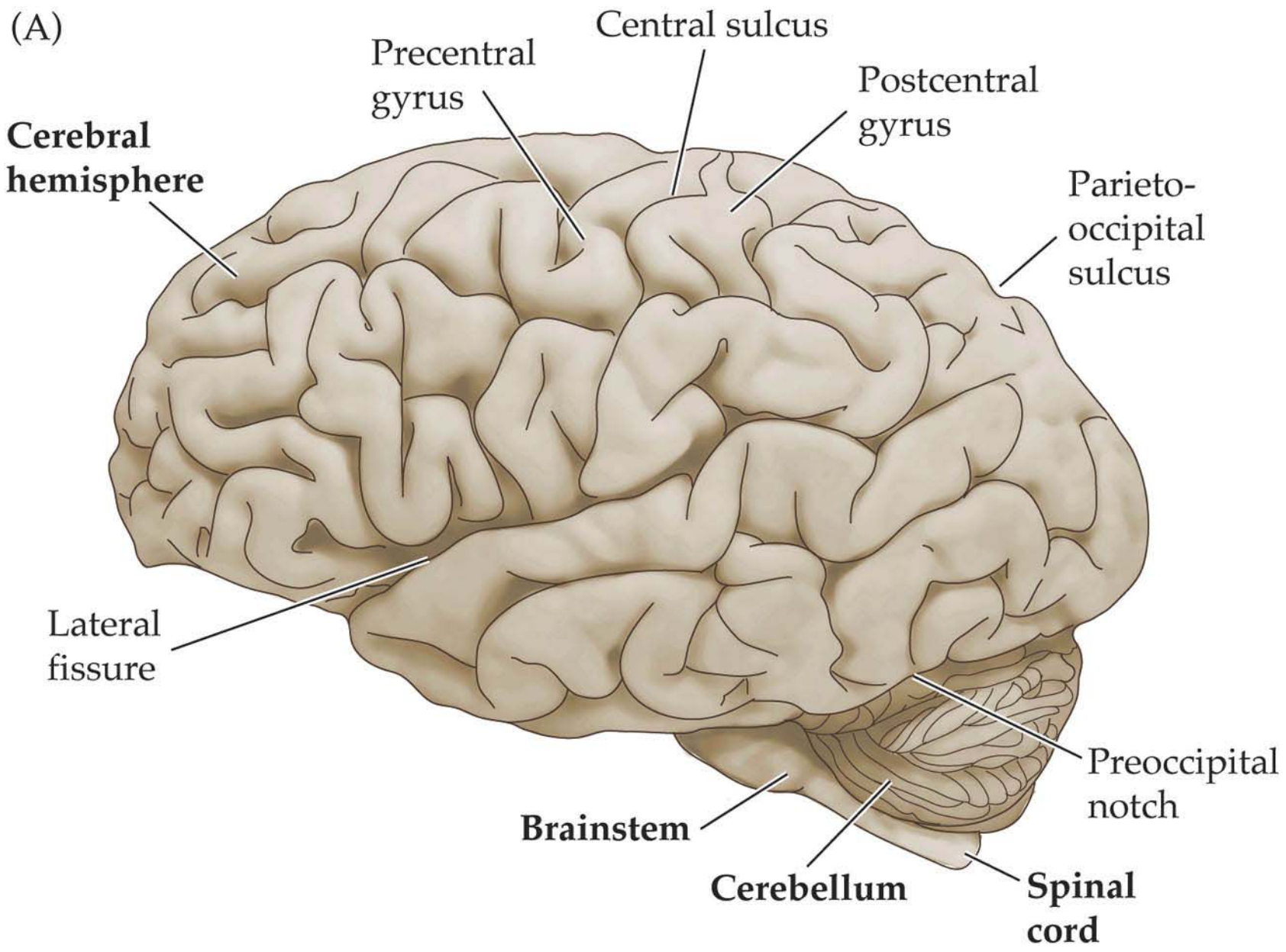


***NEUROSCIENCE, Fourth Edition,* Figure 1.6**

A1 Ventral view of the brainstem showing the locations of the cranial nerves.

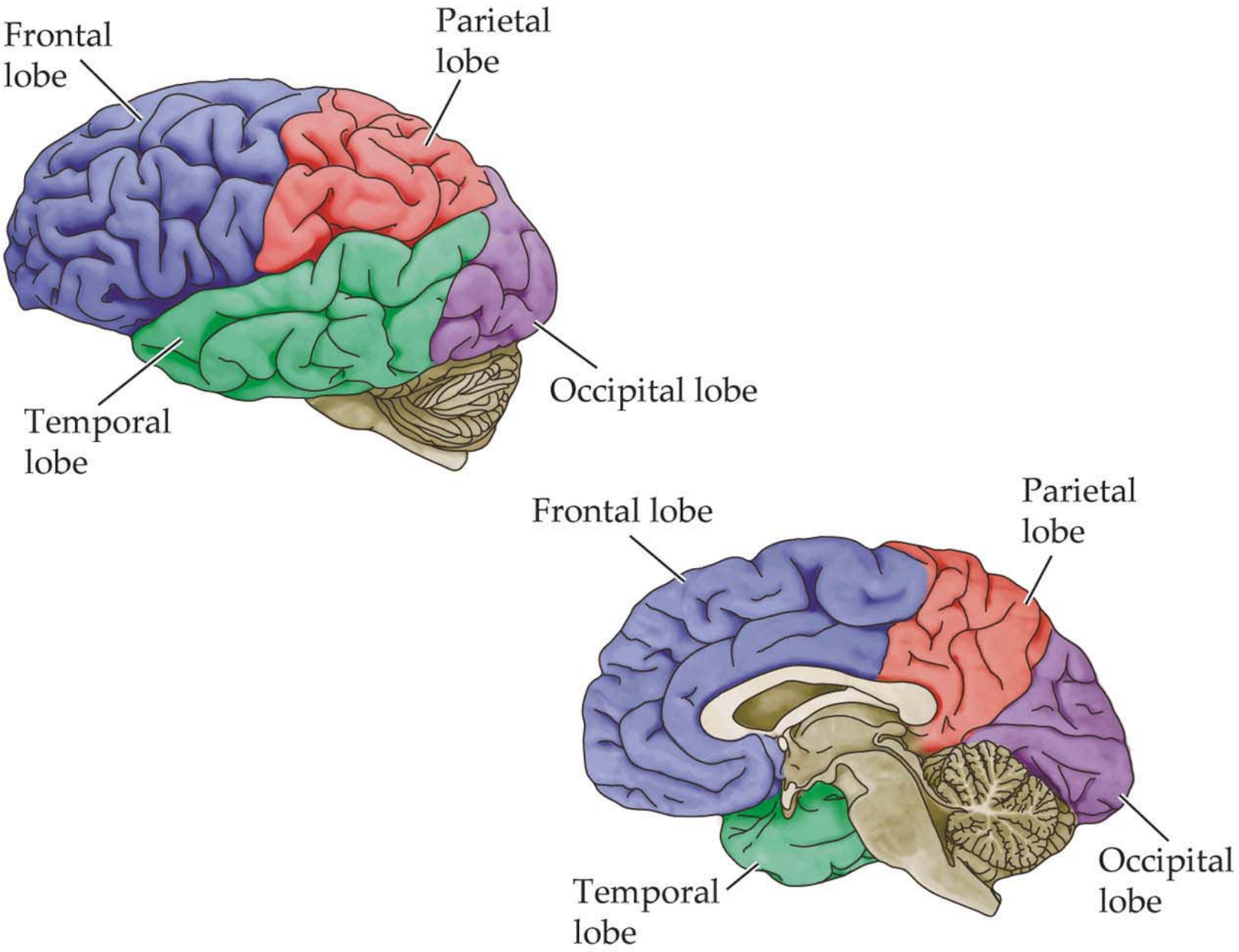


1.12 Gross anatomy of the forebrain. (Part 1)

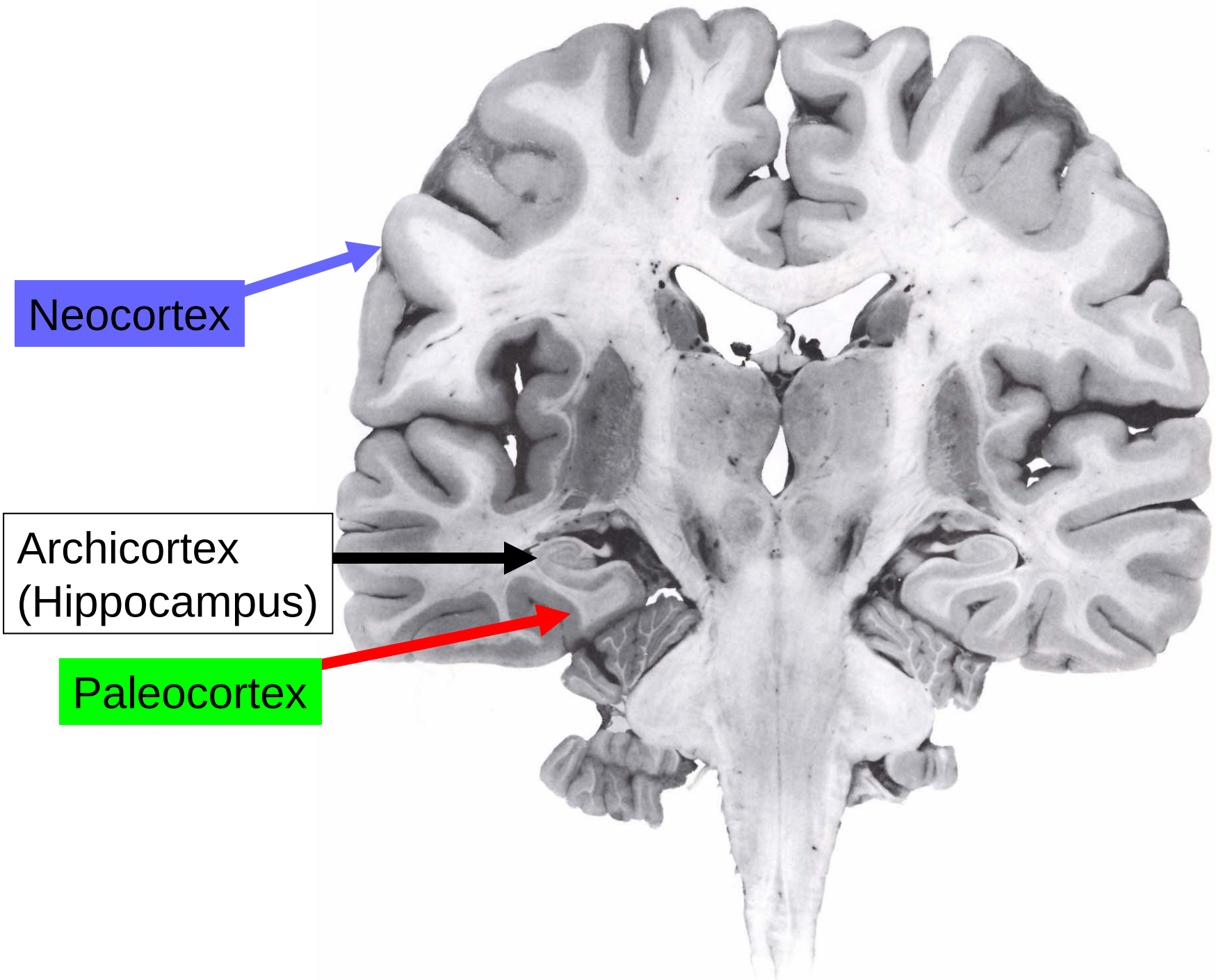


NEUROSCIENCE, Third Edition, **Figure 1.12 (Part 1)**

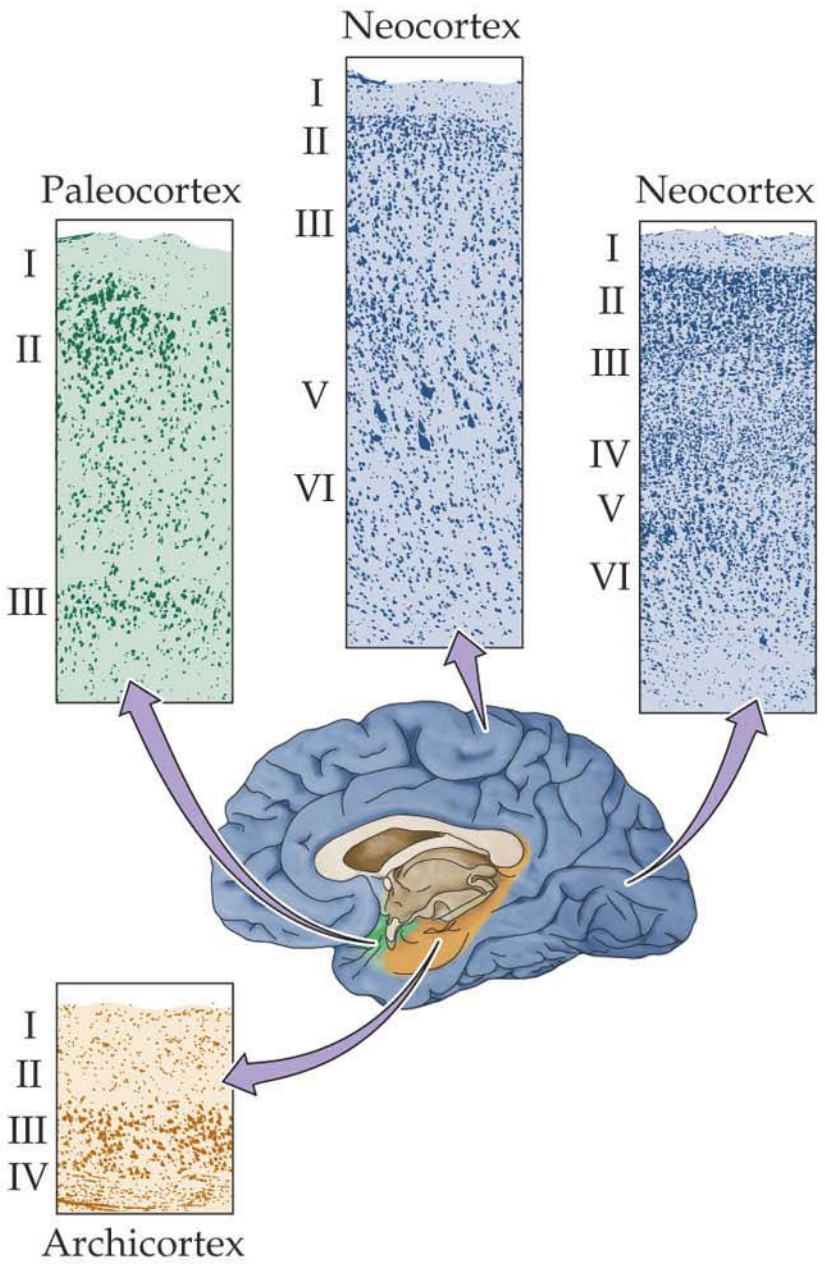
(C)



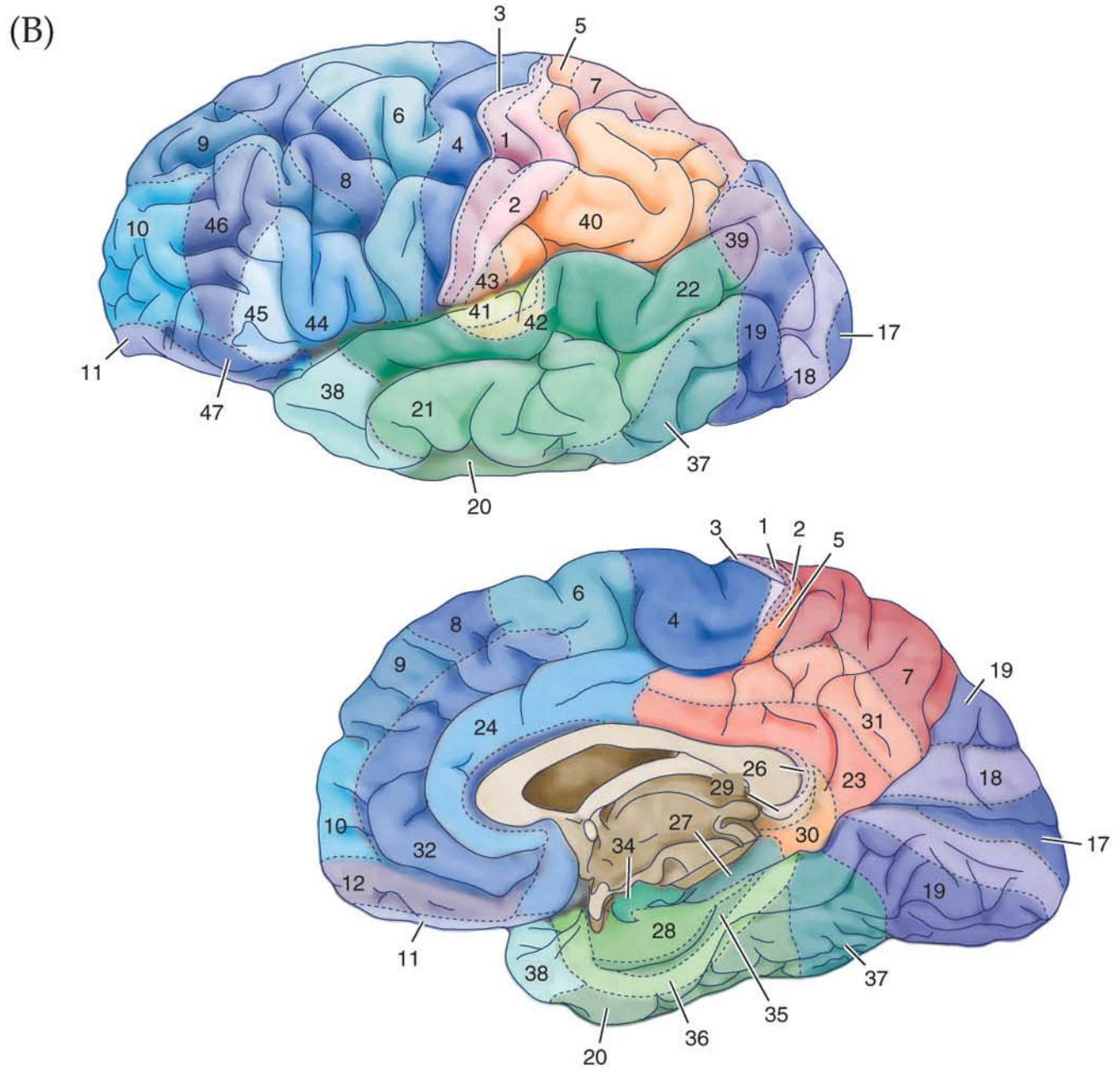
***NEUROSCIENCE, Third Edition,* Figure 1.12 (Part 3)**


Neocortex
Archicortex
(Hippocampus)
Paleocortex

Box A A More Detailed Look at Cortical Lamination

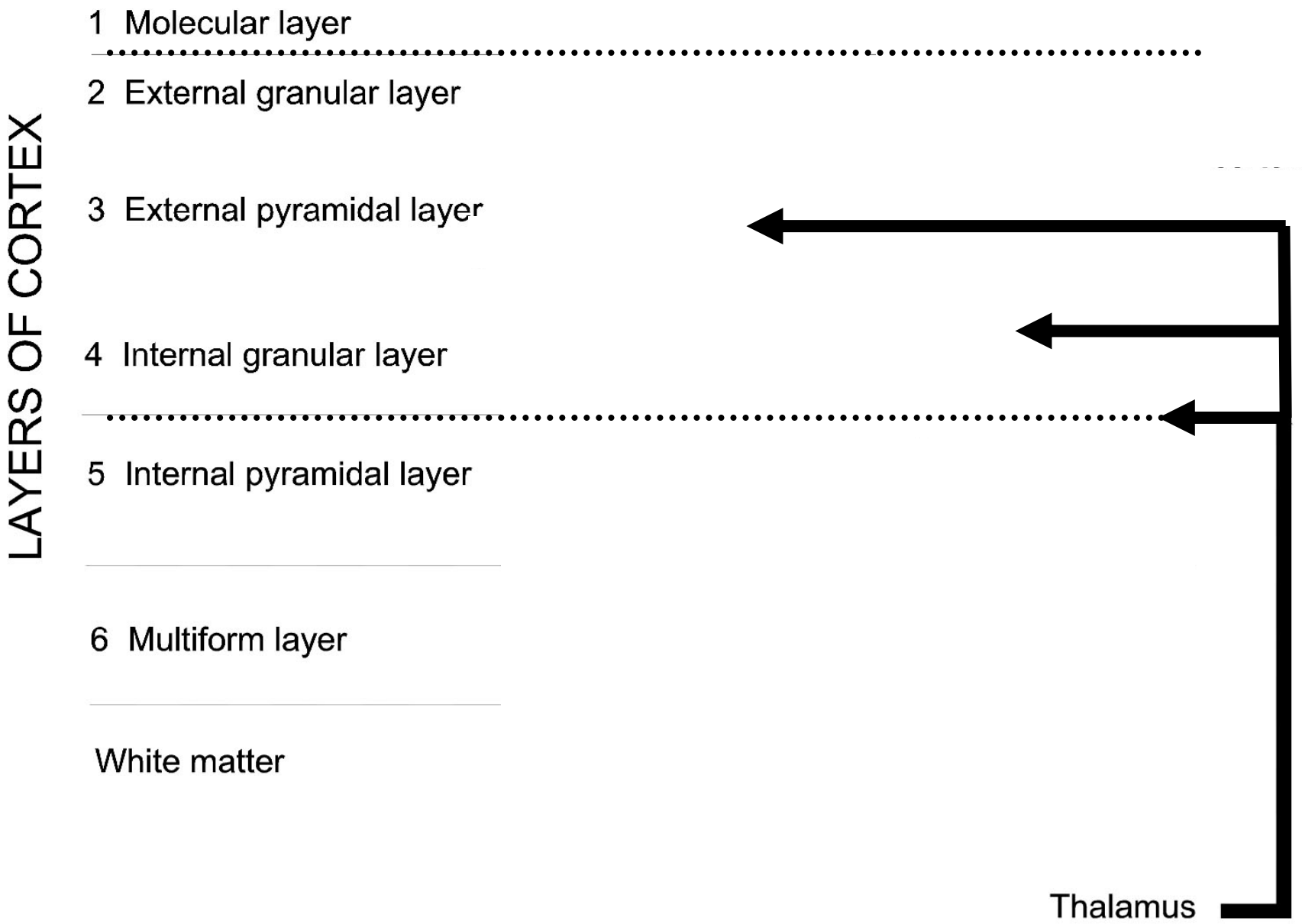


25.2 The structure of the human neocortex, including the association cortices. (Part 2)

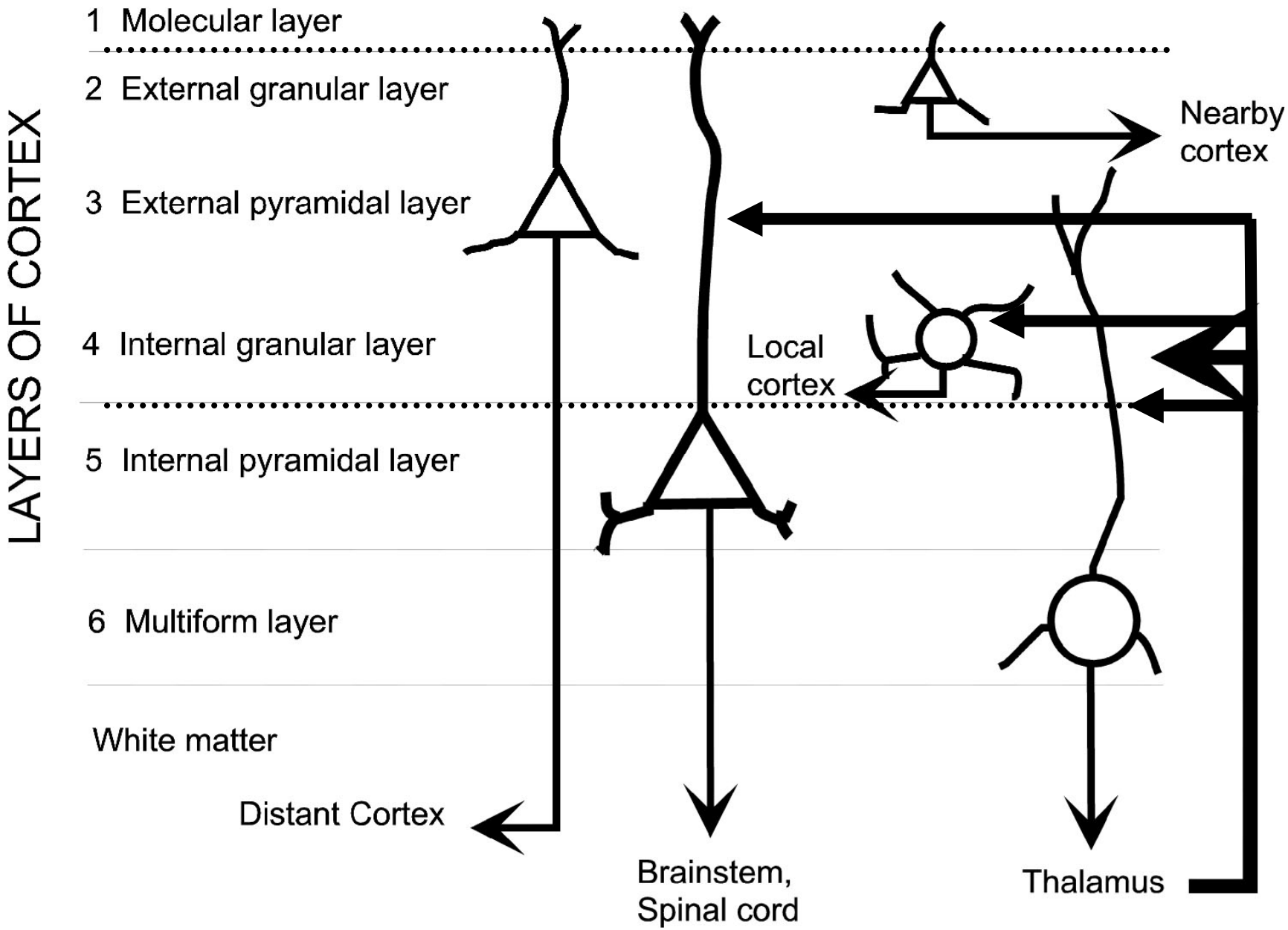


NEUROSCIENCE, Third Edition, **Figure 25.2 (Part 2)**

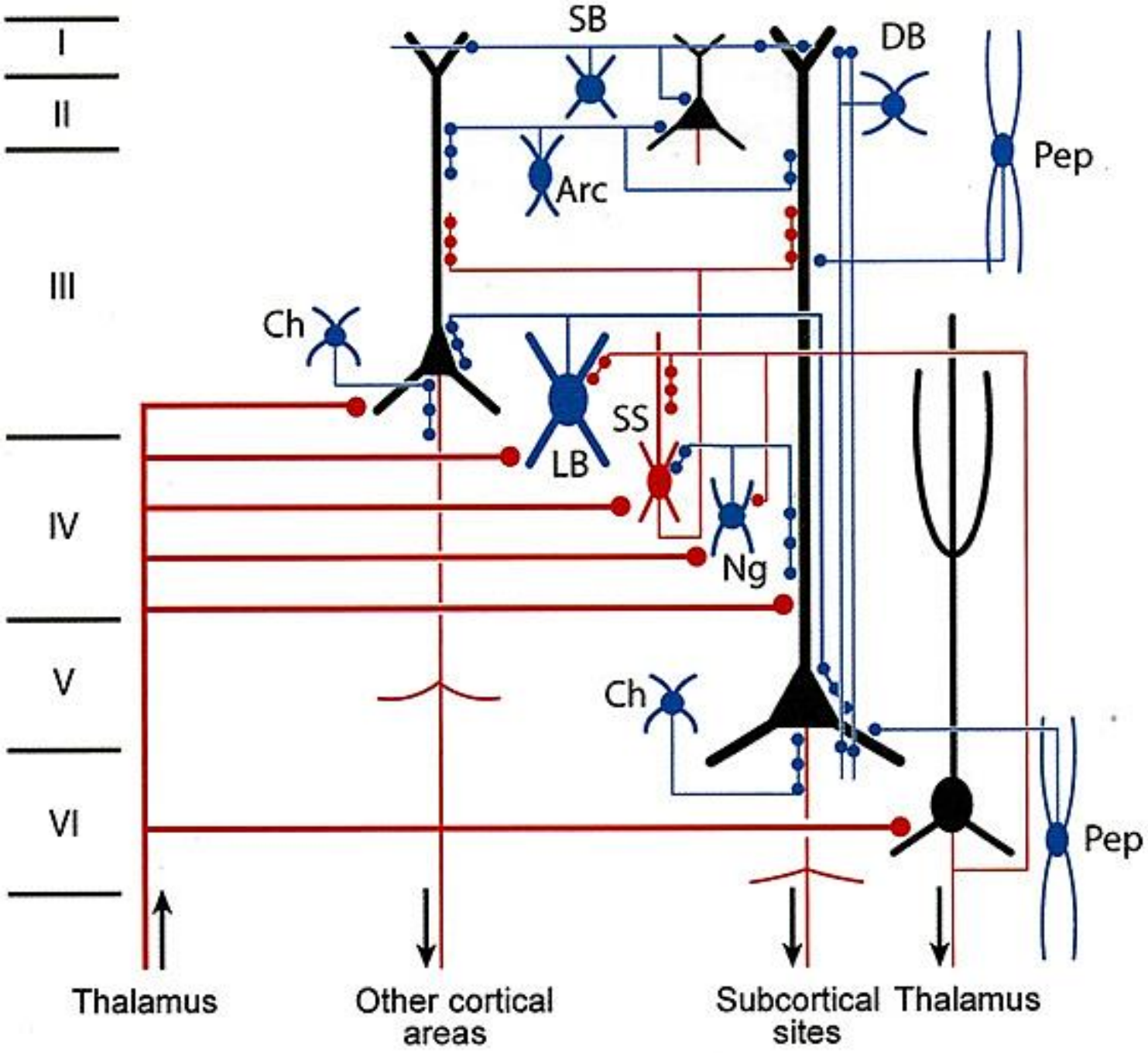
Neural circuitry of neocortex – Glutamatergic neurons



Neural circuitry of neocortex – Glutamatergic neurons



Cortical cells that receive thalamic afferents



Cortical cells that receive thalamic afferents

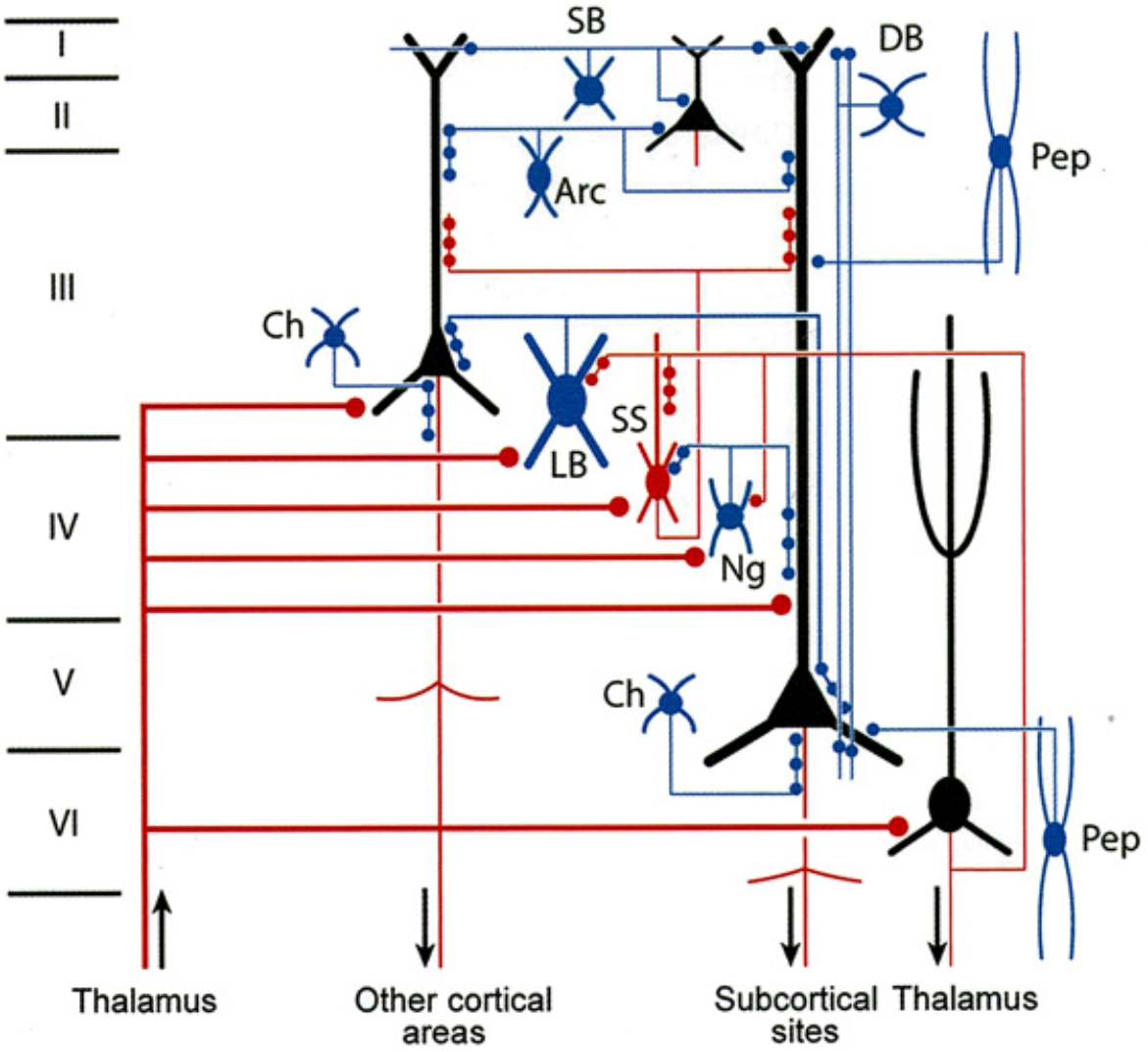
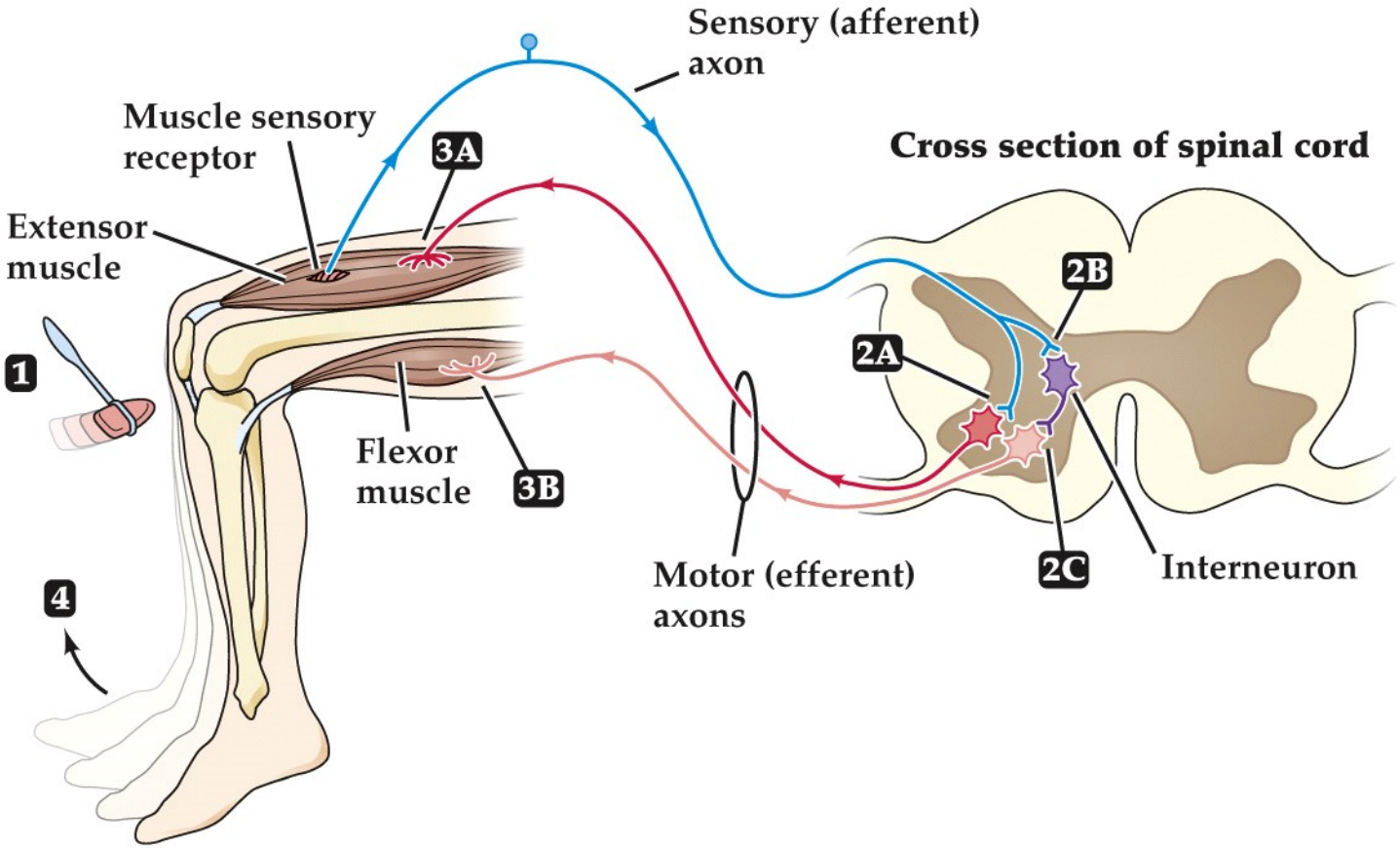


FIGURE 1–2. A schematic circuit based upon the known cortical cells upon which thalamic afferent fibers terminate in cats and monkeys. The GABAergic smooth intereneurons (blue) are identified by the names that they have received in these species. Arc, neuron with arciform axon; Ch, chandelier cell; DB, double bouquet cell; LB, large basket cell; Ng, neurogliaform cell; Pep, peptidergic neuron. Excitatory neurons (red) include pyramidal cells of layers II–VI and the spiny stellate cells (SS) of layer IV. (Based on Jones, 2007)

Figure 1.7 The “knee-jerk response,” a simple reflex circuit



1 Hammer tap stretches tendon, which, in turn, stretches sensory receptors in leg extensor muscle

2A Sensory neuron synapses with and excites motor neuron in the spinal cord

2B Sensory neuron also excites spinal interneuron

2C Interneuron synapse inhibits motor neuron to flexor muscles

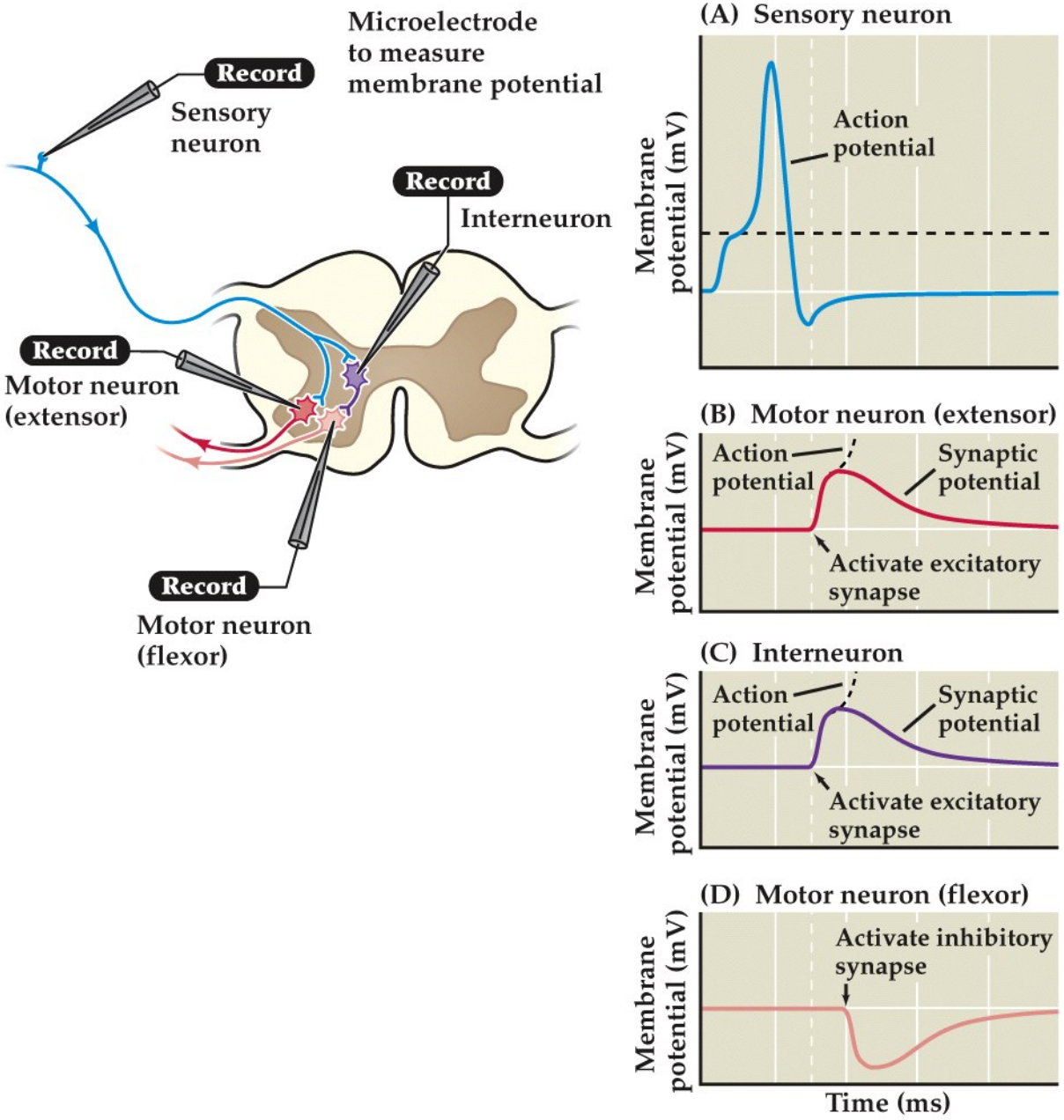
3A Motor neuron conducts action potential to synapses on extensor muscle fibers, causing contraction

3B Flexor muscle relaxes because the activity of its motor neurons has been inhibited

4 Leg extends

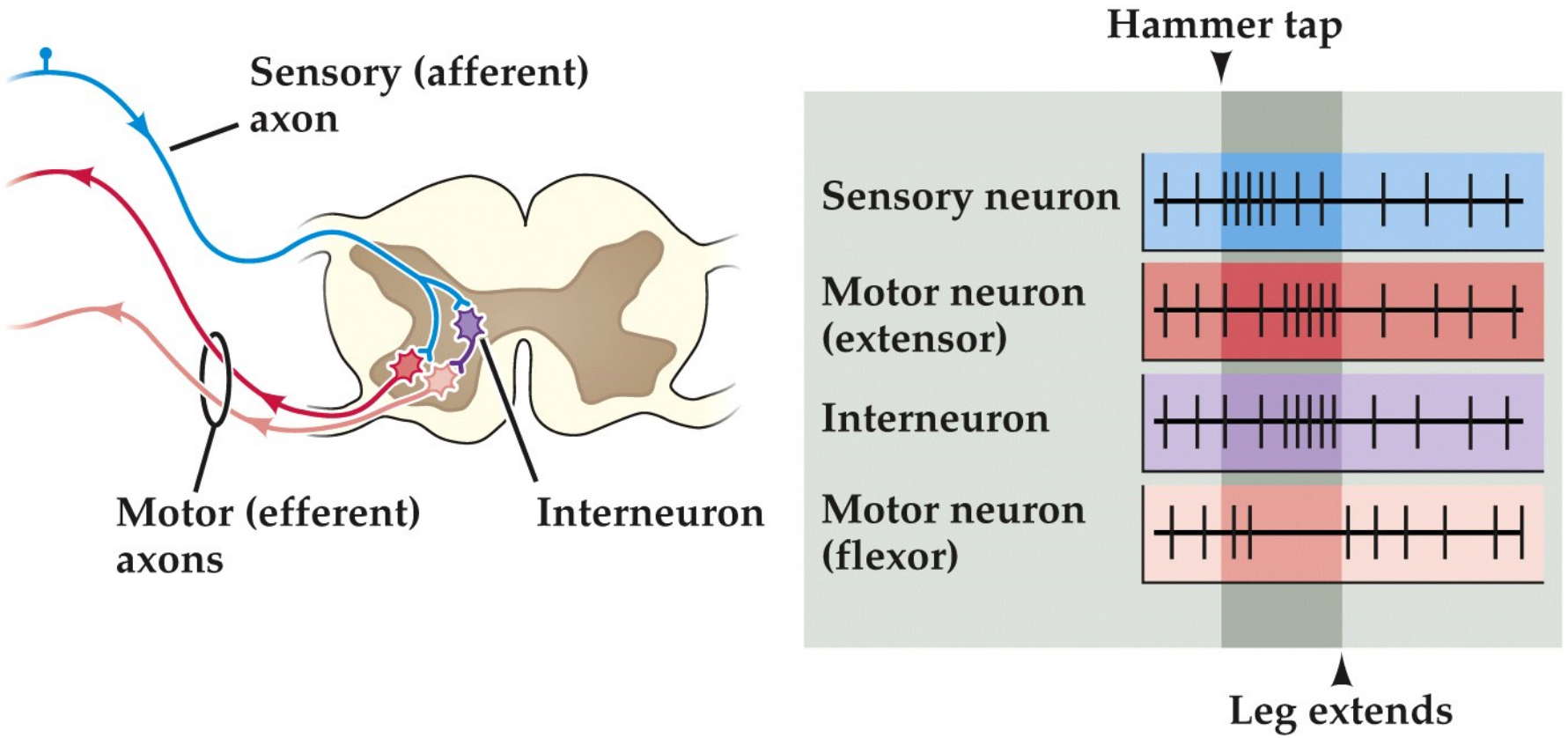
***NEUROSCIENCE 5e*, Figure 1.7**

Figure 1.9 Intracellularly recorded responses underlying the myotatic reflex



***NEUROSCIENCE 5e*, Figure 1.9**

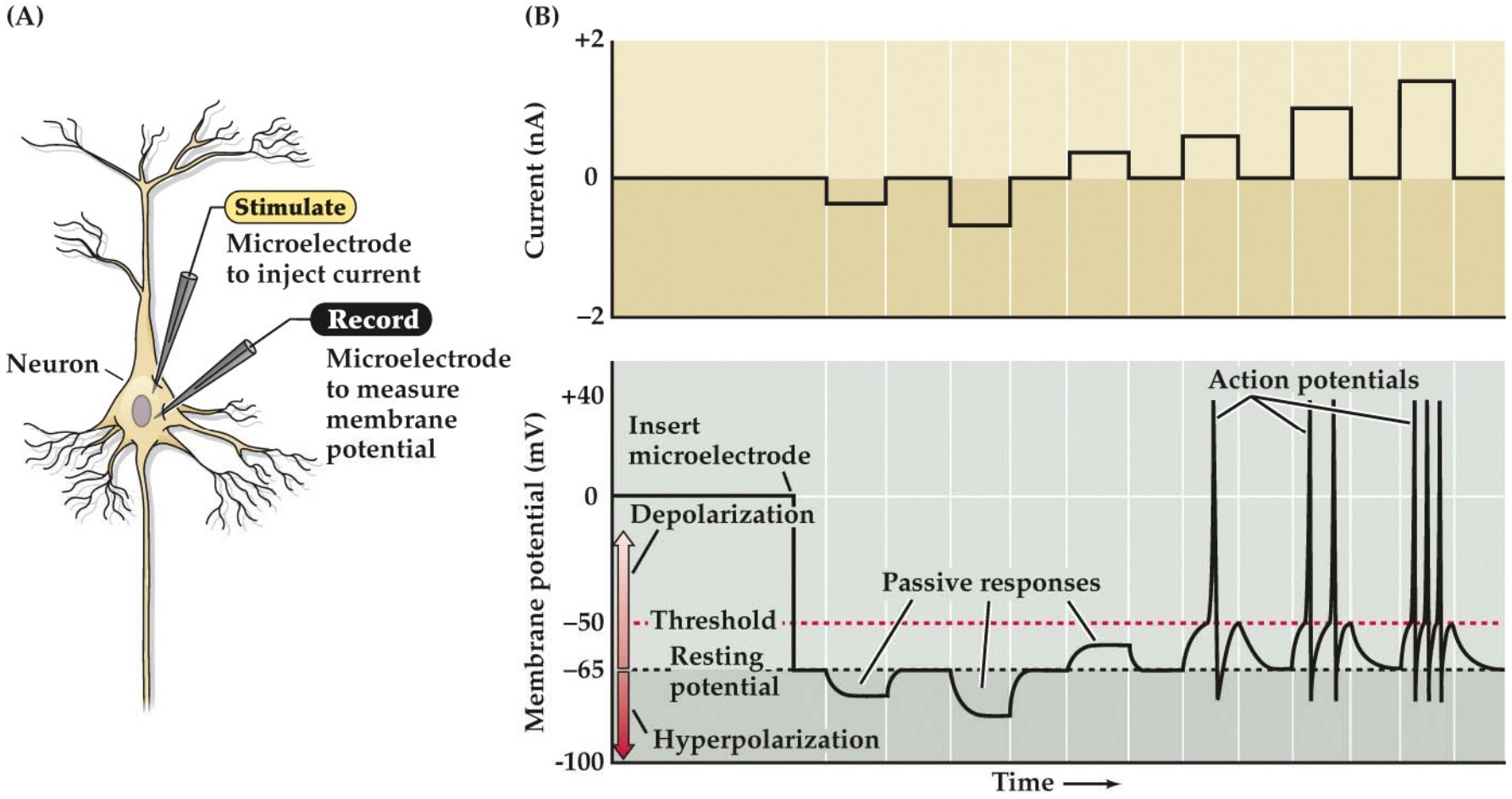
Figure 1.8 Extracellular recording shows the relative frequency of action potentials in the



***NEUROSCIENCE 5e*, Figure 1.8**

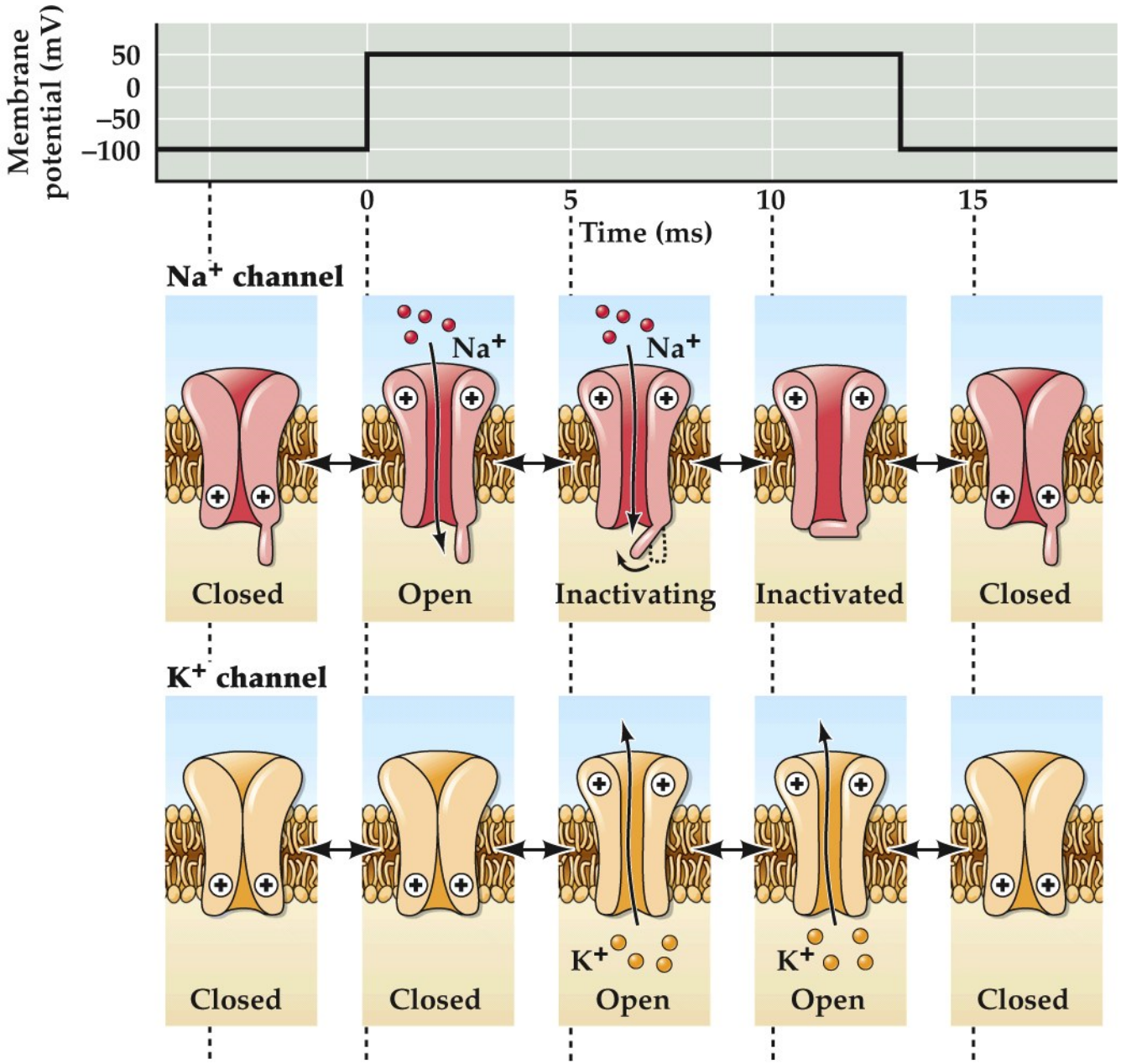
EXCITABLE MEMBRANES, ACTION POTENTIALS, AND SYNAPSES

Figure 2.2 Recording passive and active electrical signals in a nerve cell



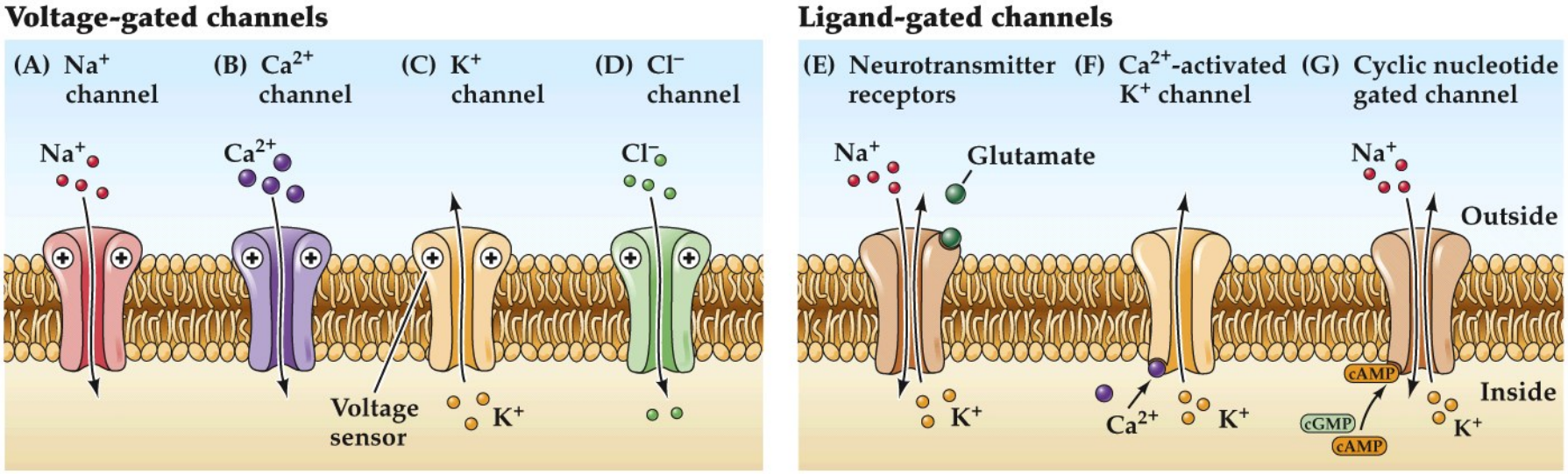
***NEUROSCIENCE 5e*, Figure 2.2**

Figure 4.3 Functional states of voltage-gated Na^+ and K^+ channels.



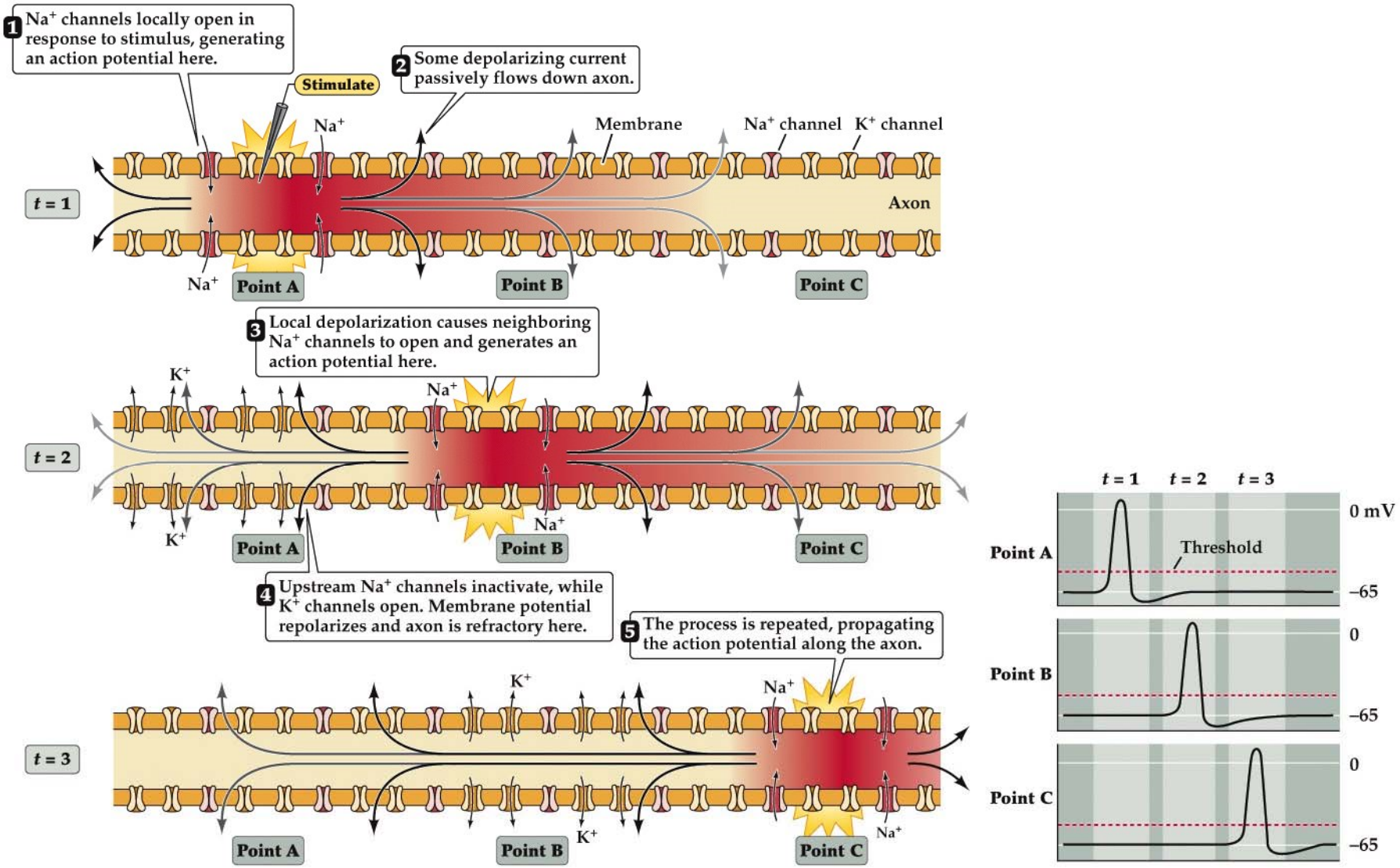
***NEUROSCIENCE 5e*, Figure 4.3**

Figure 4.4 Types of voltage-gated ion channels



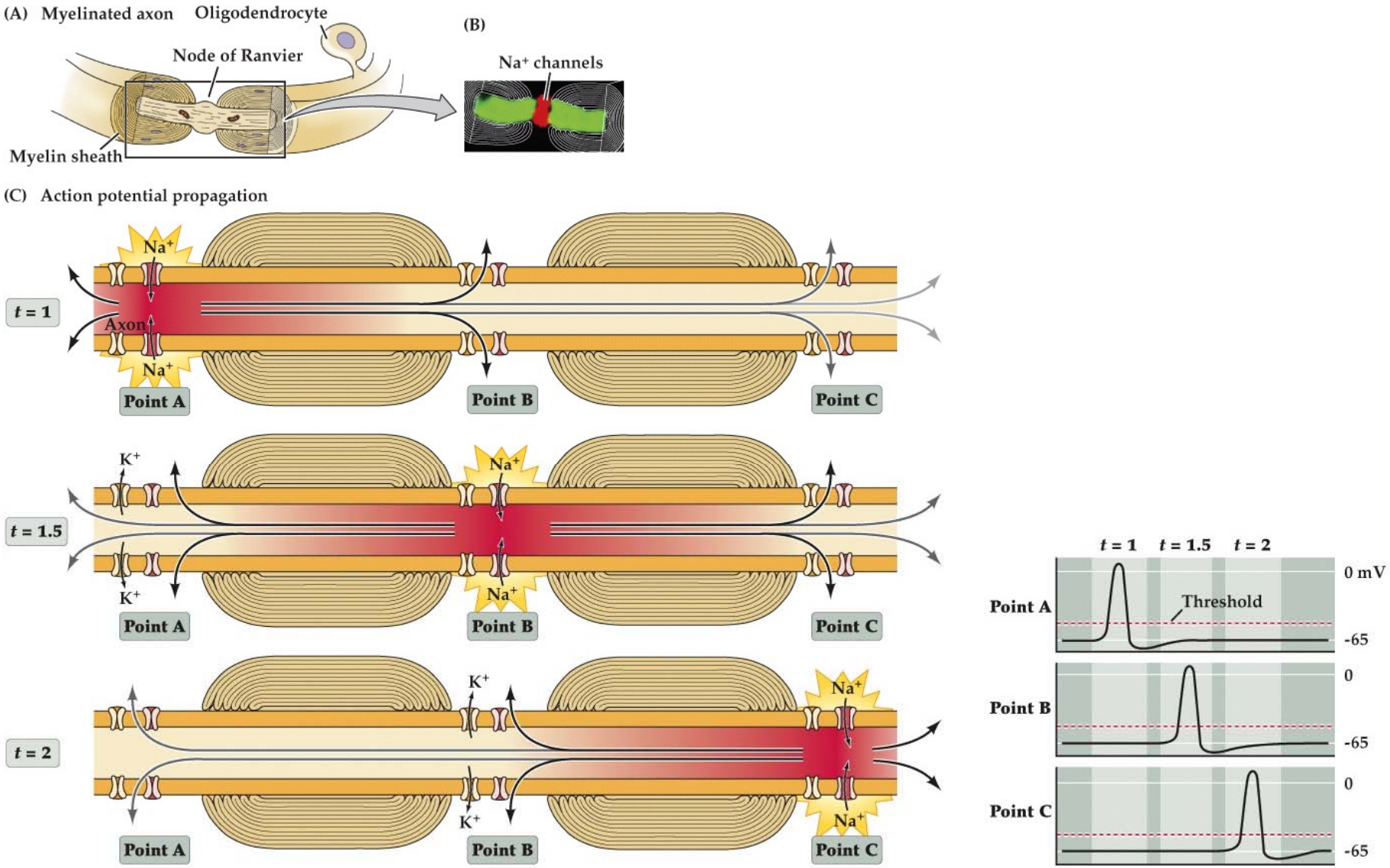
***NEUROSCIENCE 5e*, Figure 4.4**

Figure 3.10 Action potential conduction requires both active and passive current flow



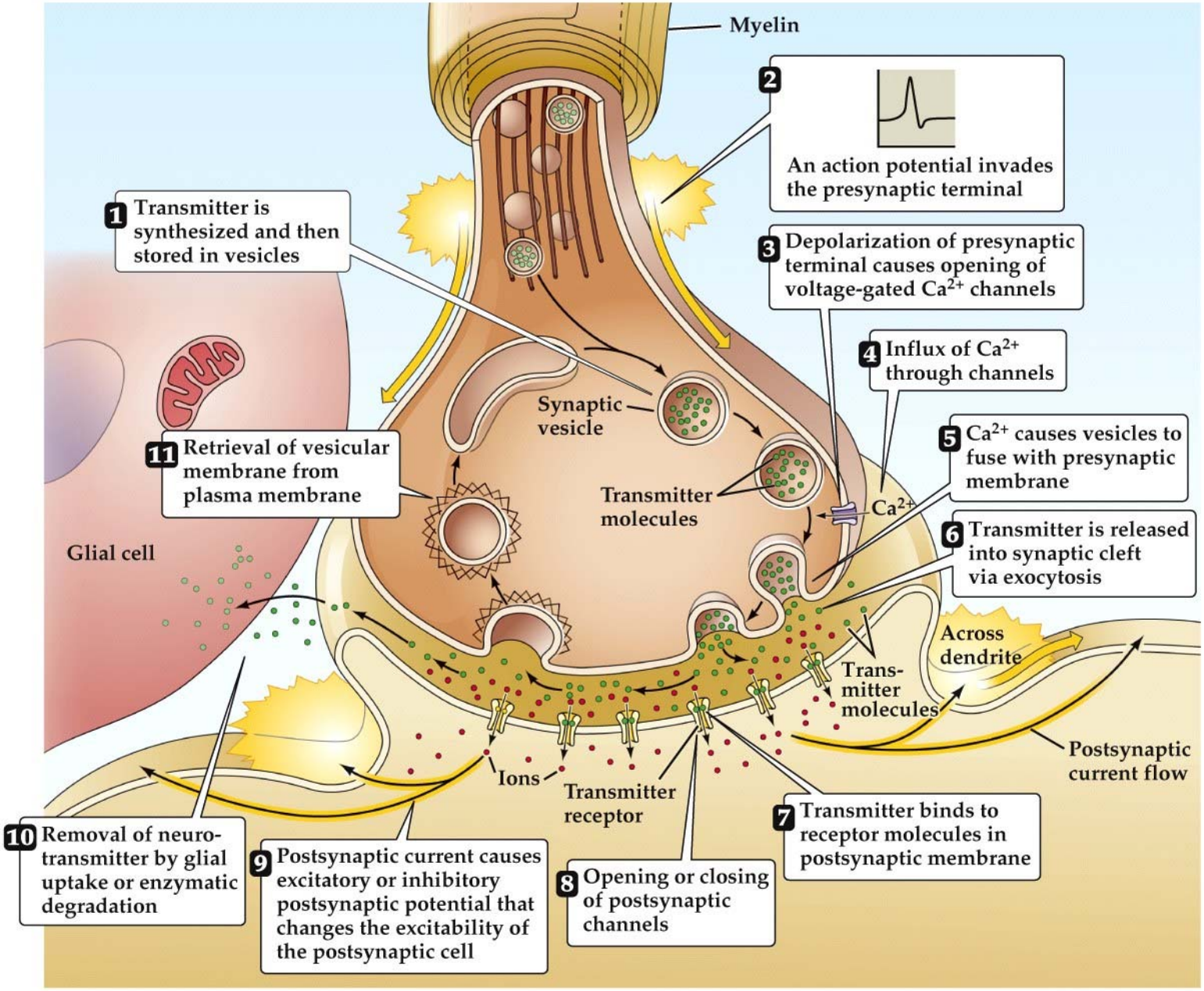
***NEUROSCIENCE 5e*, Figure 3.10**

Figure 3.11 Saltatory action potential conduction along a myelinated axon



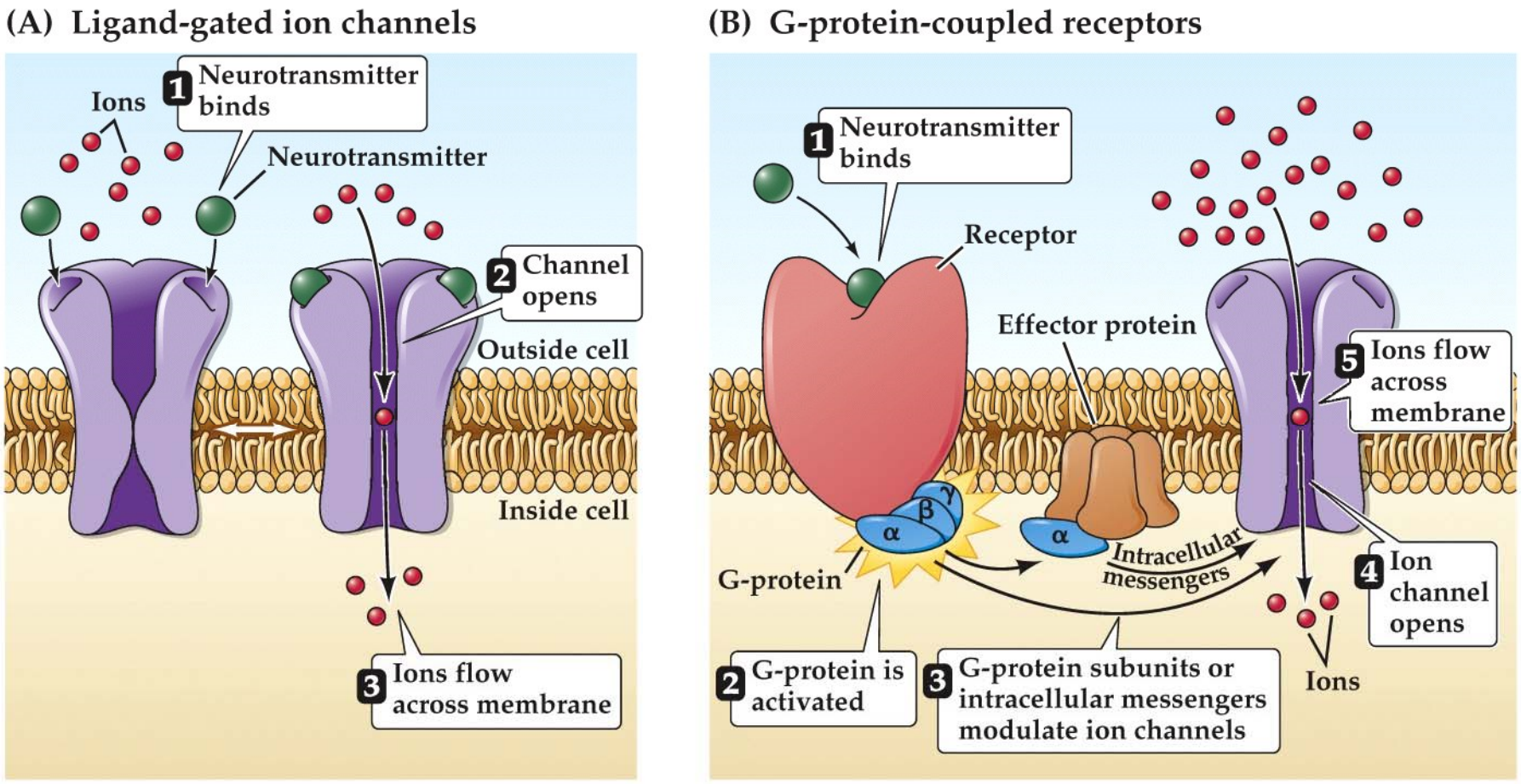
***NEUROSCIENCE 5e*, Figure 3.11**

Figure 5.3 Sequence of events involved in transmission at a typical chemical synapse



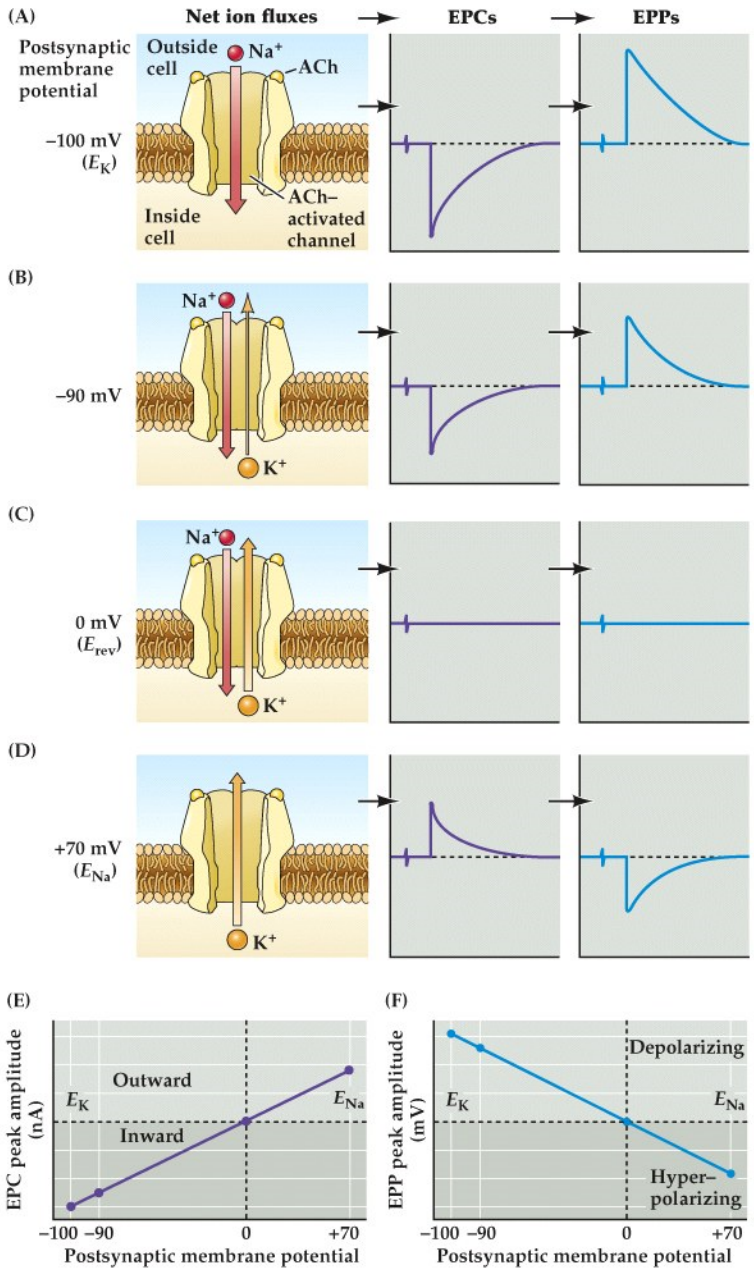
***NEUROSCIENCE 5e*, Figure 5.3**

Figure 5.16 Two different types of neurotransmitter receptor



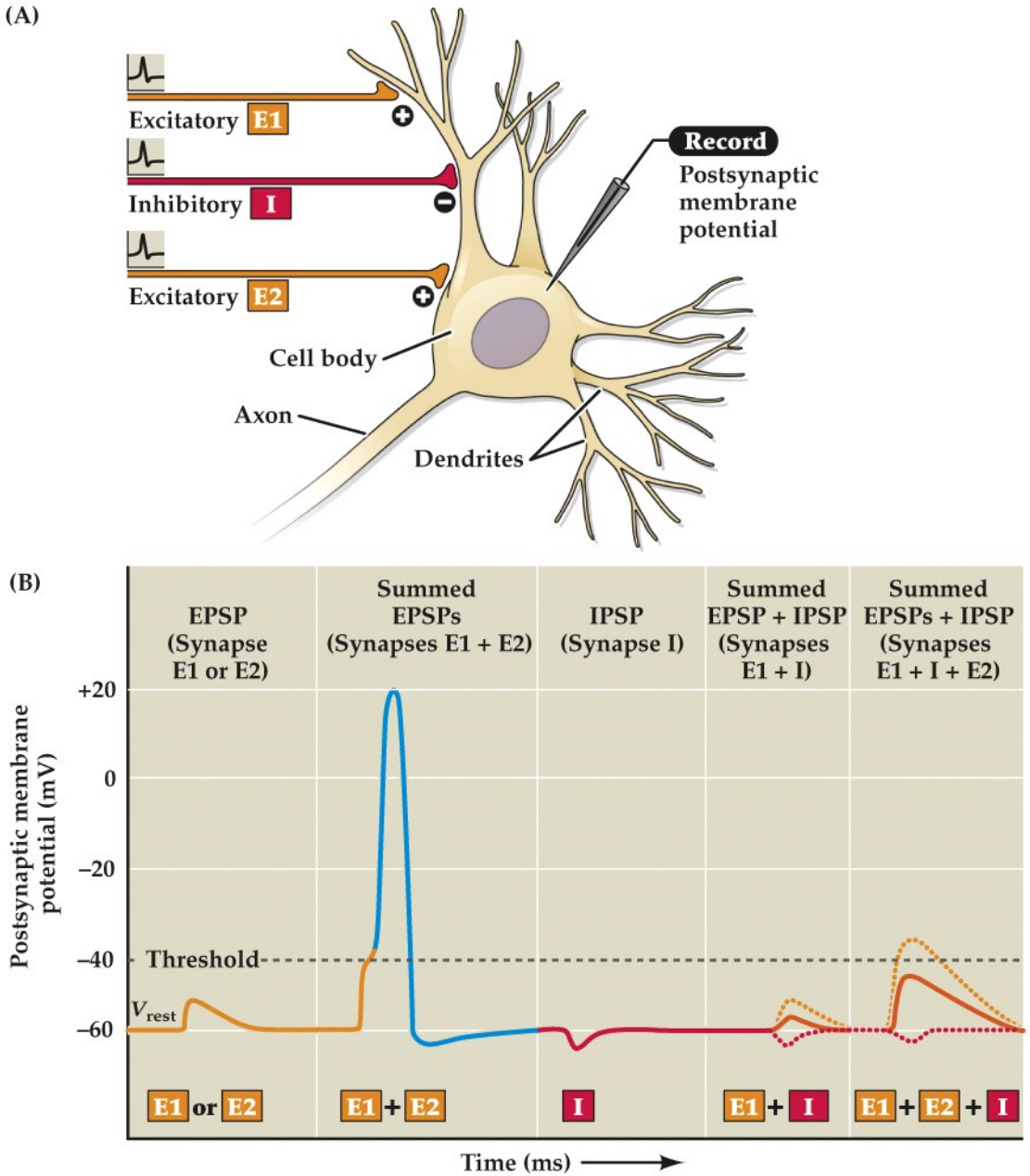
***NEUROSCIENCE 5e*, Figure 5.16**

Figure 5.20 Na^+ and K^+ movements during EPCs and EPPs



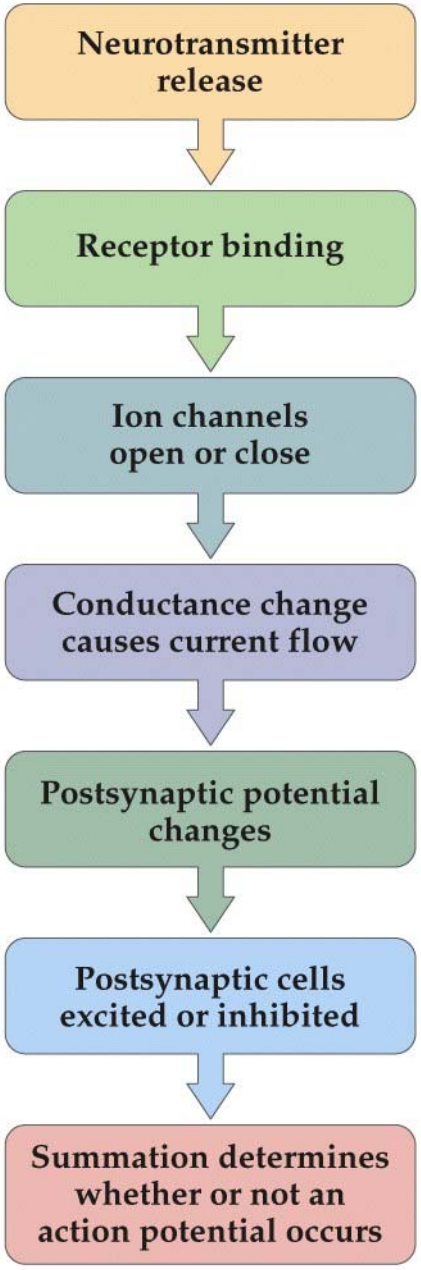
***NEUROSCIENCE 5e*, Figure 5.20**

Figure 5.22 Summation of postsynaptic potentials



***NEUROSCIENCE 5e*, Figure 5.22**

Figure 5.23 Events from neurotransmitter release to postsynaptic excitation or inhibition



***NEUROSCIENCE 5e*, Figure 5.23**

TABLE 6.1 Functional Features of the Major Neurotransmitters

NEUROTRANSMITTER	POSTSYNAPTIC EFFECT[a]	PRECURSOR(S)	RATE-LIMITING STEP IN SYNTHESIS	REMOVAL MECHANISM	TYPE OF VESICLE
ACh	Excitatory	Choline + acetyl CoA	CAT	AChEase	Small, clear
Glutamate	Excitatory	Glutamine	Glutaminase	Transporters	Small, clear
GABA	Inhibitory	Glutamate	GAD	Transporters	Small, clear
Glycine	Inhibitory	Serine	Phosphoserine	Transporters	Small, clear
Catecholamines (epinephrine, norepinephrine, dopamine)	Excitatory	Tyrosine	Tyrosine hydroxylase	Transporters, MAO, COMT	Small dense-core, or large irregular dense-core
Serotonin (5-HT)	Excitatory	Tryptophan	Tryptophan hydroxylase	Transporters, MAO	Large, dense-core
Histamine	Excitatory	Histidine	Histidine decarboxylase	Transporters	Large, dense-core
ATP	Excitatory	ADP	Mitochondrial oxidative phosphorylation; glycolysis	Hydrolysis to AMP and adenosine	Small, clear
Neuropeptides	Excitatory and inhibitory	Amino acids (protein synthesis)	Synthesis and transport	Proteases	Large, dense-core
Endocannabinoids	Inhibits inhibition	Membrane lipids	Enzymatic modification of lipids	Hydrolysis by FAAH	None
Nitric oxide	Excitatory and inhibitory	Arginine	Nitric oxide synthase	Spontaneous oxidation	None

[a]The most common postsynaptic effect is indicated; the same transmitter can elicit postsynaptic excitation or inhibition, depending on the nature of the receptors and ion channels activated by transmitter binding (see Chapter 5).

***NEUROSCIENCE 5e*, Table 6.1**