BMD ENG 301
Quantitative Systems Physiology (Nervous System)

Lecture 2: Neuroanatomy

Professor Malcolm MacIver

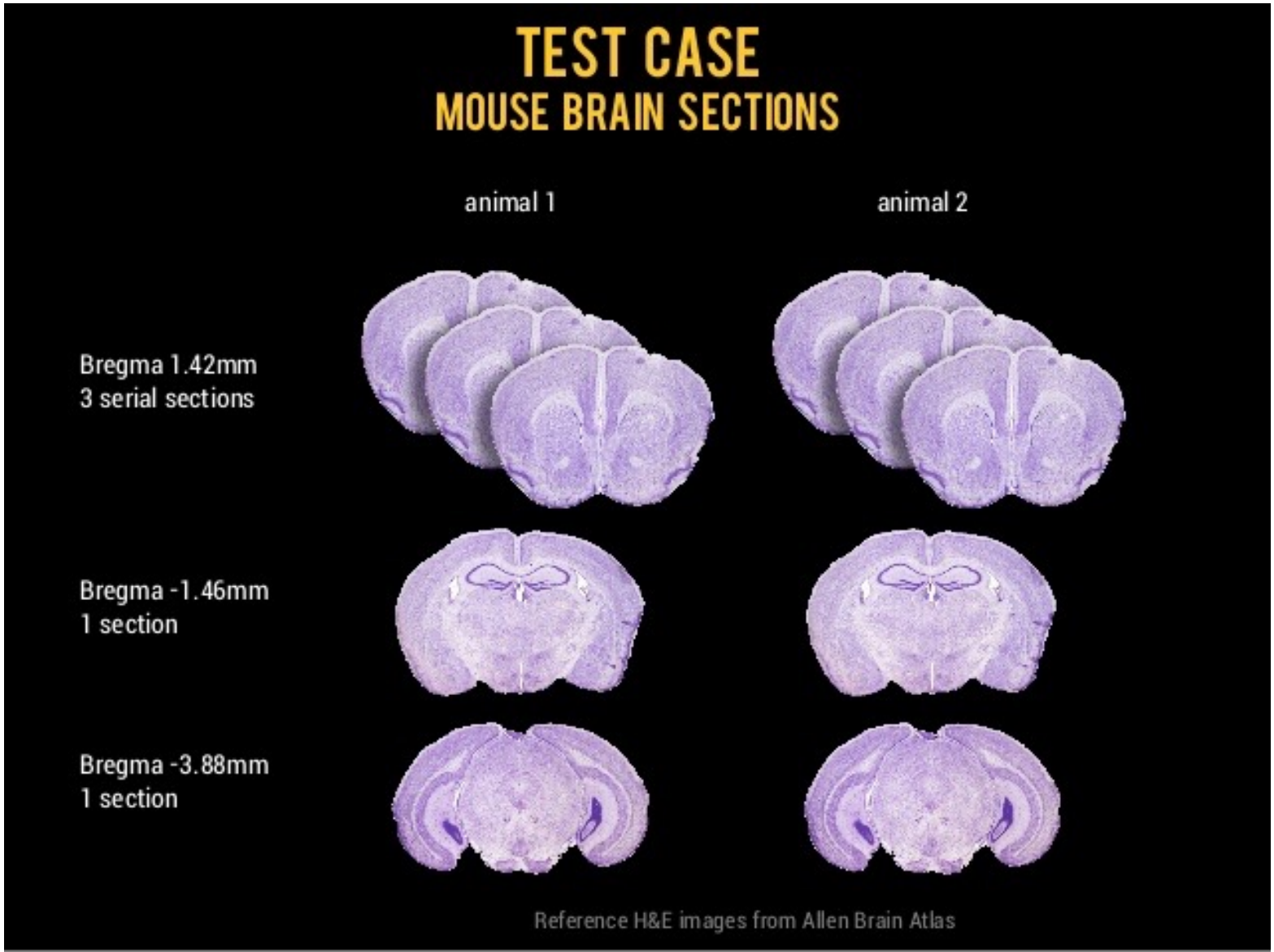
Quick announcements

- Tuesday section 11-12
- Aim for each section to be 24
- We need 16 hands to go up to shift (at 1:40pm), of which 6 needs to be from the Friday section, and 11 needs to be from Tuesday section)

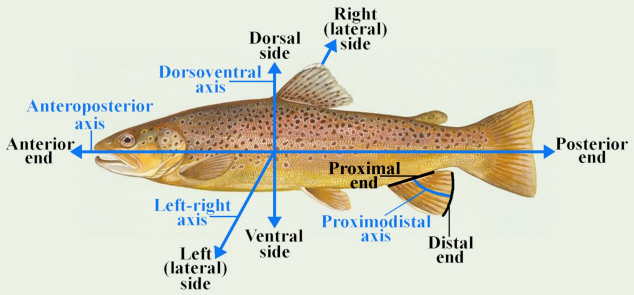
If you want to study the brain …

- Classical Neuroanatomy
- Functional Neuroanatomy
- *In vivo* Modern Brain Imaging

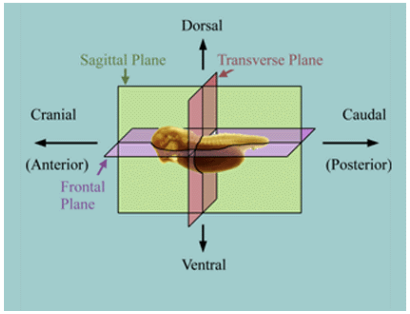
Classical Neuroanatomy

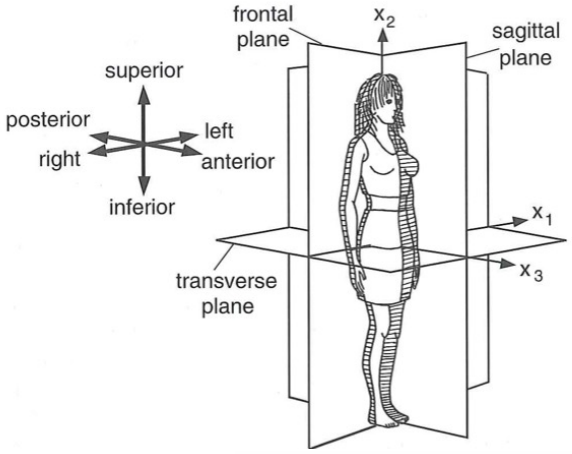


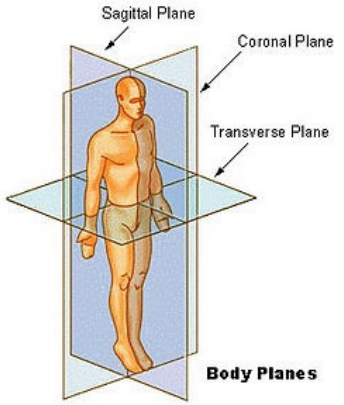
Note: Not in textbook



terms of location
Vertebrates
(all non-human animals)







terms of location
humans

Neuroanatomical Nomenclature – Orientation terms

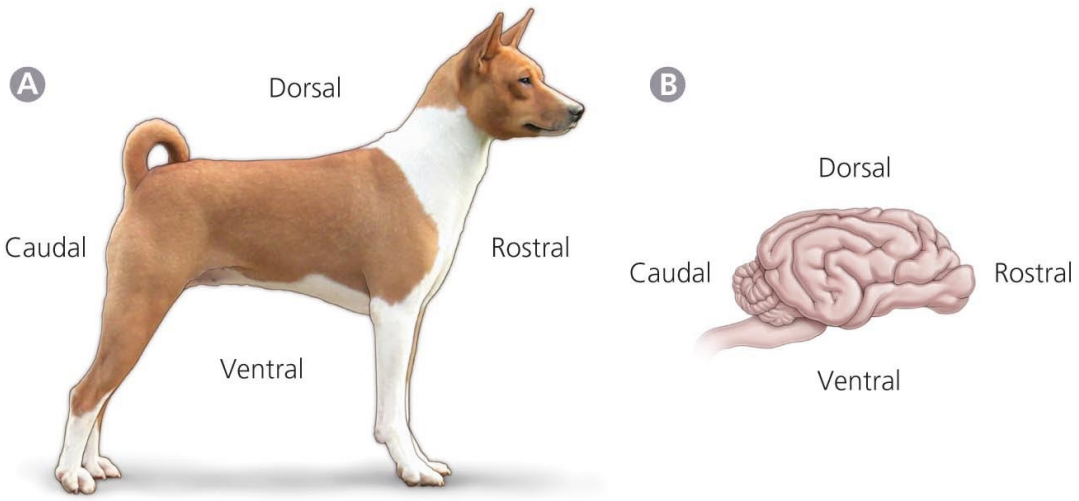


Fig. 1.2

Human bodies & brains require different orientation terms

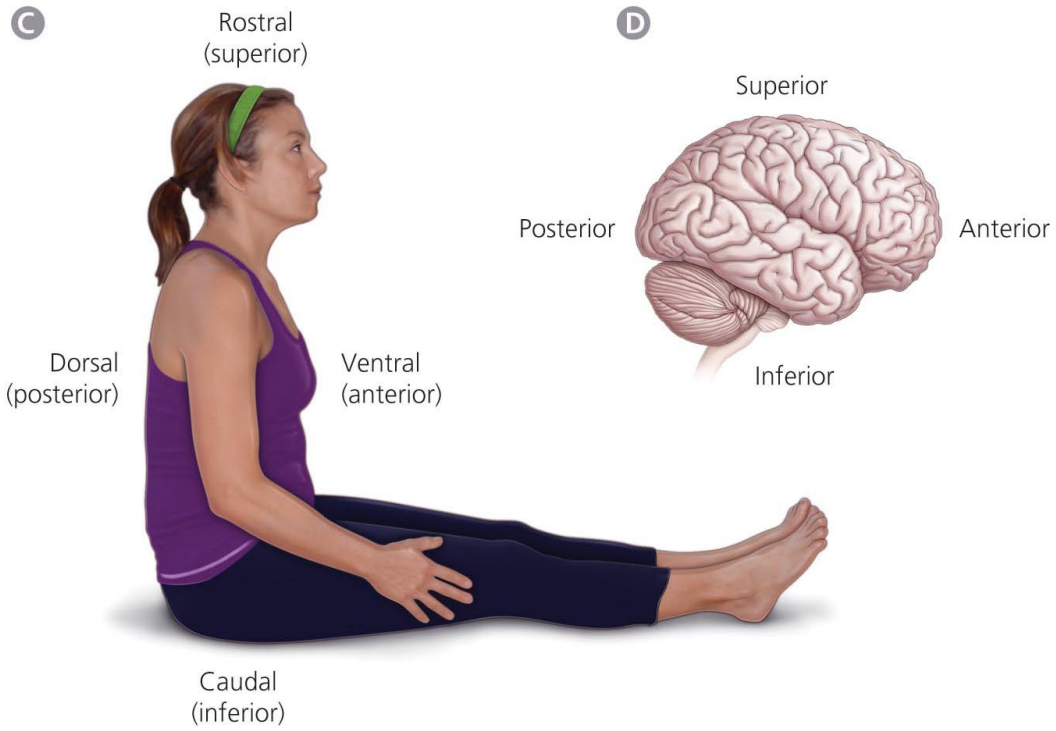
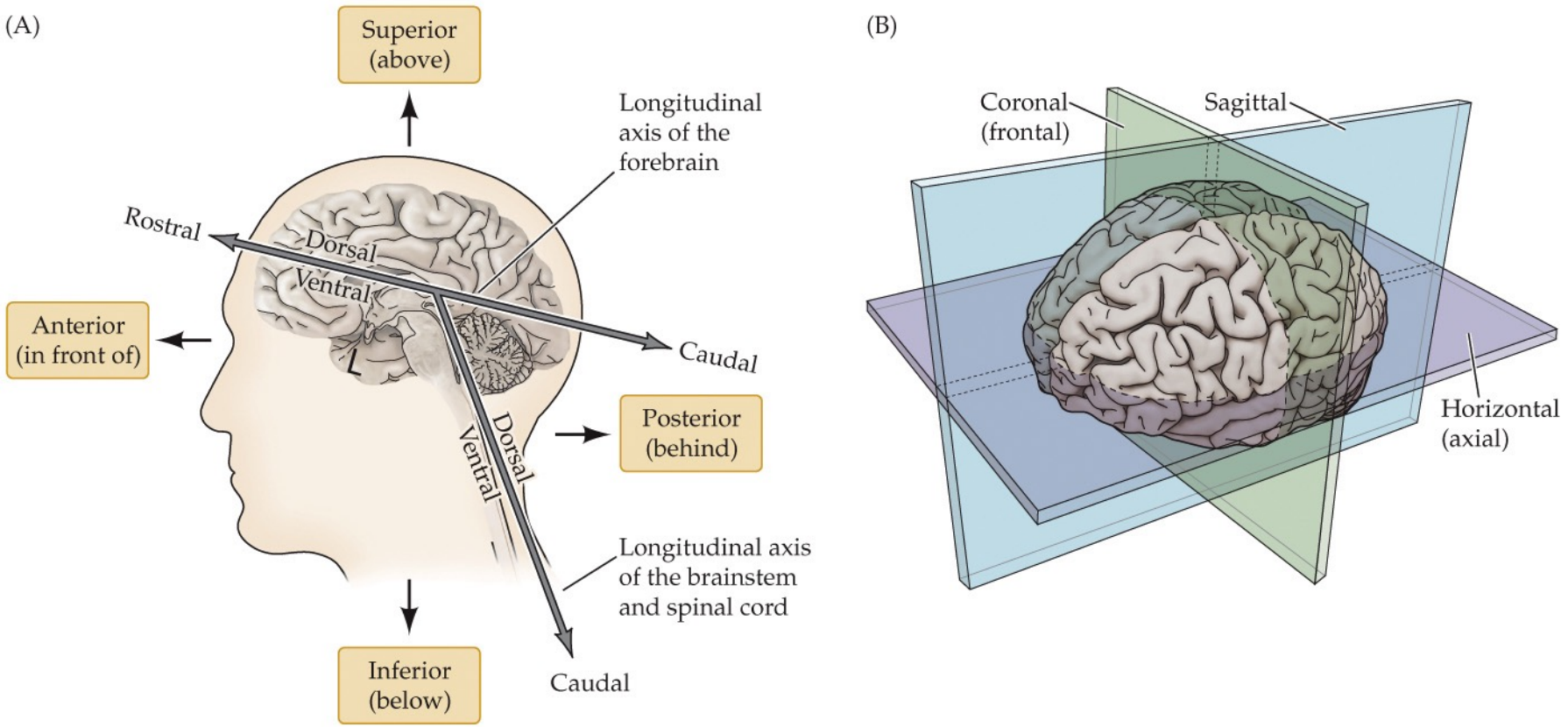
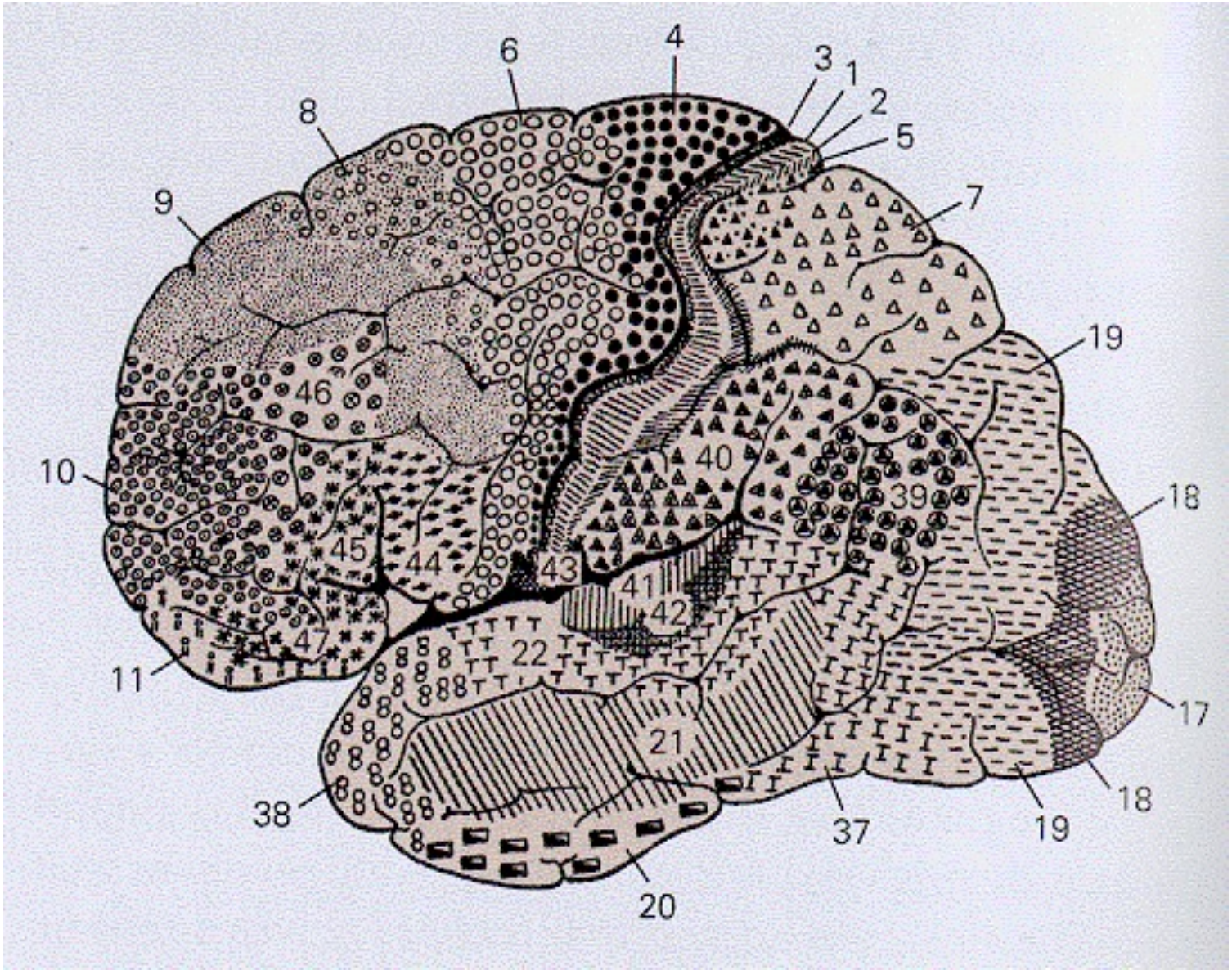


Fig. 1.2



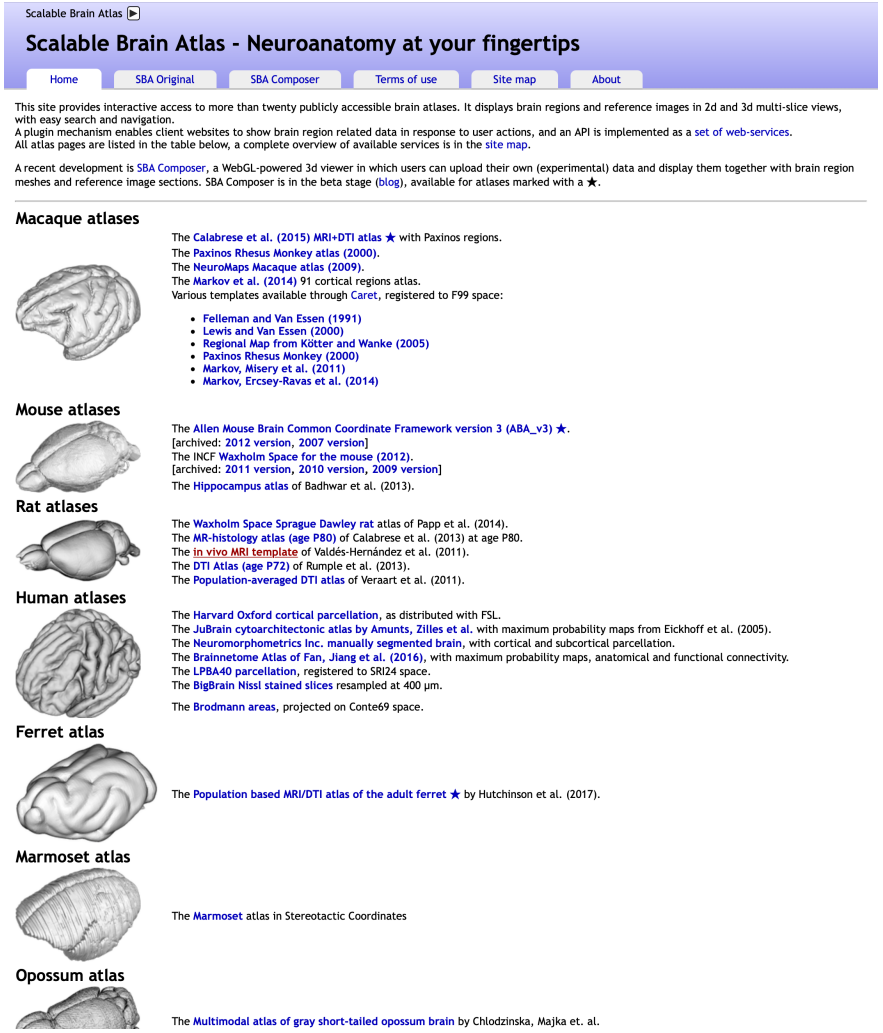
NEUROSCIENCE 6e, Figure A1

Brodmann Areas

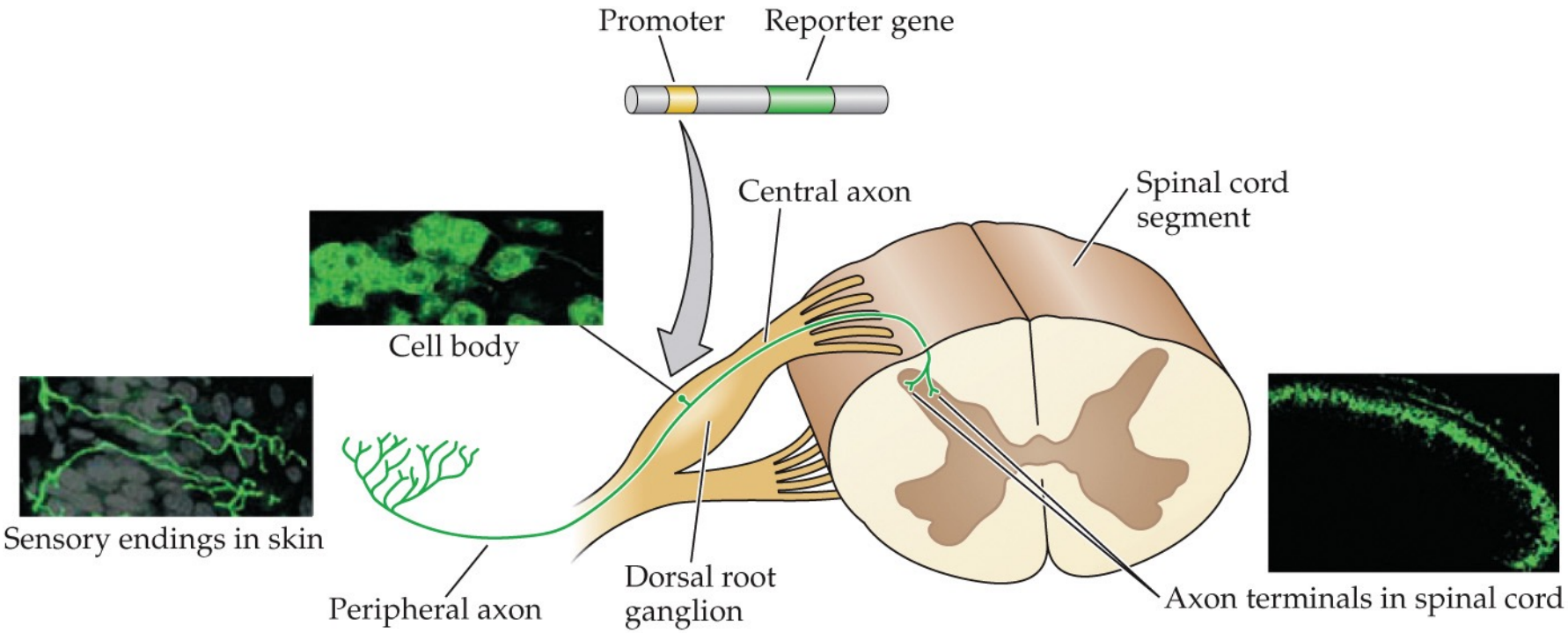


Online resource

https://scalablebrainatlas.incf.org



Tracing Pathways



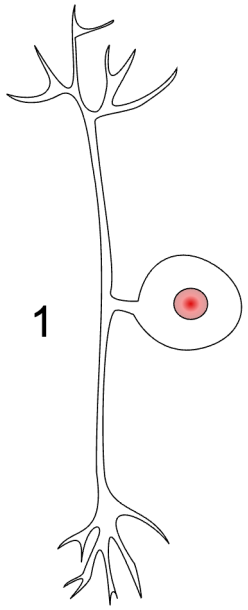
From Zylka et al. (2005) *Neuron* 46: 17–25.

***NEUROSCIENCE 6e*, Figure 1.15**

The psuedounipolar neuron

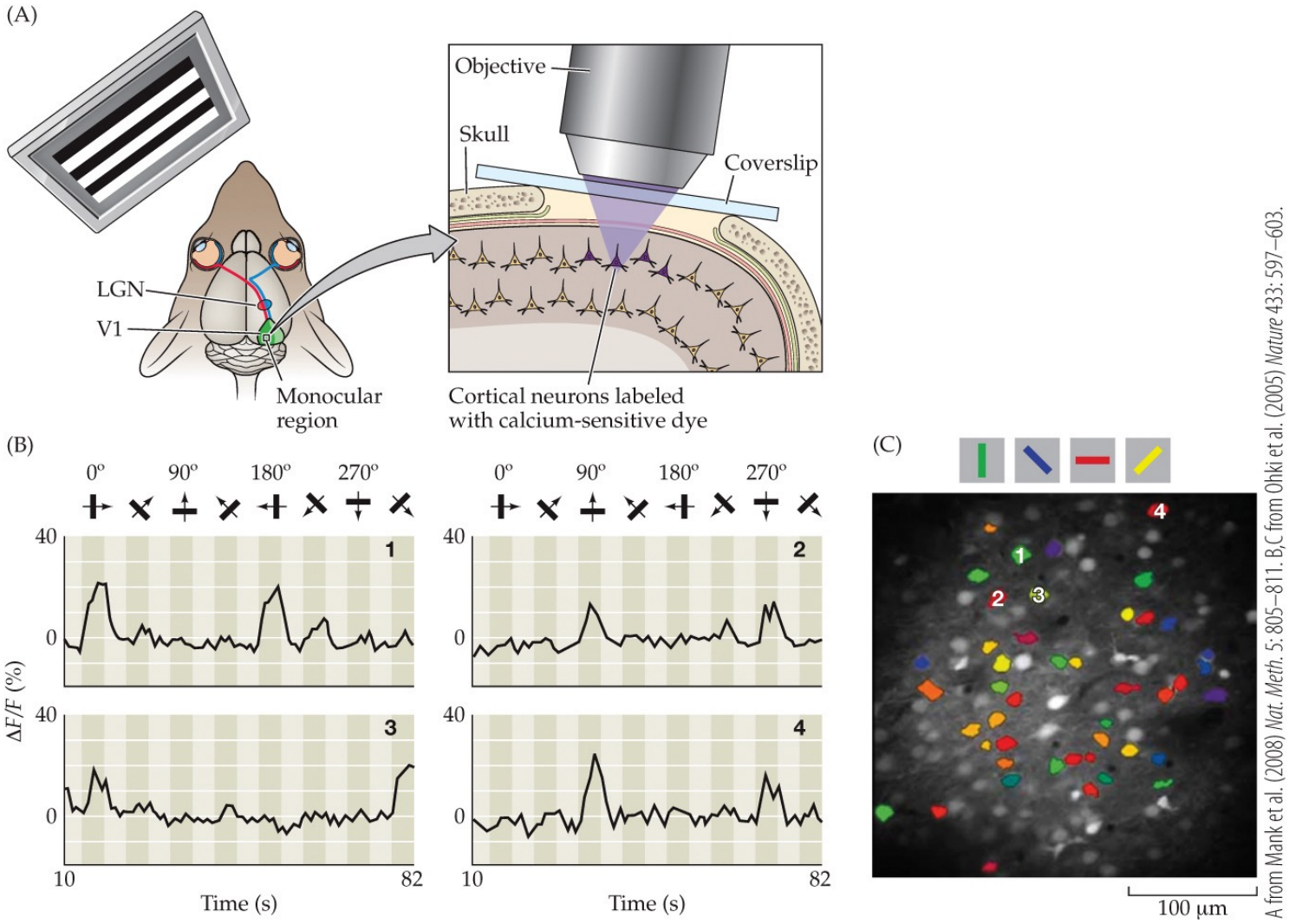
Most sensory afferent neurons are pseudounipolar…. Pseudounipolar neurons have one projection from the cell body, which splits into two axons: one that extends into the periphery and one that extends into the central nervous system.

Afferents that project into the spinal cord from skin and muscle are typically pseudounipolar. The cell bodies of these afferents are located in the dorsal root ganglia near the spinal cord…. The peripheral branch extends through a peripheral nerve, and is part of the sensory receptor in skin or muscle. The central branch projects through the dorsal (posterior) root into the spinal cord, and terminates on interneurons or motoneurons in the spinal cord, and may even project to the brainstem.



From: http://pittmedneuro.com/neuron.html

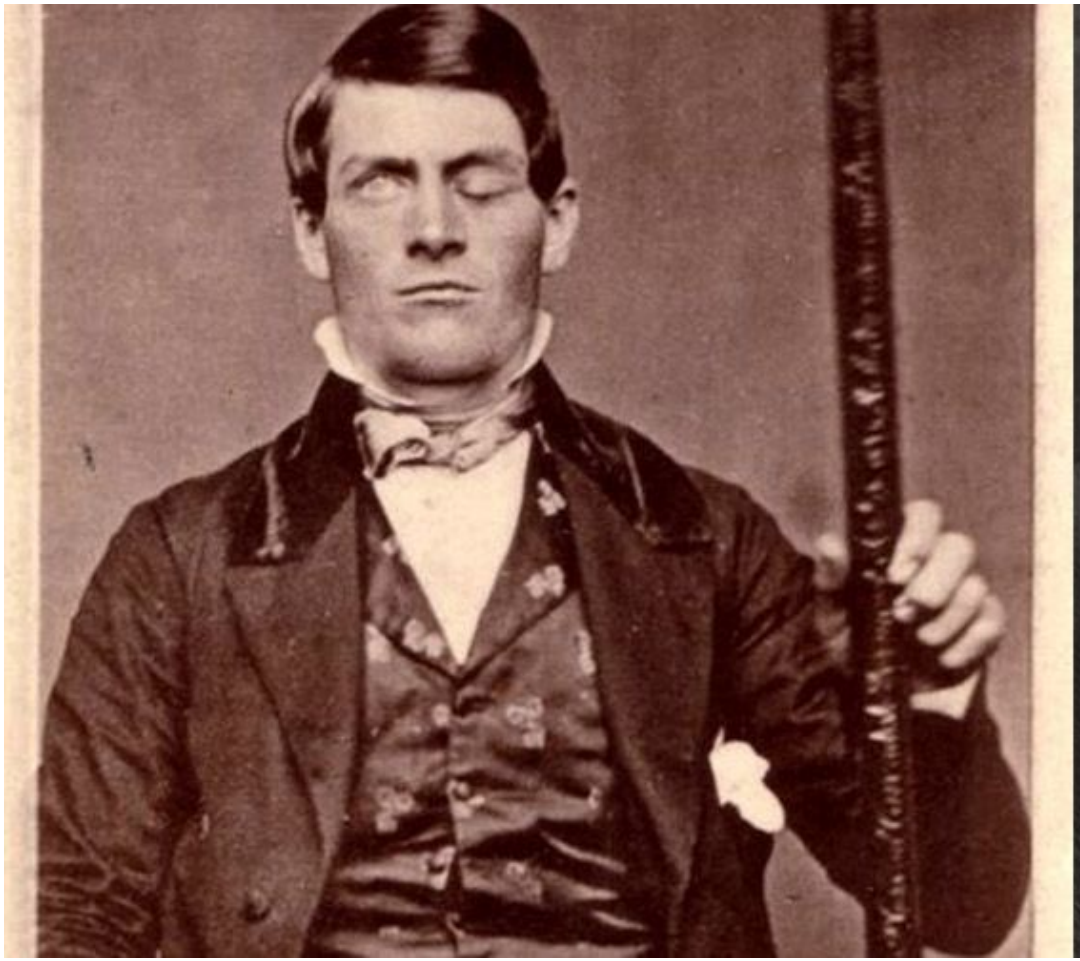
Functional Neuroanatomy



A from Mank et al. (2008) *Nat. Meth.* 5: 805–811. B,C from Ohki et al. (2005) *Nature* 433: 597–603.

NEUROSCIENCE 6e, Figure 1.10

Functional Neuroanatomy



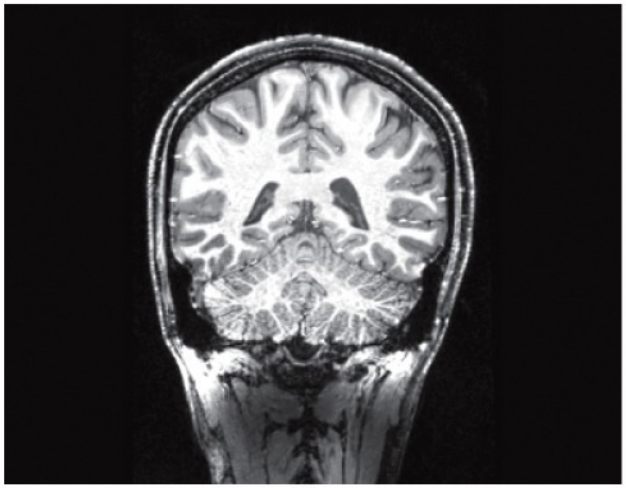
Phinaes Gage

In vivo Structural Brain Imaging

(A)

© iStock.com/kot63.

(B)

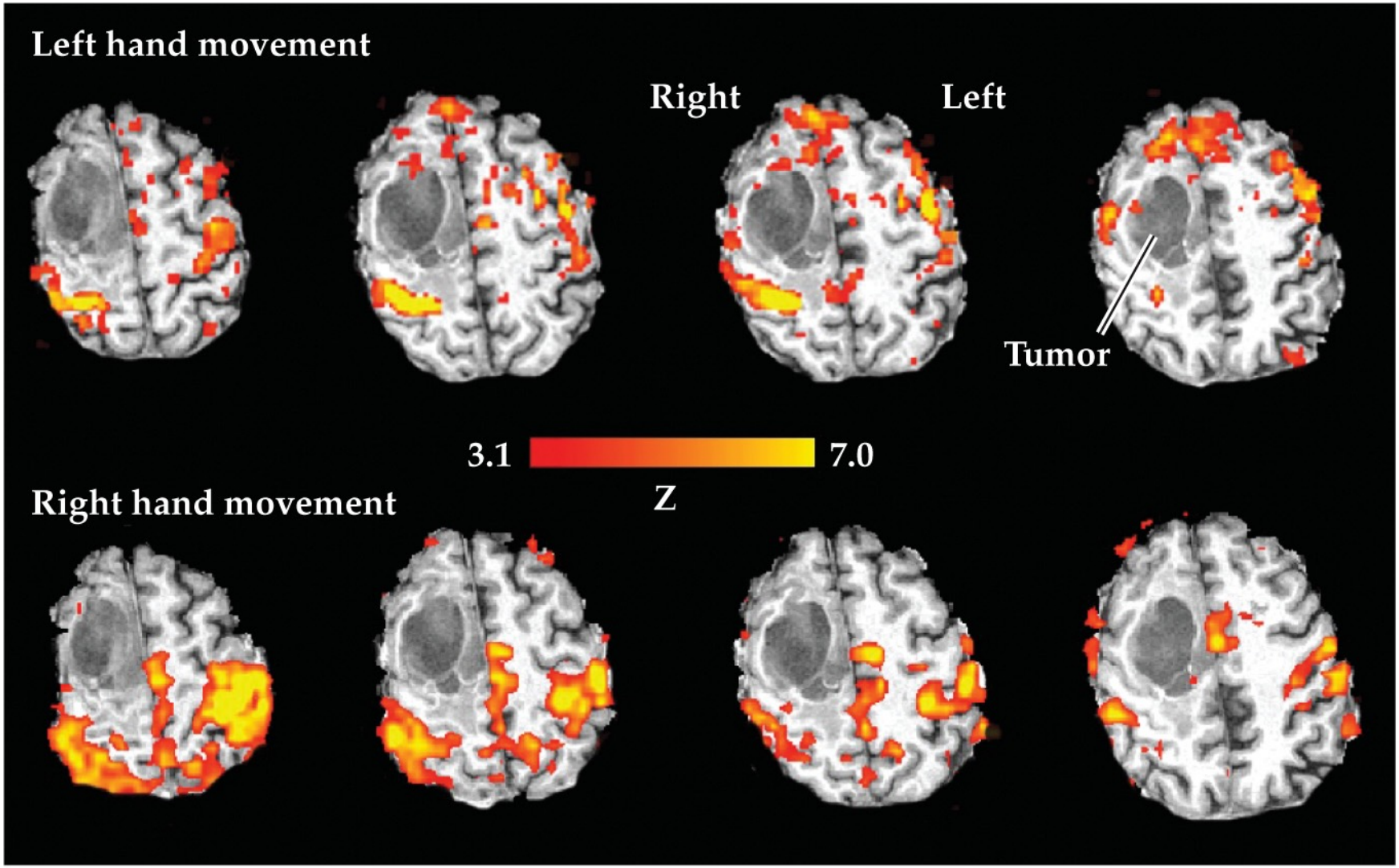


(C)

B, C from Seiger et al. (2015) *Neuroimage* 113: 207–216.

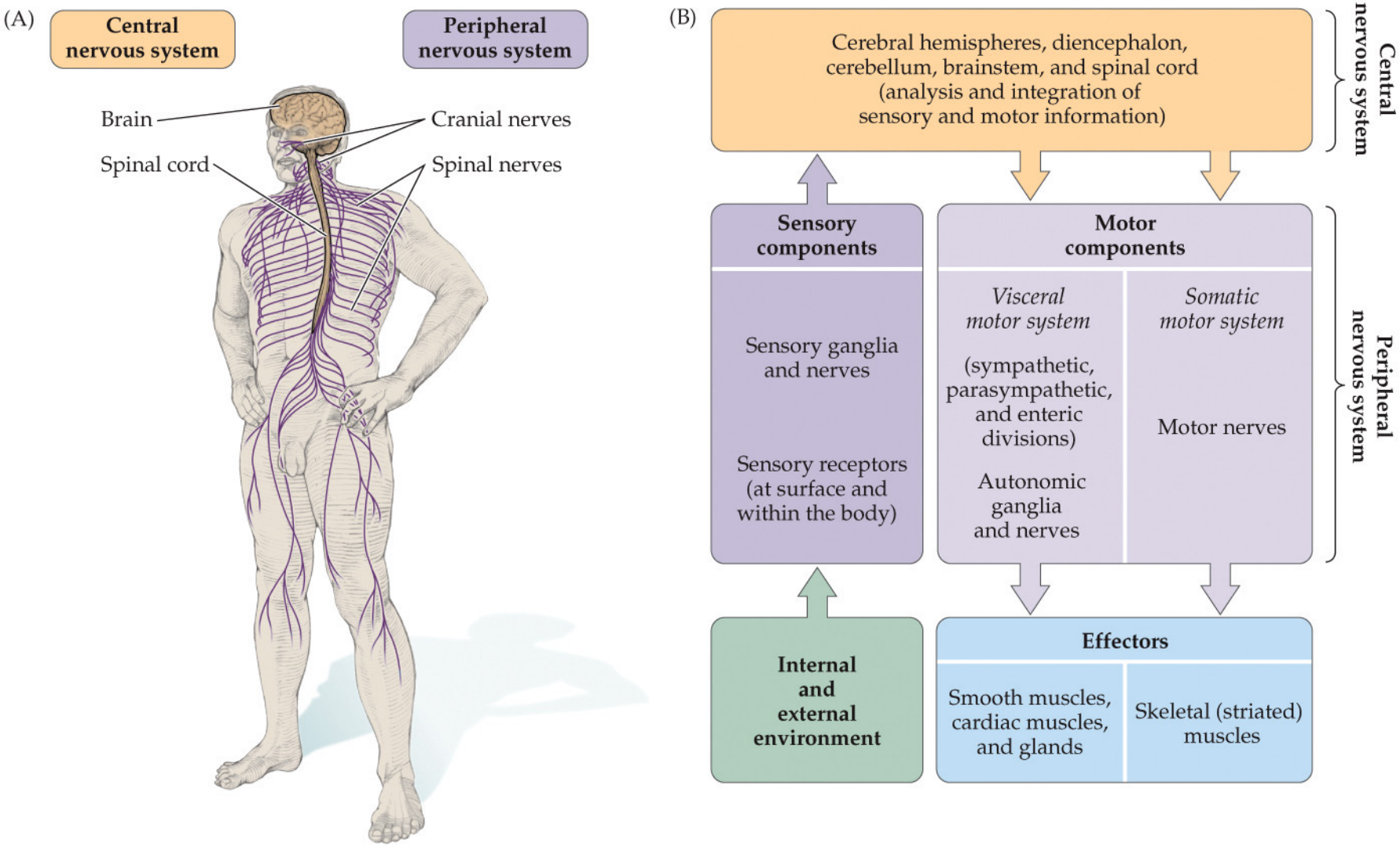
***NEUROSCIENCE 6e*, Figure 1.20**

In vivo Functional Brain Imaging

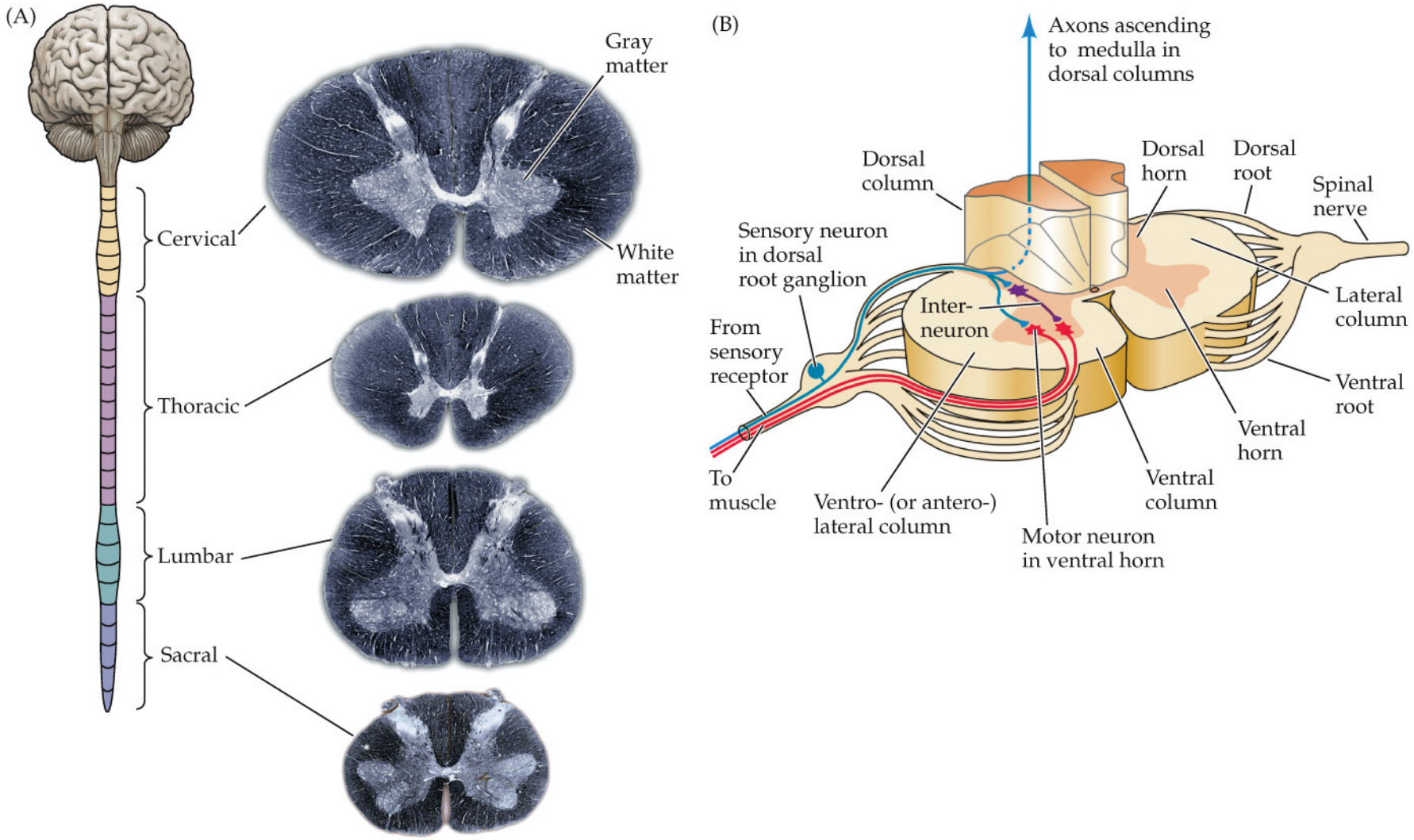


From Goodyear and Mosher (2014). *InTech*. doi: 10.5772/58270.

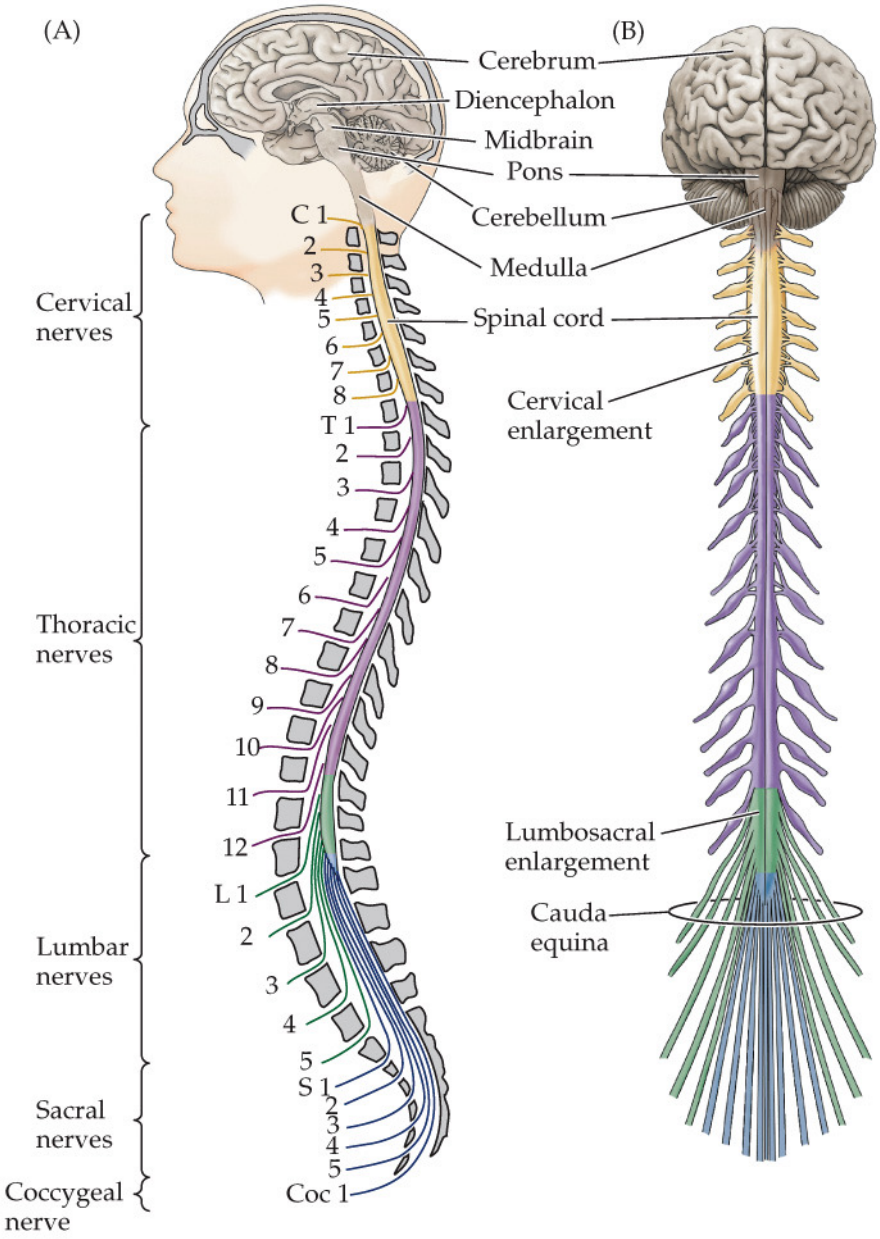
NEUROSCIENCE 6e, Figure 1.21



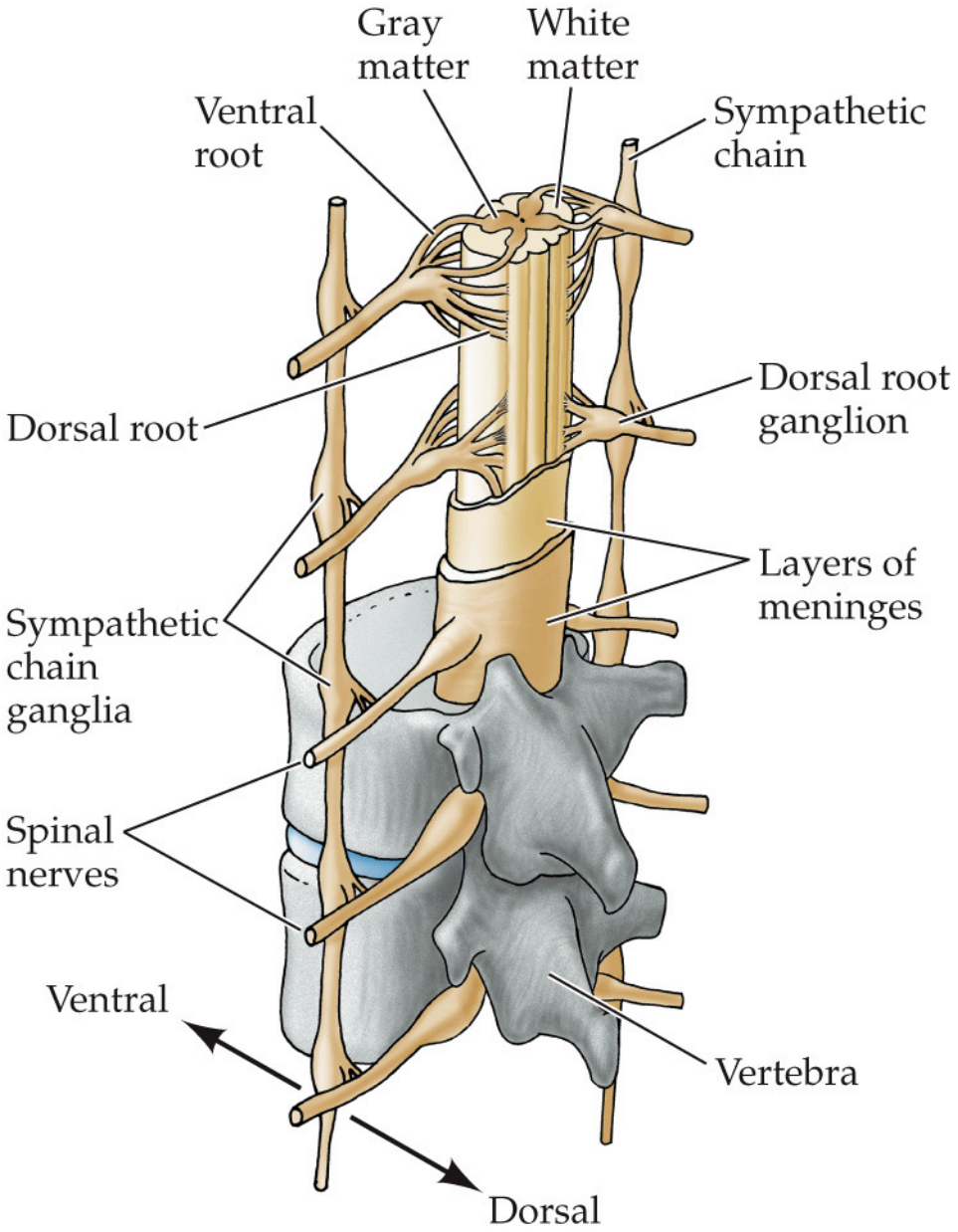
NEUROSCIENCE 6e, Figure 1.12



NEUROSCIENCE 6e, Figure A6

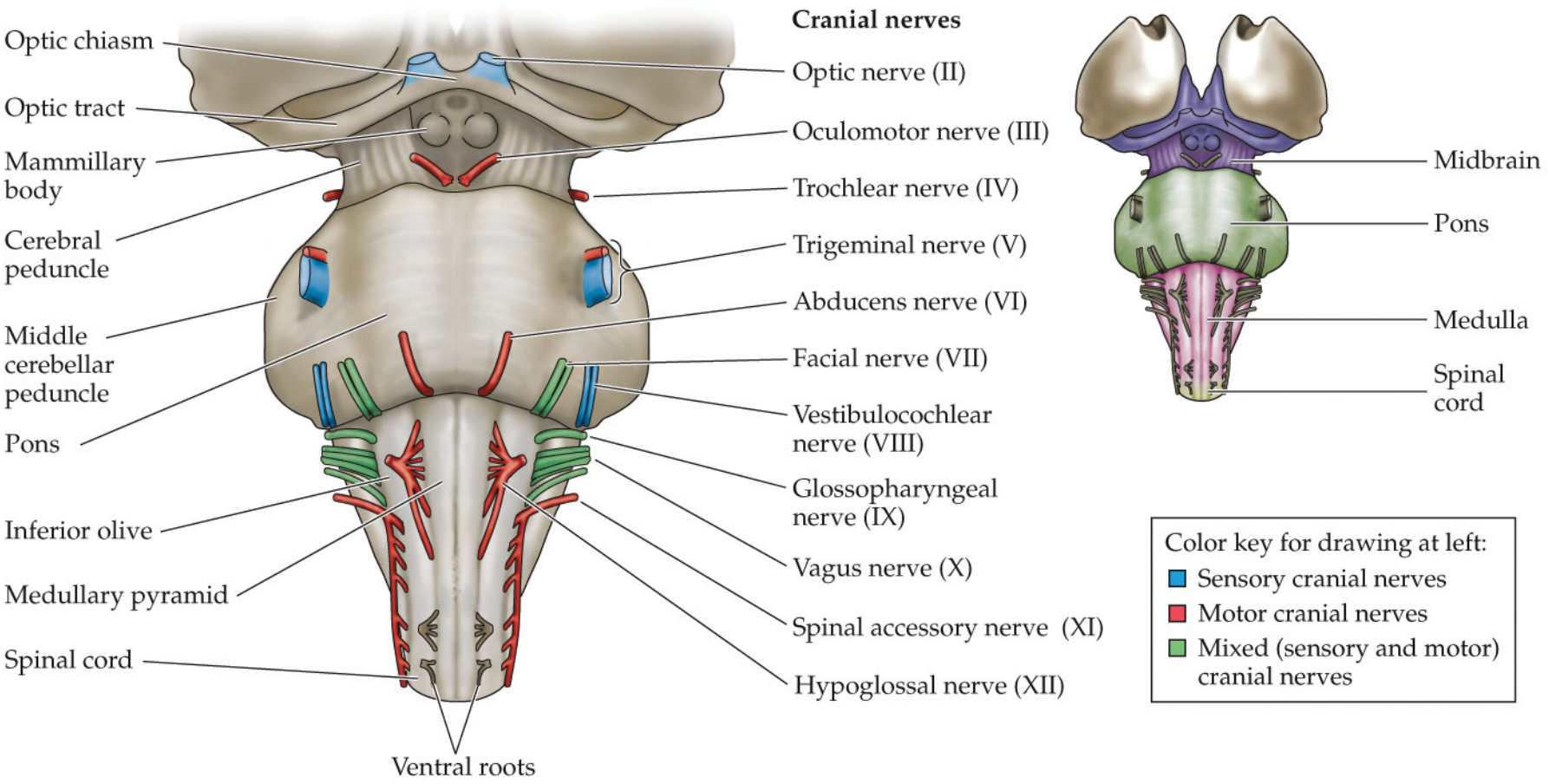


***NEUROSCIENCE 6e*, Figure A3**



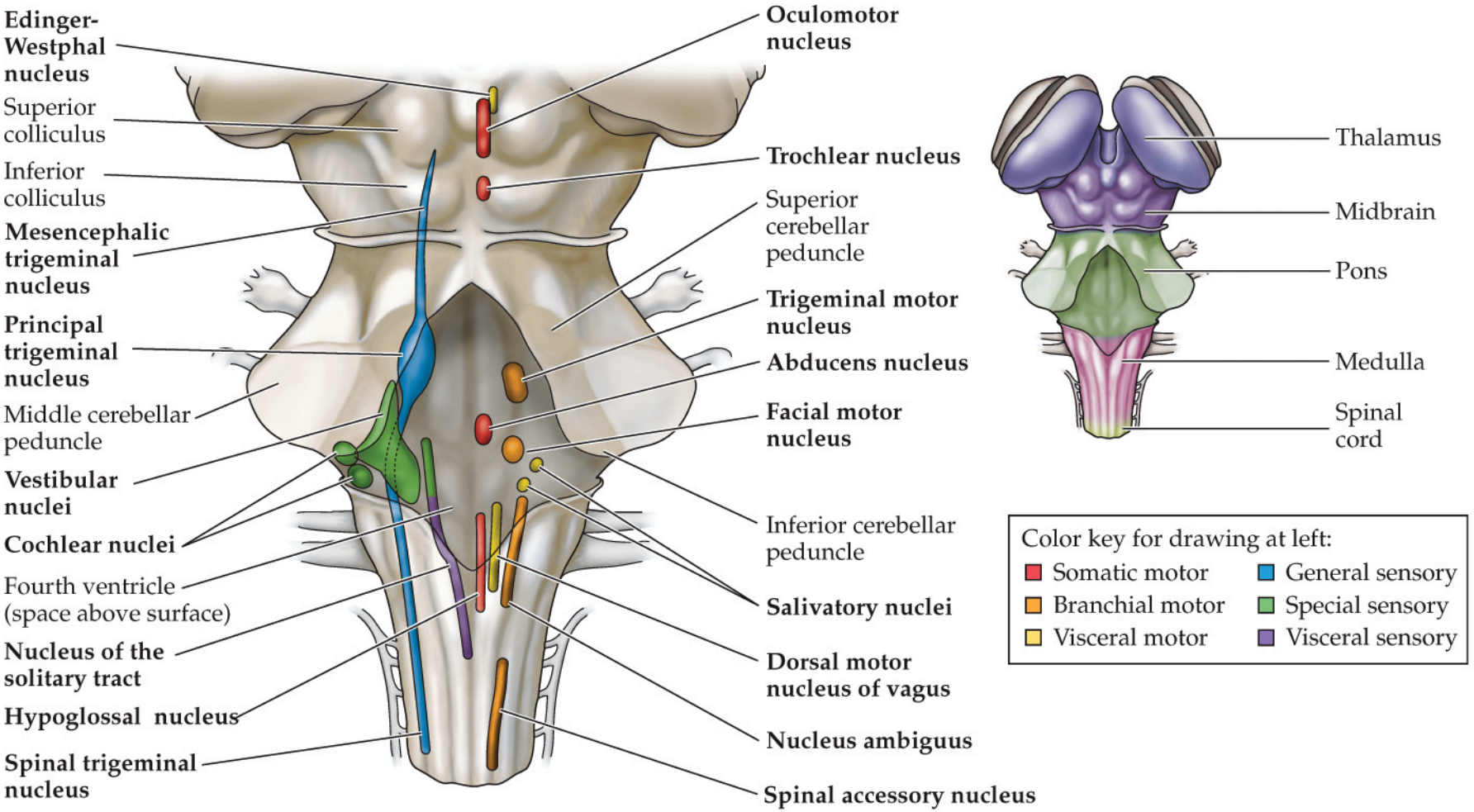
NEUROSCIENCE 6e, Figure A5

Cranial nerves of the brainstem



NEUROSCIENCE 6e, Figure A8

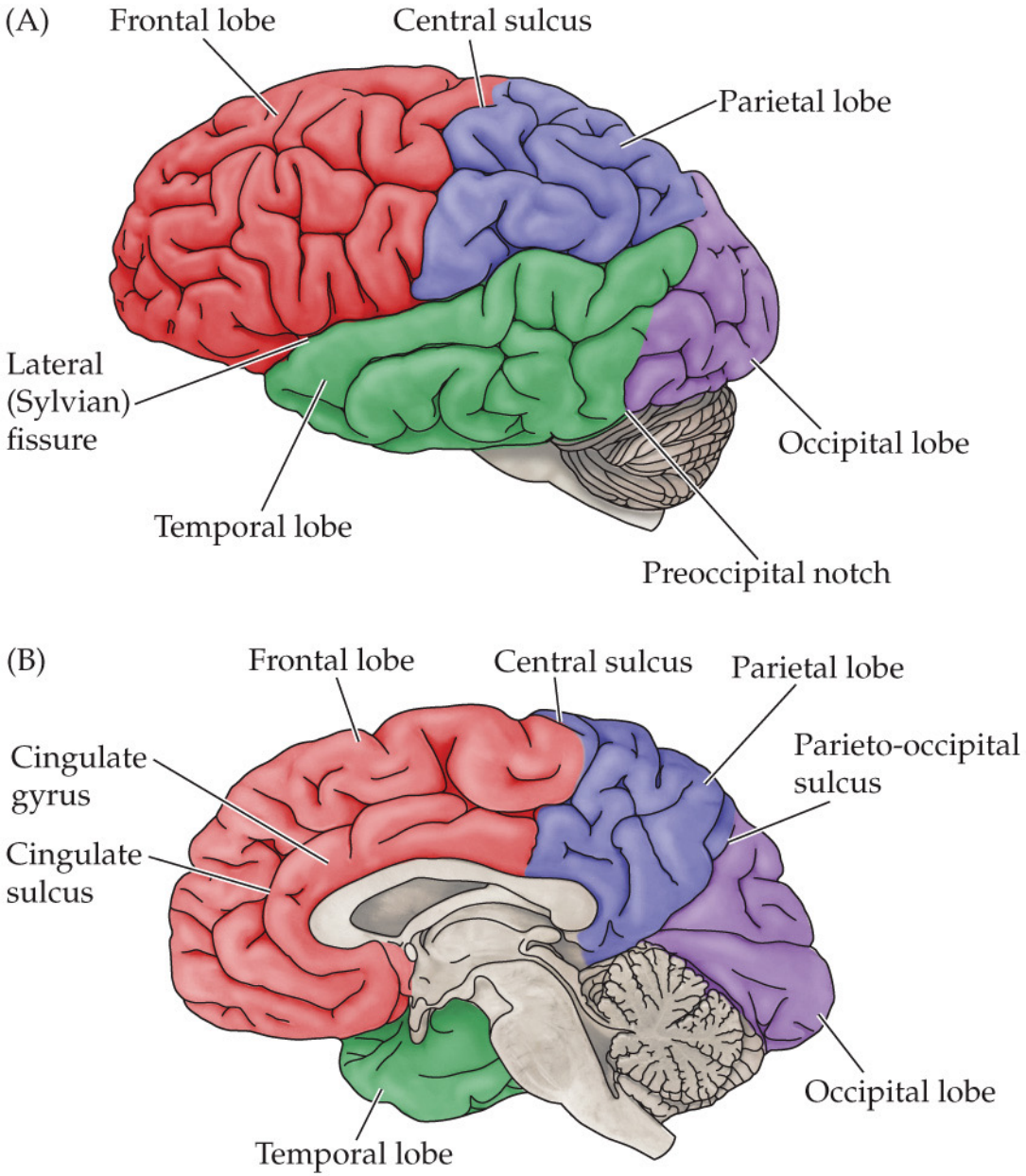
Cranial nerve nuclei of the brainstem



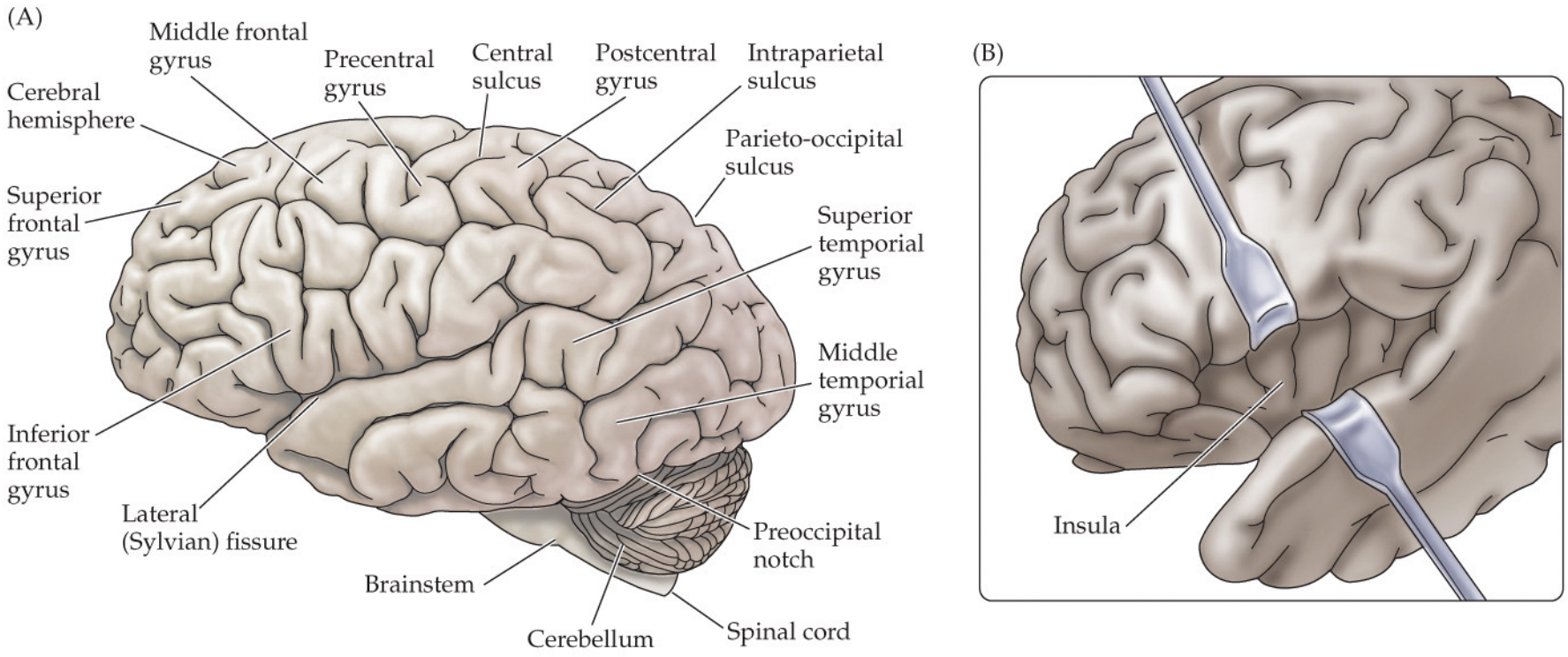
NEUROSCIENCE 6e, Figure A9

Terminology

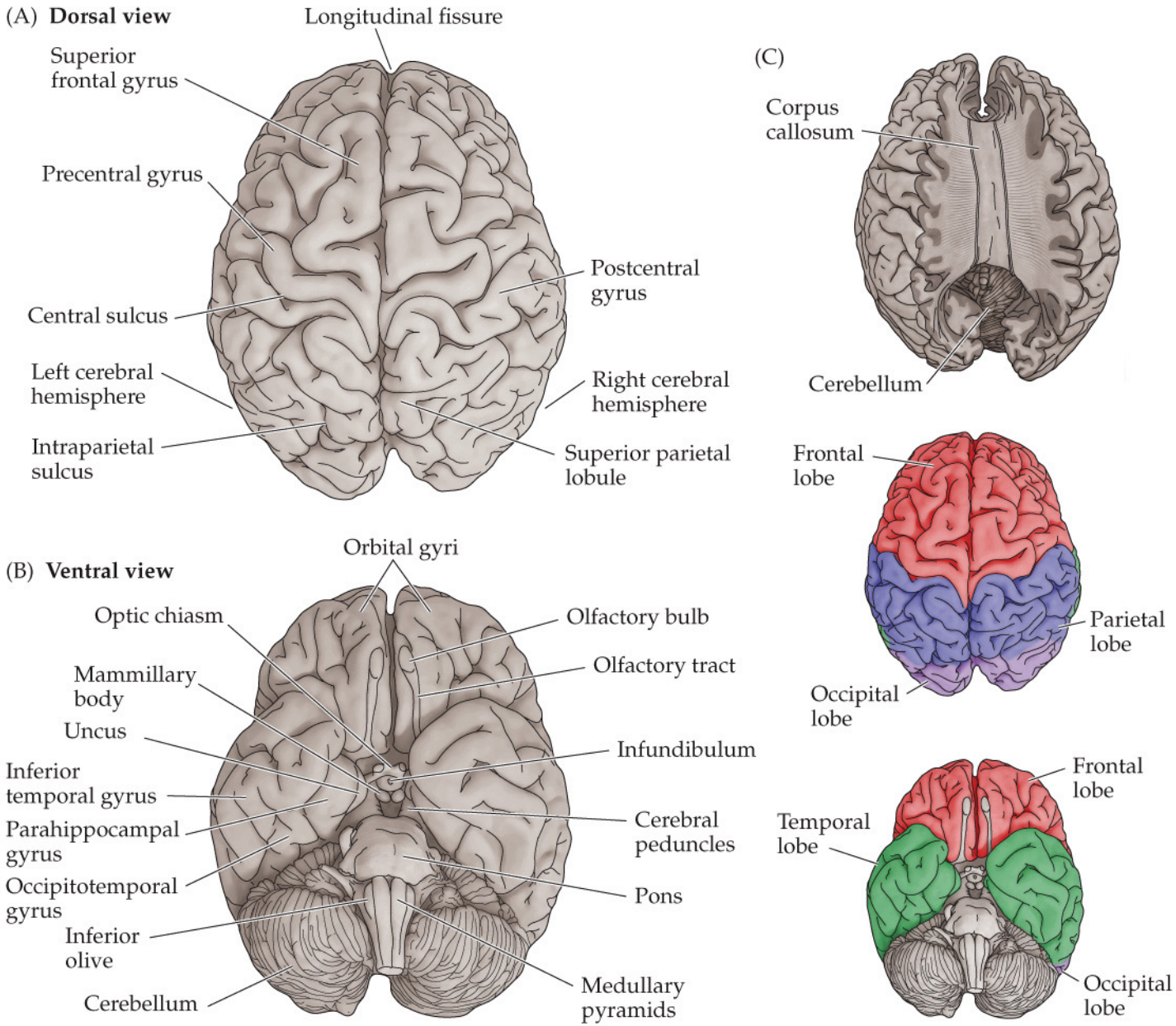
- Ganglion: Collections of hundreds to thousands of neuronal cell bodies found outside the CNS along the course of peripheral nerves
- Nucleus: Collections of hundreds to thousands of neuronal cell bodies found inside the CNS



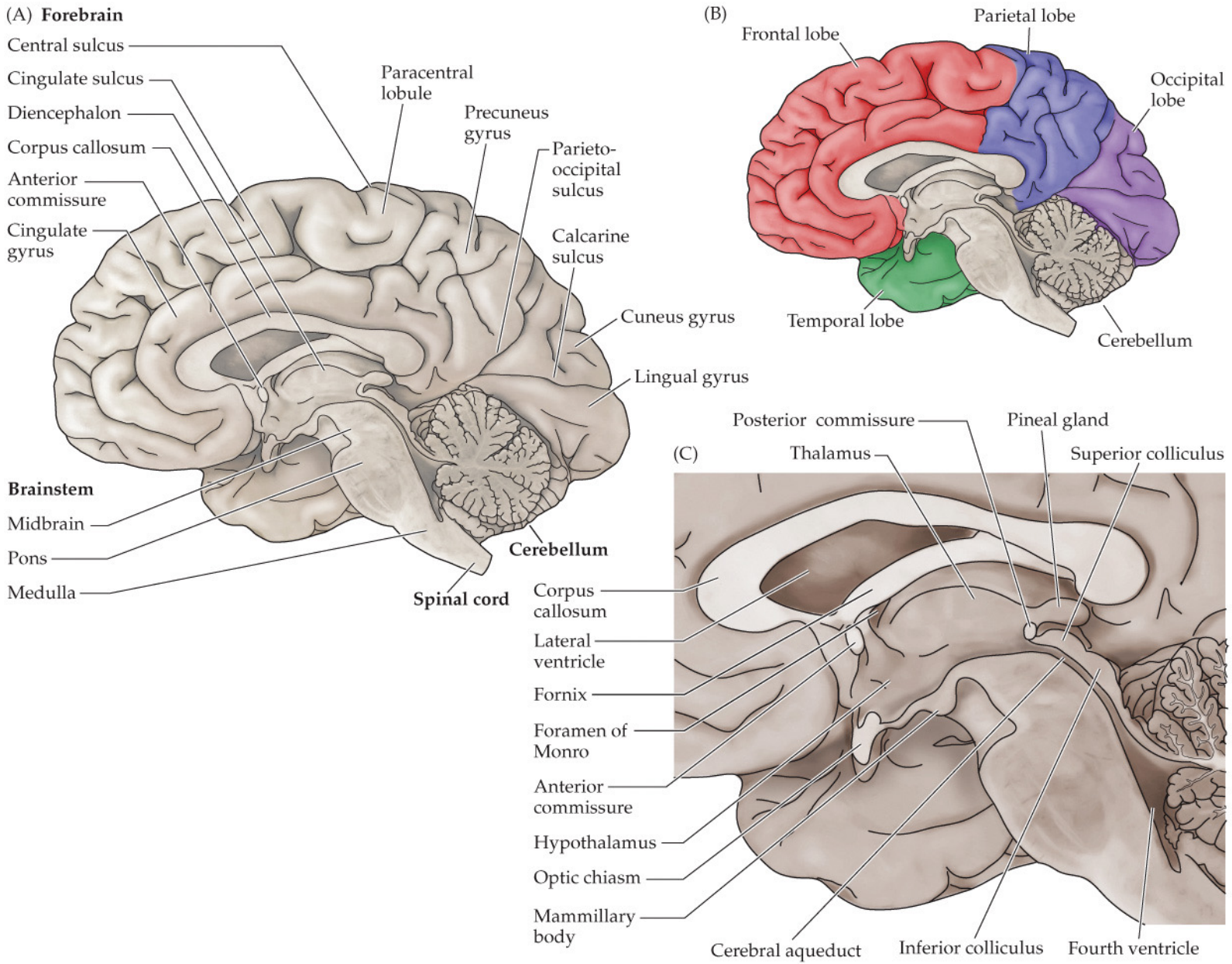
NEUROSCIENCE 6e, Figure A4



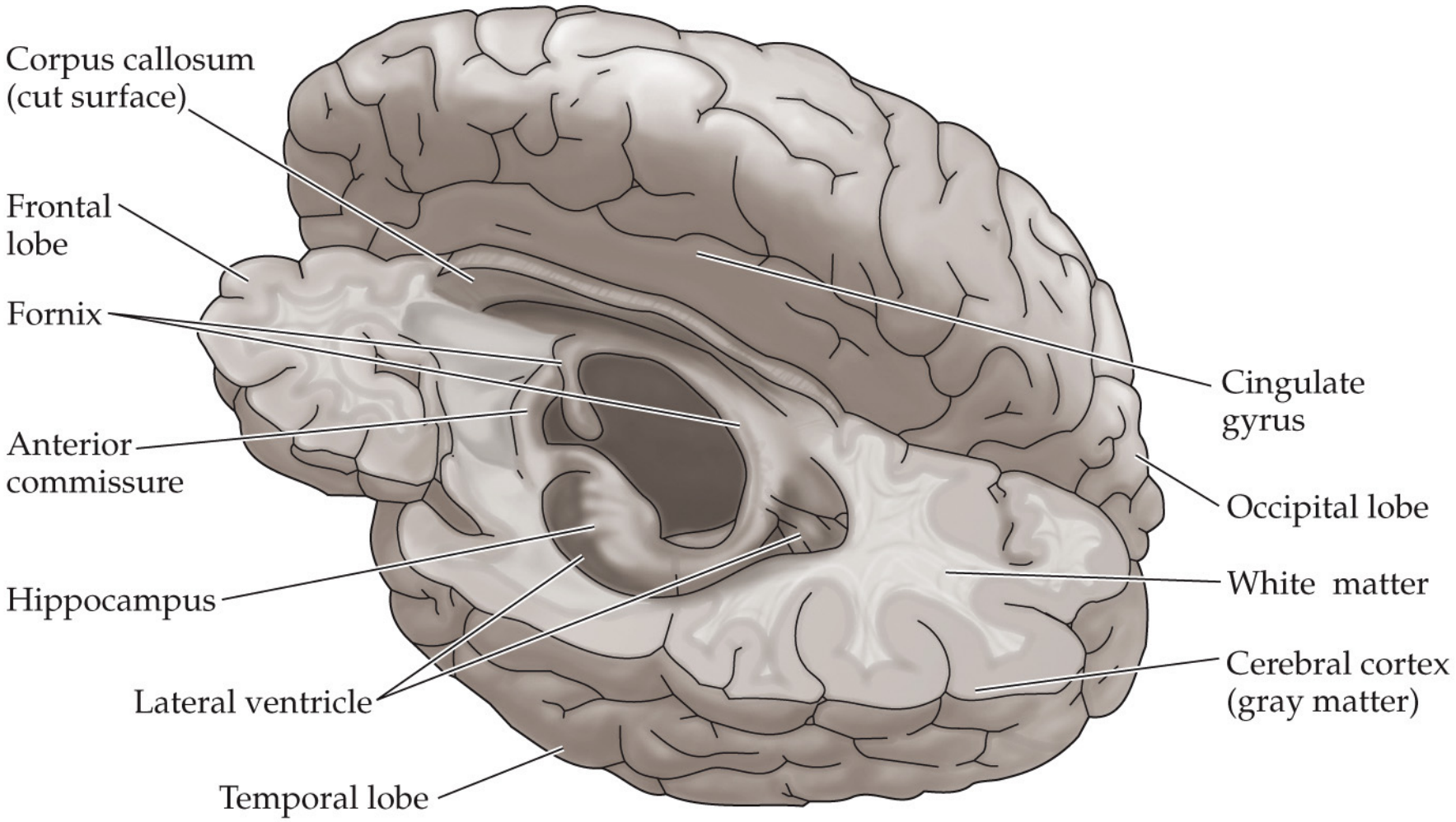
NEUROSCIENCE 6e, **Figure A12**



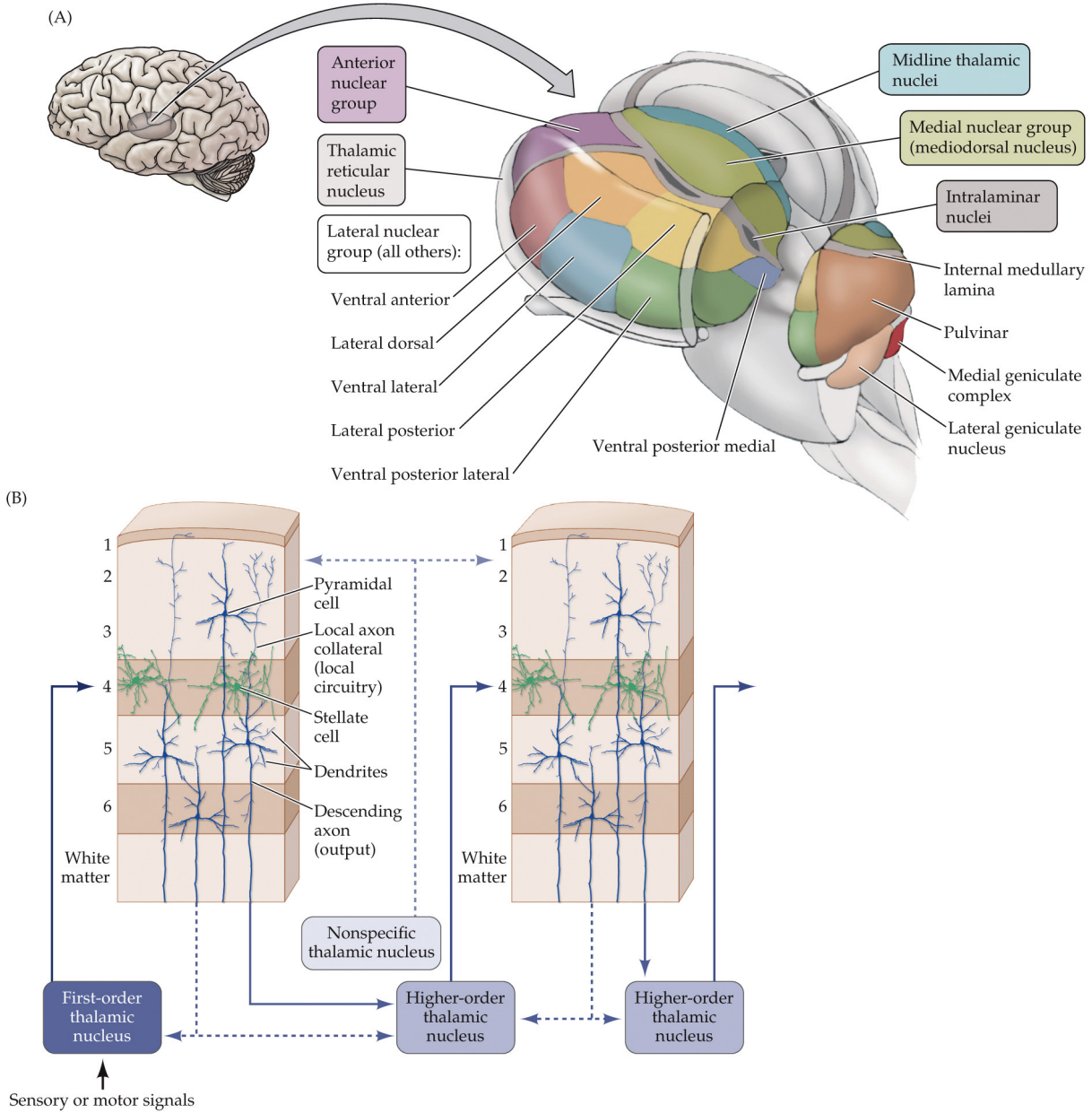
NEUROSCIENCE 6e, Figure A13



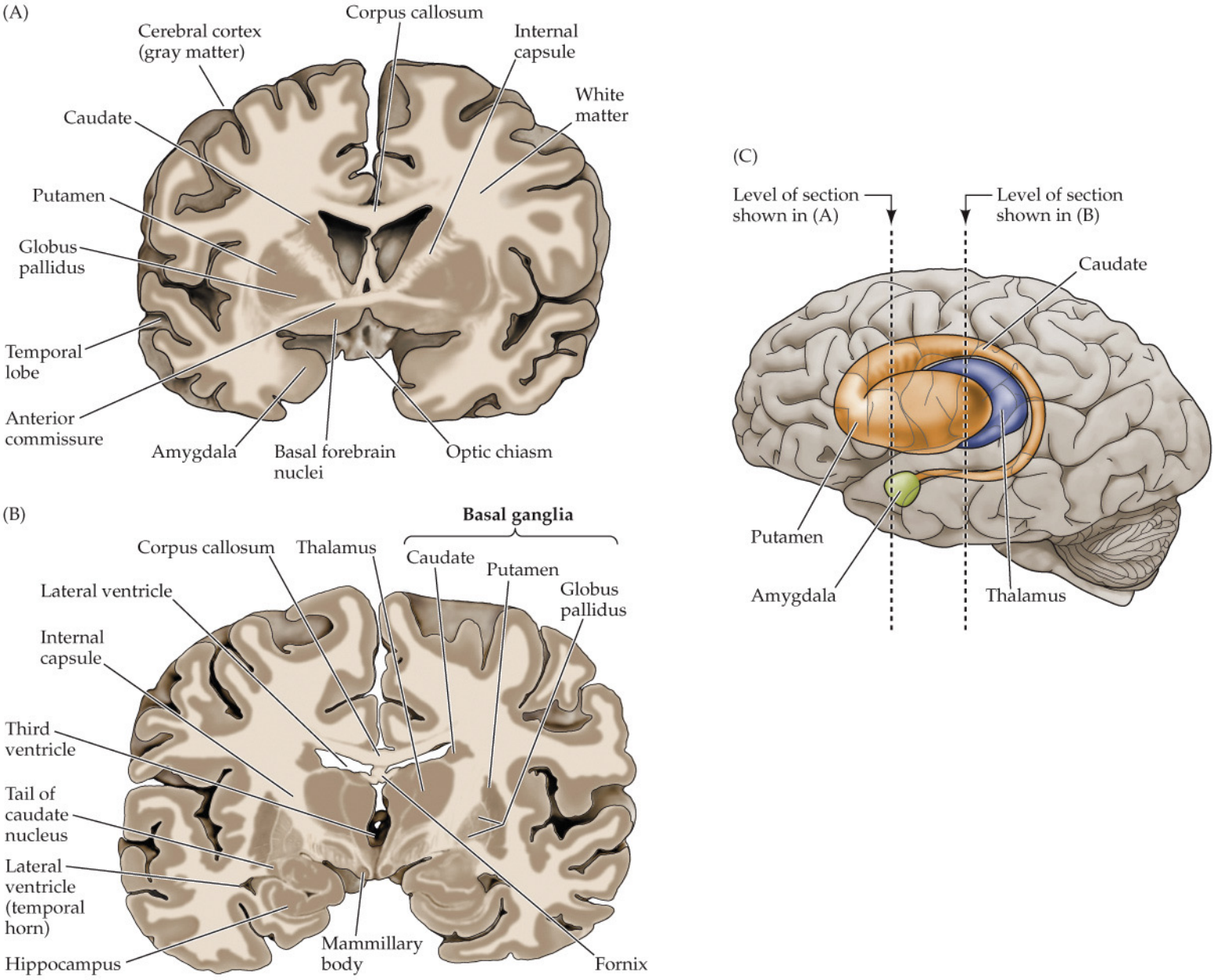
NEUROSCIENCE 6e, Figure A14



NEUROSCIENCE 6e, Figure A15



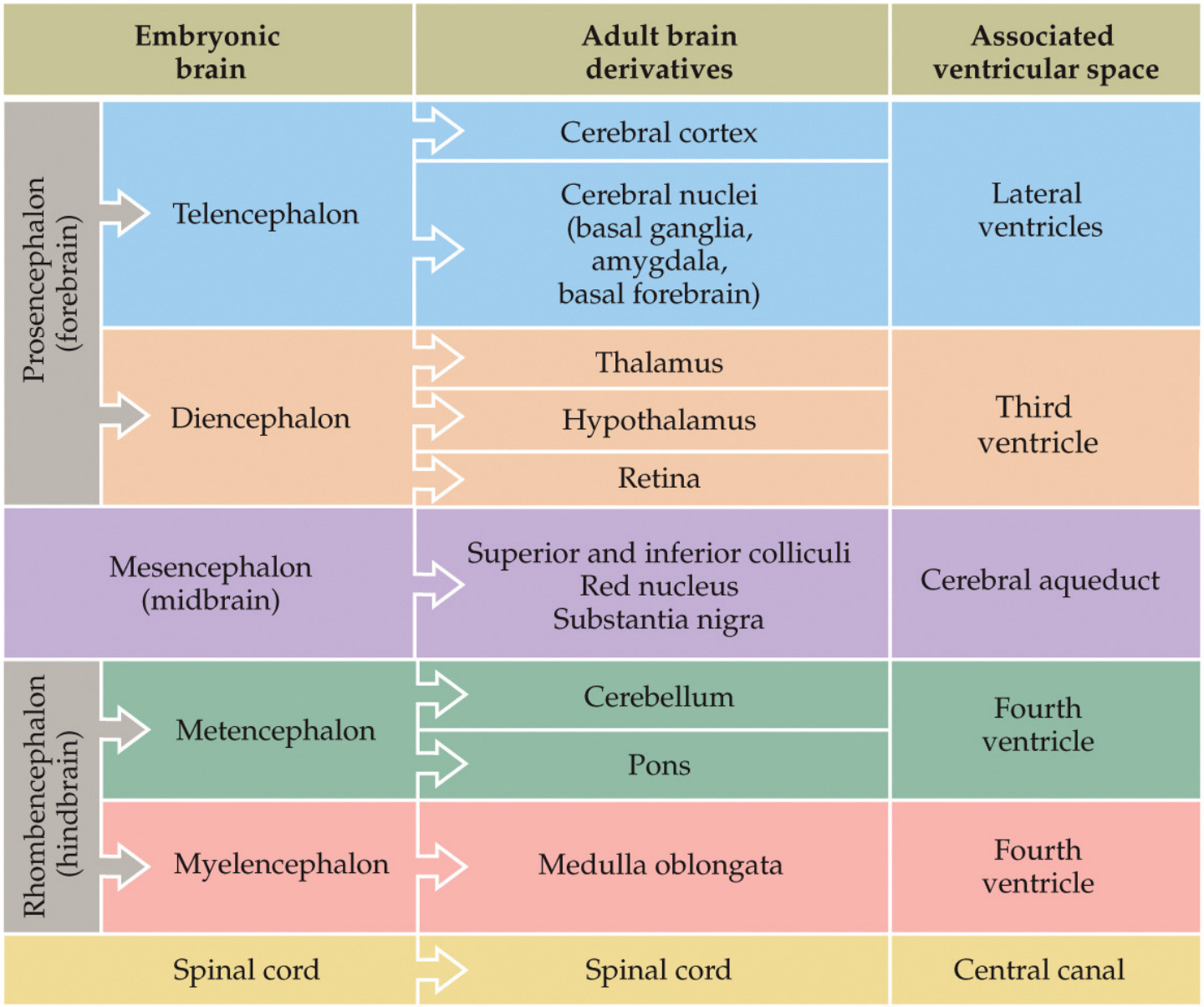
NEUROSCIENCE 6e, Box A



***NEUROSCIENCE 6e*, Figure A16**

Divisions of the CNS

- Cerebrum
  - cerebral hemispheres, basal ganglia, etc.
- Diencephalon
  - Thalamus, hypothalamus, retina, etc.
- Midbrain
  - Inferior and superior colliculi, etc.
- Pons
- Cerebellum
- Medulla
- Spinal cord



NEUROSCIENCE 6e, Figure A2

Recap

- CNS, PNS, Cranial nerves, Spinal nerves
- Cerebrum (Cerebral hemispheres), Diencephalon, Cerebellum, Brainstem (Midbrain, Pons, Medulla), Spinal Cord
- Cervical nerves, Thoracic Nerves, Lumbar Nerves, Sacral Nerves, Coccygeal Nerves
- Gray Matter, White Matter
- Dorsal, Ventral, Anterior, Posterior, Caudal, Rostral, Inferior, Superior, Coronal, Horizontal, Sagittal, Transverse