Structure of the Nervous System

Ipsilateral — Two structures that are on the same side of the midline

Contralateral — Two structures that are on opposite sides of the midline

Decussate or Decussation — To cross the midline of the body.

— place where axons cross the midline

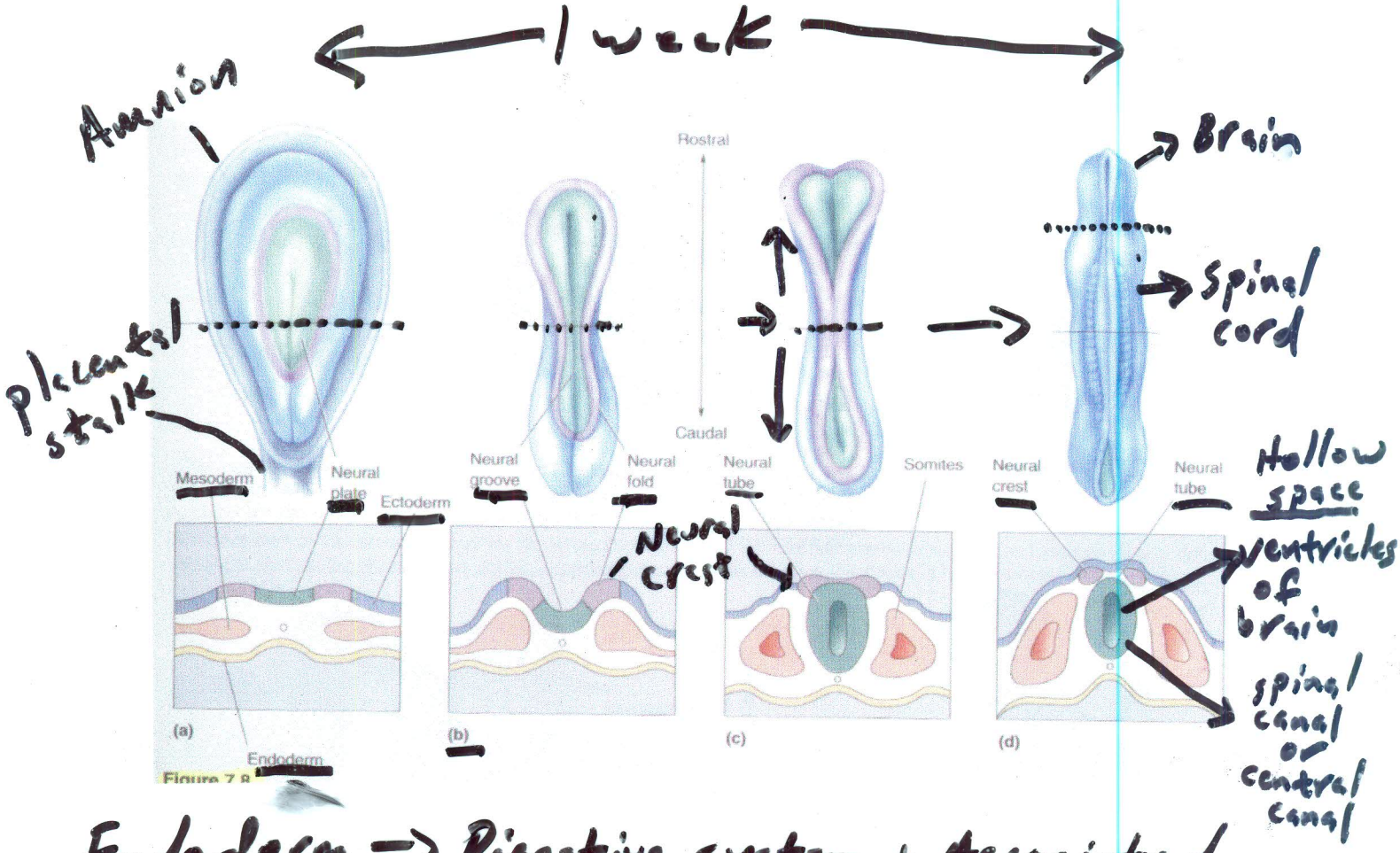
Two major anatomical divisions of Nervous System:

- Central Nervous system (CNS)
  Brain + spinal cord
- Peripheral Nervous system (PNS)
  - Ganglia

- Nerves
  bundles of axons that have their soma in the CNS or in ganglia of the PNS
- Sensory structures
  - eyes, & ears
- Receptors
  - separate sensory cells (ex. taste bud cells)
  - free nerve endings (ex. pain receptors)

Development of CNS begins 3-4 wks after fertilization of the egg

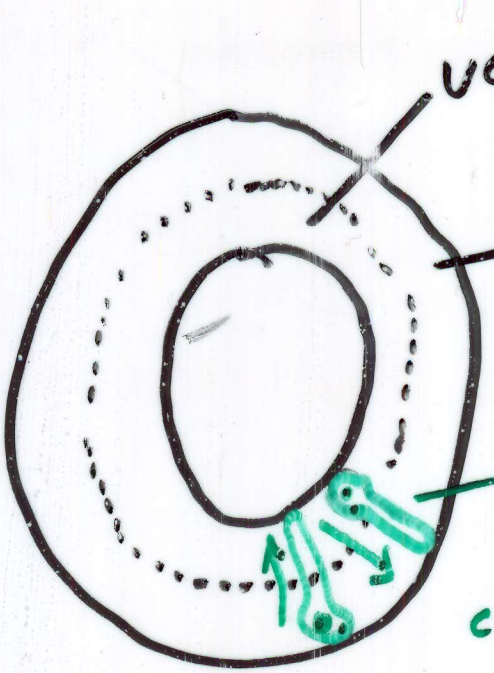
Neurulation - process of nervous system development



Endoderm → Digestive system + Associated structures

Mesoderm → Muscles, bones, + circulatory system

Ectoderm → Skin, and Nervous system



cell body migrates out into marginal zone. DNA duplicates during migration of the cell body.

During migration of the precusor cell body back into ventricular zone the cell undergoes cell division, to produce two daughter cells.

Vertical cell division → two new precusor cells are result

Horizontal cell division → one daughter cell remains a precursor cell

the other cell will differentiate into a neuron or glial cell.

Spinal cord development

Dorsal column – composed of axons that carry somatic sensory information up to the brain. Ex. sense of touch

Lateral & Ventral columns – composed, in part, of axons coming down from the brain to synapse on motor neurons in the ventral horns.

And, in part, of axons that carry sensory information (ex. pain) from the body up to the brain.

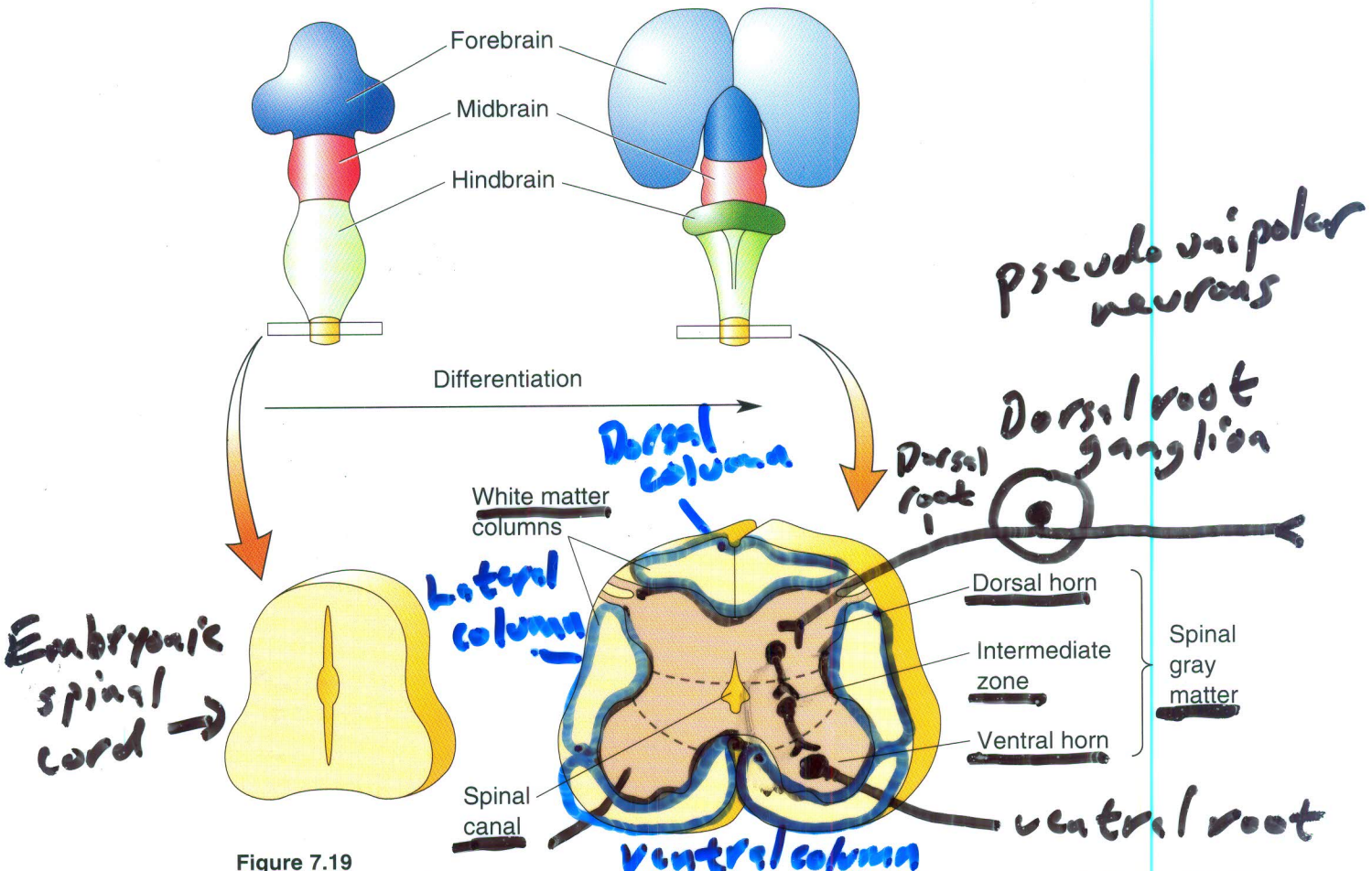


Figure 7.19
Differentiation of the spinal cord. The butterfly-shaped core of the spinal cord is gray matter, divisible into dorsal and ventral horns, and an intermediate zone. Surrounding the gray matter are white matter columns running rostrocaudally, up and down the cord. The narrow CSF-filled channel is the spinal canal. (Drawings are not to scale.)

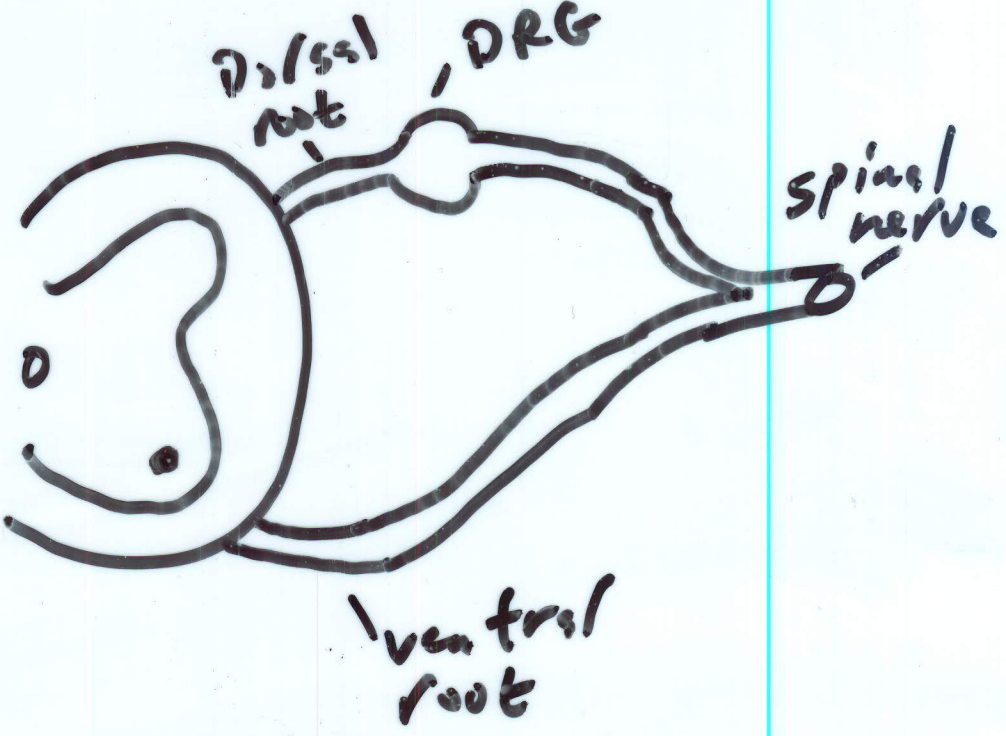
Ventral horn - comprised of motor neurons that send their axons out to innervate somatic muscles

Dorsal horn - neuron that receive sensory inputs from the PNS

Intermediate Zone - comprised of interneurons

Human spinal cord is composed of 30 spinal segments + 1 coccygeal segment

Each spinal segment has a pair of dorsal root ganglia + a pair ventral roots



Each spinal segment innervates a specific region of the body called a dermatome

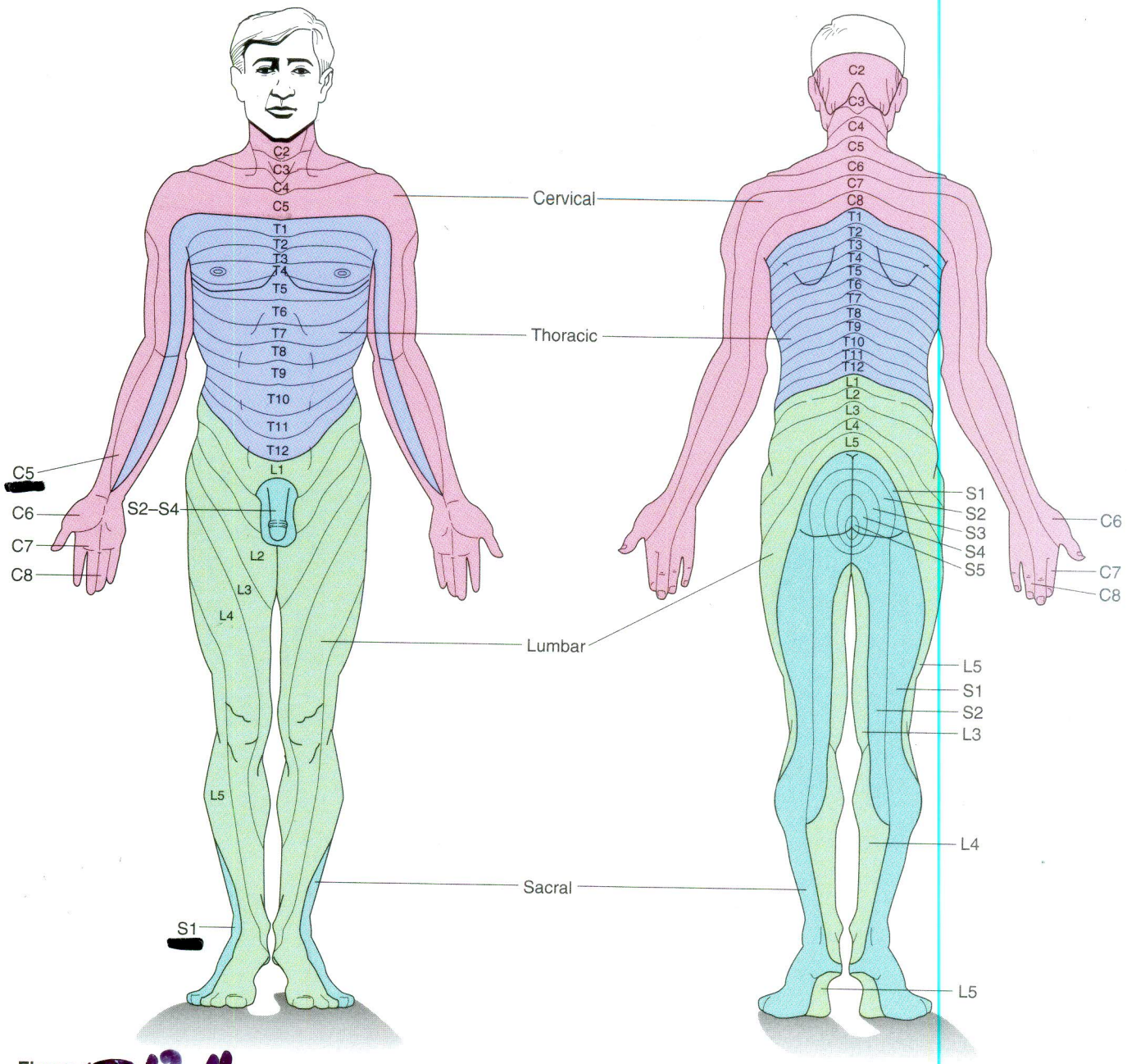


Figure 12.11
Dermatomes. This map shows the approximate boundaries of the dermatomes.

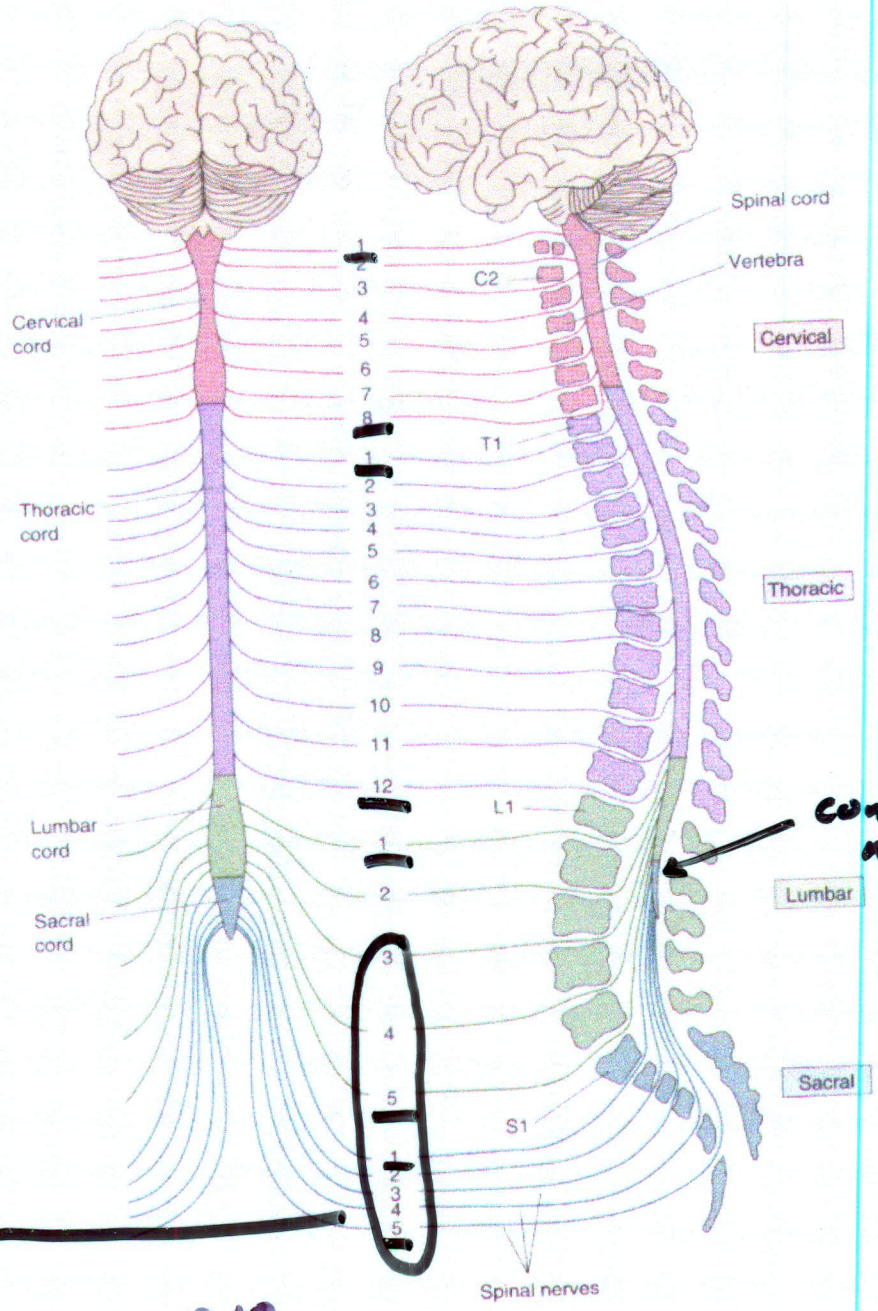


Figure 12.10
Segmental organization of the spinal cord. The spinal cord is divided into cervi-

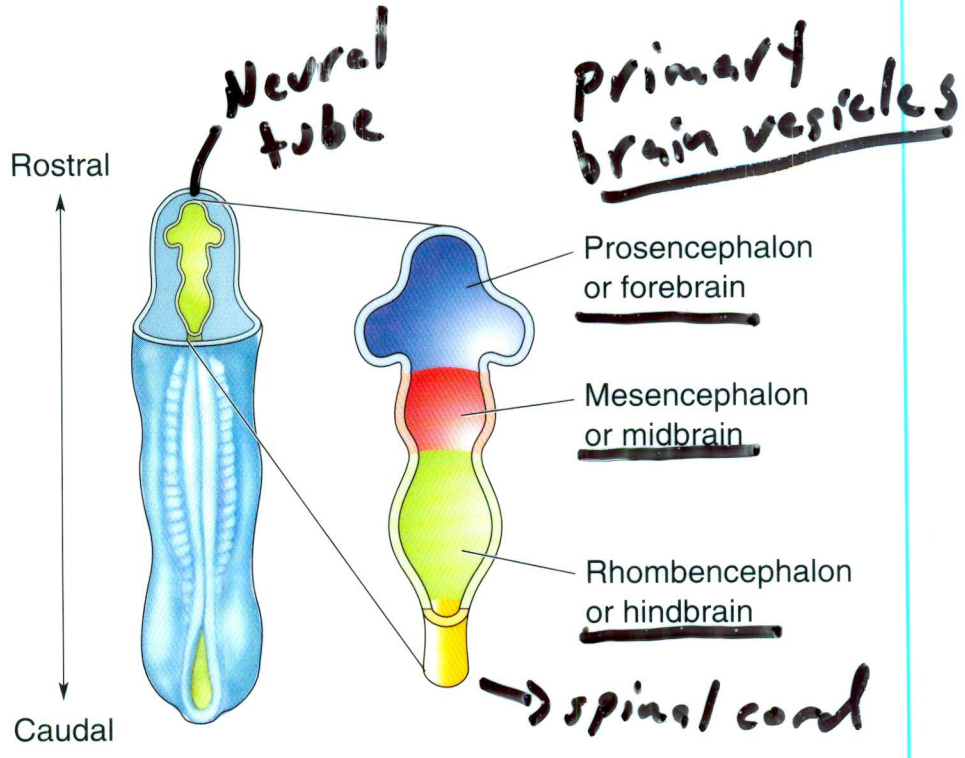


Figure 7.9
The three primary brain vesicles. The rostral end of the neural tube differentiates to form the three vesicles that will give rise to the entire brain. This view is from above, and the vesicles have been cut horizontally so that we can see the inside of the neural tube.

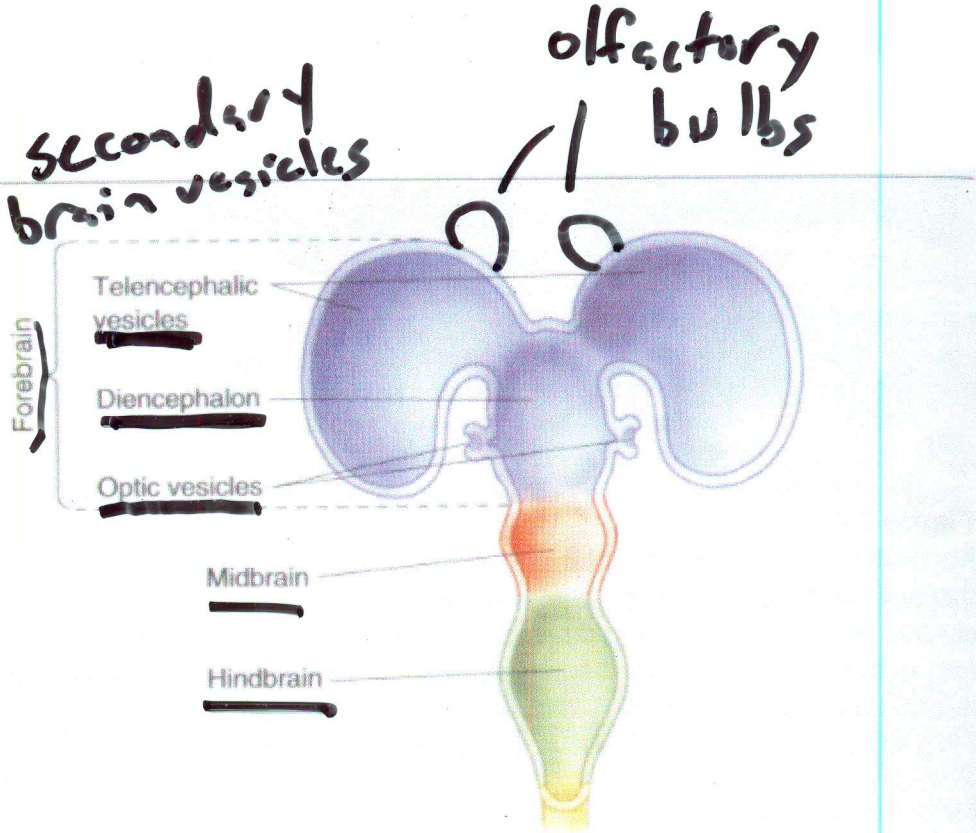


Figure 7.10
The secondary brain vesicles of the forebrain. The forebrain differentiates into the paired telencephalic and optic vesicles, and the diencephalon. The optic vesicles develop into the eyes.

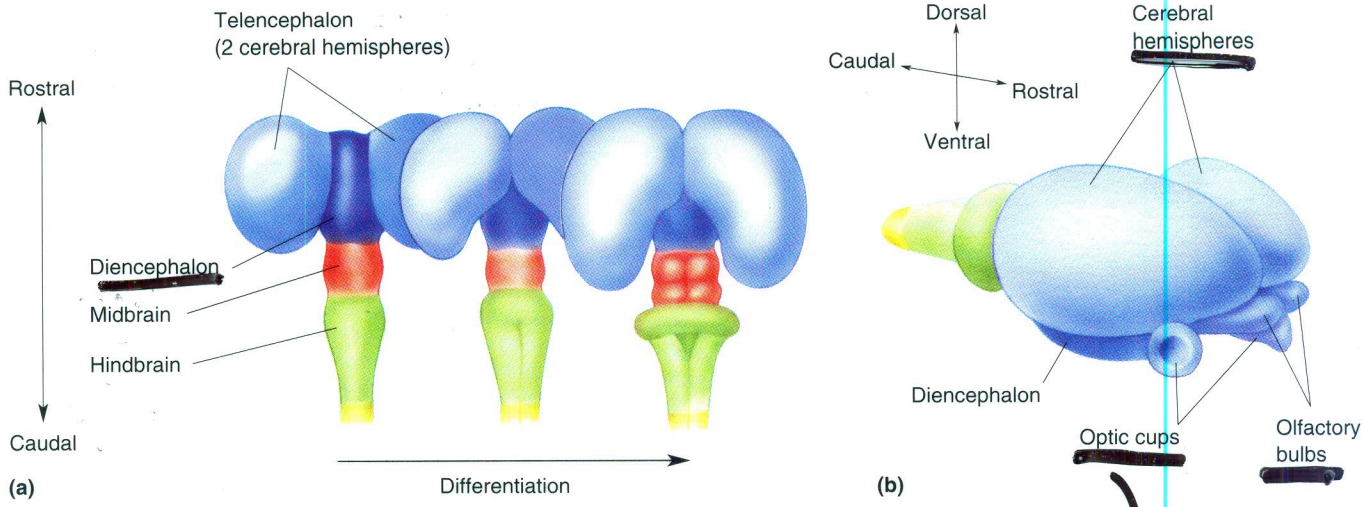


Figure 7.12
Differentiation of the telencephalon. (a) As development proceeds, the cerebral hemispheres swell and grow posteriorly and laterally to envelop the diencephalon. **(b)** The olfactory bulbs sprout off the ventral surfaces of each telencephalic vesicle.

Retina + optic nerves

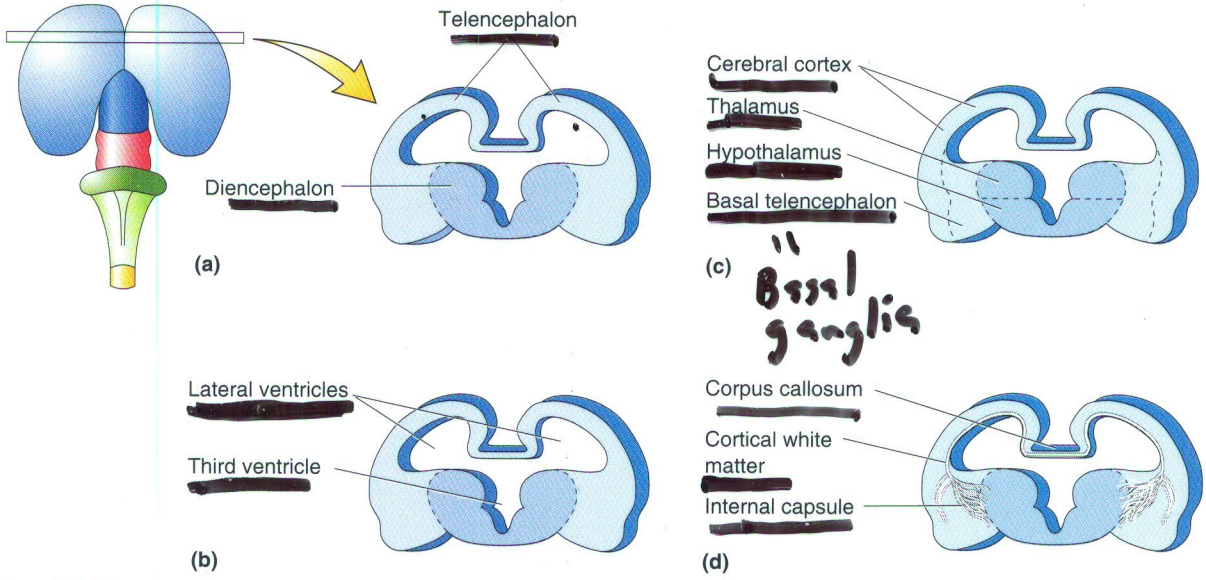


Figure 7.13
Structural features of the forebrain. **(a)** A coronal section through the primitive forebrain, showing the two main divisions: the telencephalon and the diencephalon. **(b)** Ventricles of the forebrain. **(c)** Gray matter of the forebrain. **(d)** White matter systems of the forebrain.

Cortical white matter – comprised of axons that connect the neurons within the same cerebral hemisphere

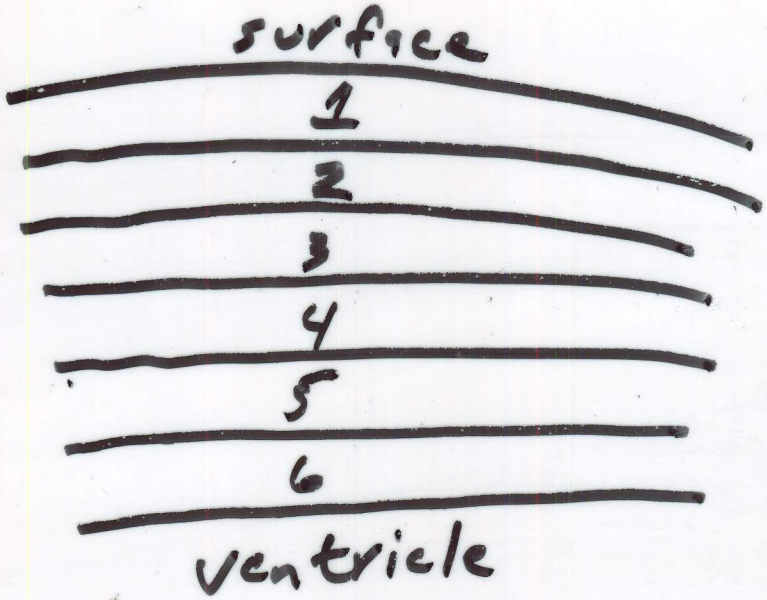
Corpus callosum – comprised of axons that connect the neurons in one cerebral hemisphere with neurons in the other cerebral hemisphere

Internal capsule – comprised of axons that connect neurons in the cerebral hemispheres with neurons in the lower parts of the CNS.

Cerebral hemispheres develop into cerebral cortex

Most of the cerebral hemispheres is composed of Isocortex or Neocortex (only found in mammals)

Has 6 layers of neurons



Hippocampal cortex = Hippocampus or Hippocampal formation

composed of a single layer of neurons.

Olfactory cortex – composed of two layers of neurons.

Thalamus – composed of neurons that relay sensory info from the body to the neurons in the isocortex.

Hypothalamus – controls & coordinates involuntary functions of the body.
Ex. Regulation of body temp., behavioral drives (hunger, thirst, etc.)

Also controls release of hormones from the pituitary gland.

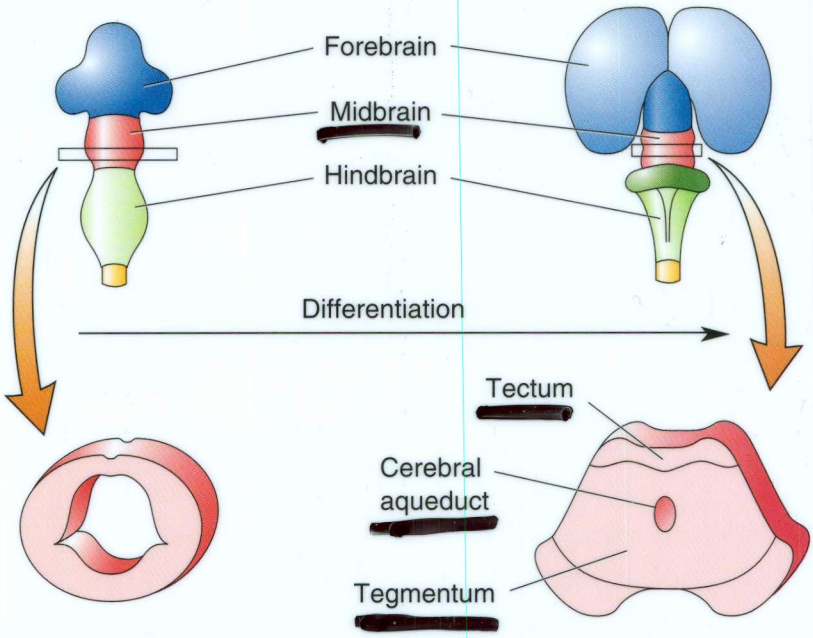
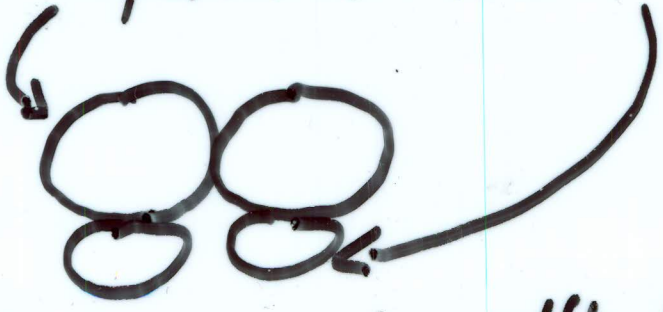


Figure 7.15
Differentiation of the midbrain. The midbrain differentiates into the tectum and the tegmentum. The CSF-filled space at the core of the midbrain is the cerebral aqueduct. (Drawings are not to scale.)

Tectum – Superior + inferior colliculi



Neurons in the superior colliculi mediate reflexes that direct your eye + head towards moving objects.

Neurons in inferior colliculi receive auditory inputs + mediate reflexes that turn your head + eyes toward

Figure 7.15

Sound stimuli

Tegmentum – composed of clusters of neurons that have wide connections throughout the CNS – comprise the diffuse modulatory systems.

Regulate overall activity of the neurons in the brain.

Thought to be related to Conciousness.

Rhombencephalon differentiates into

- Cerebellum
- Pons
- Medulla Oblongata

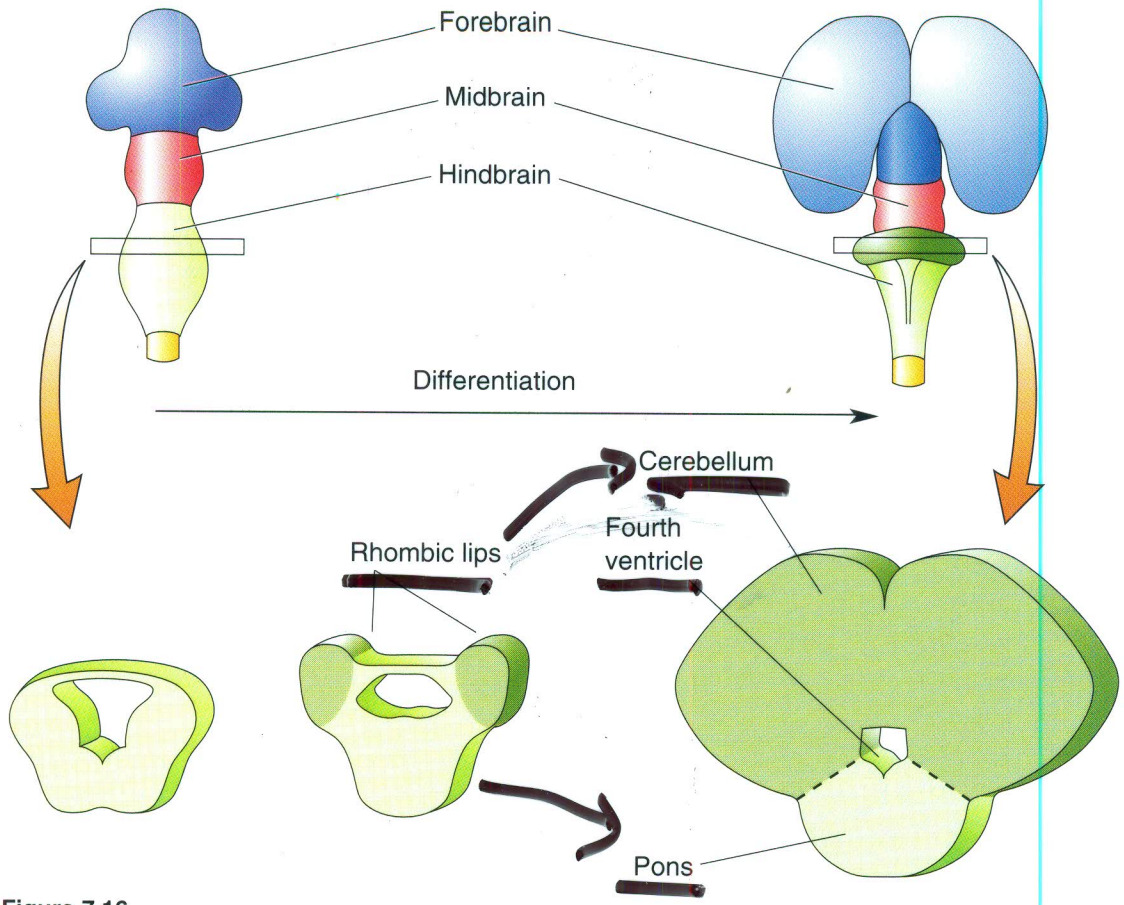


Figure 7.16
Differentiation of the rostral hindbrain. The rostral hindbrain differentiates into the cerebellum and pons. The cerebellum is formed by the growth and fusion of the rhombic lips. The CSF-filled space at the core of the hindbrain is the fourth ventricle. (Drawings are not to scale.)

Cerebellum – coordinates somatic muscle activity

Pons – axons going into the cerebellum or coming out of the cerebellum, and also has neural centers that relay information coming from

Figure 7.16

higher brain centers going into the cerebellum, and coming from the cerebellum and going to higher brain centers.

Medulla oblongata connects the spinal cord with the brain

Has 3 groups of neural centers:

- Relay centers - neural centers that receive inputs from neurons in the spinal cord + relay those inputs to higher brain centers, or vice versa

- Autonomic centers - neural centers that regulate breathing, blood pressure, + heart rate.

- Cranial nerve centers -

6 of the 12 cranial nerves have their neural centers in the medulla