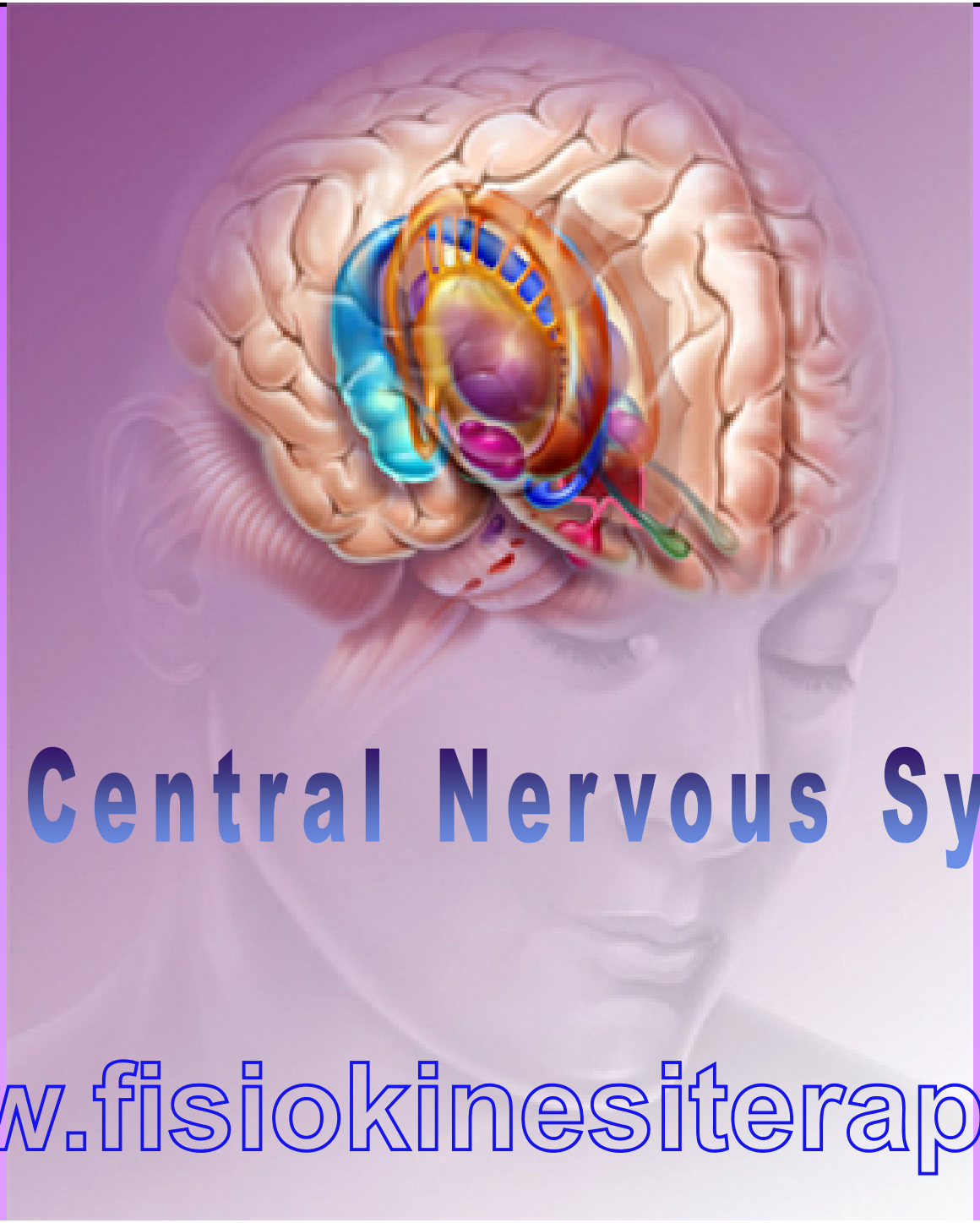
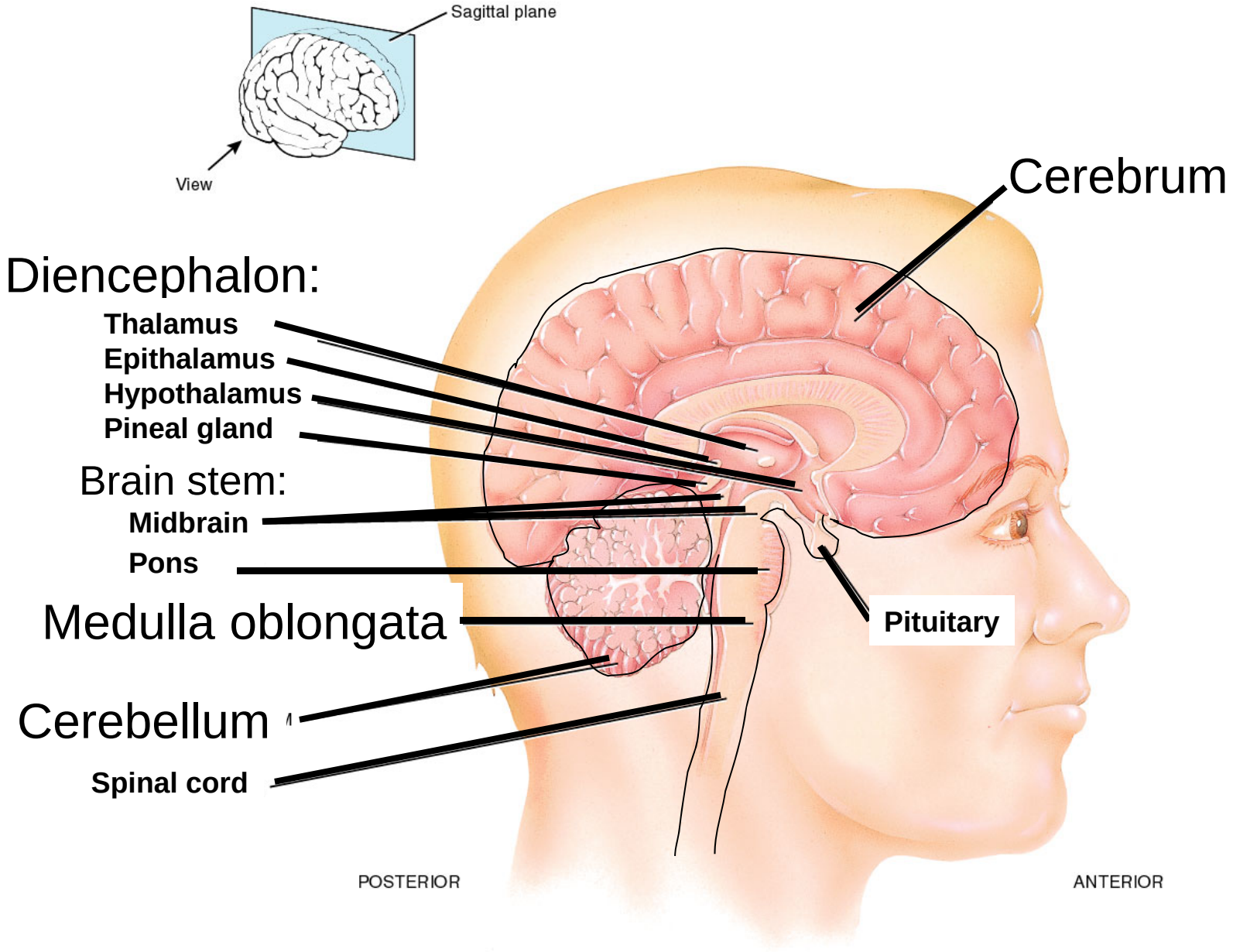


The Central Nervous System

www.fisiokinesiterapia.biz



(a) Sagittal section, medial view

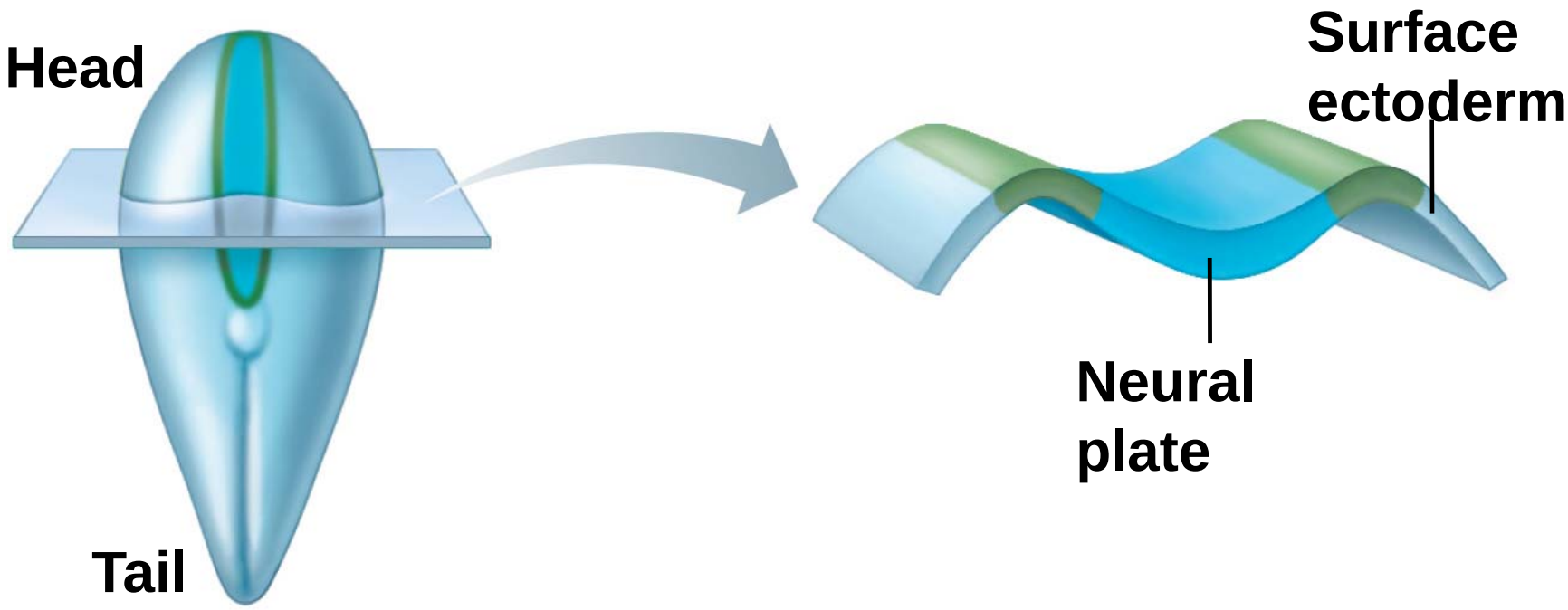
14.01a

Central Nervous System (CNS)

- CNS consists of the brain and spinal cord
- Cephalization
  - Evolutionary development of the rostral (anterior) portion of the CNS
  - Increased number of neurons in the head
  - Highest level is reached in the human brain

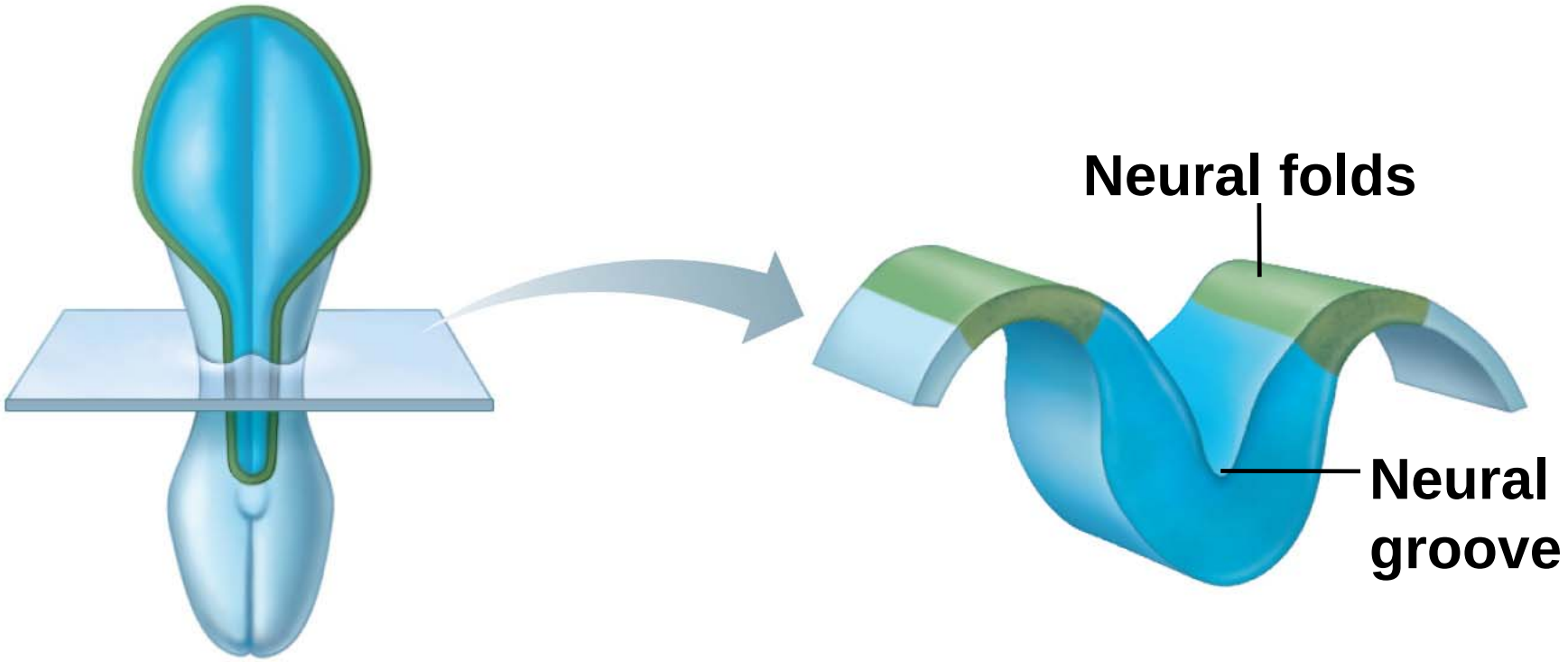
Embryonic Development

- Neural plate forms from ectoderm
- Neural plate invaginates to form a neural groove and neural folds



① The neural plate forms from surface ectoderm.

Figure 12.1, step 1

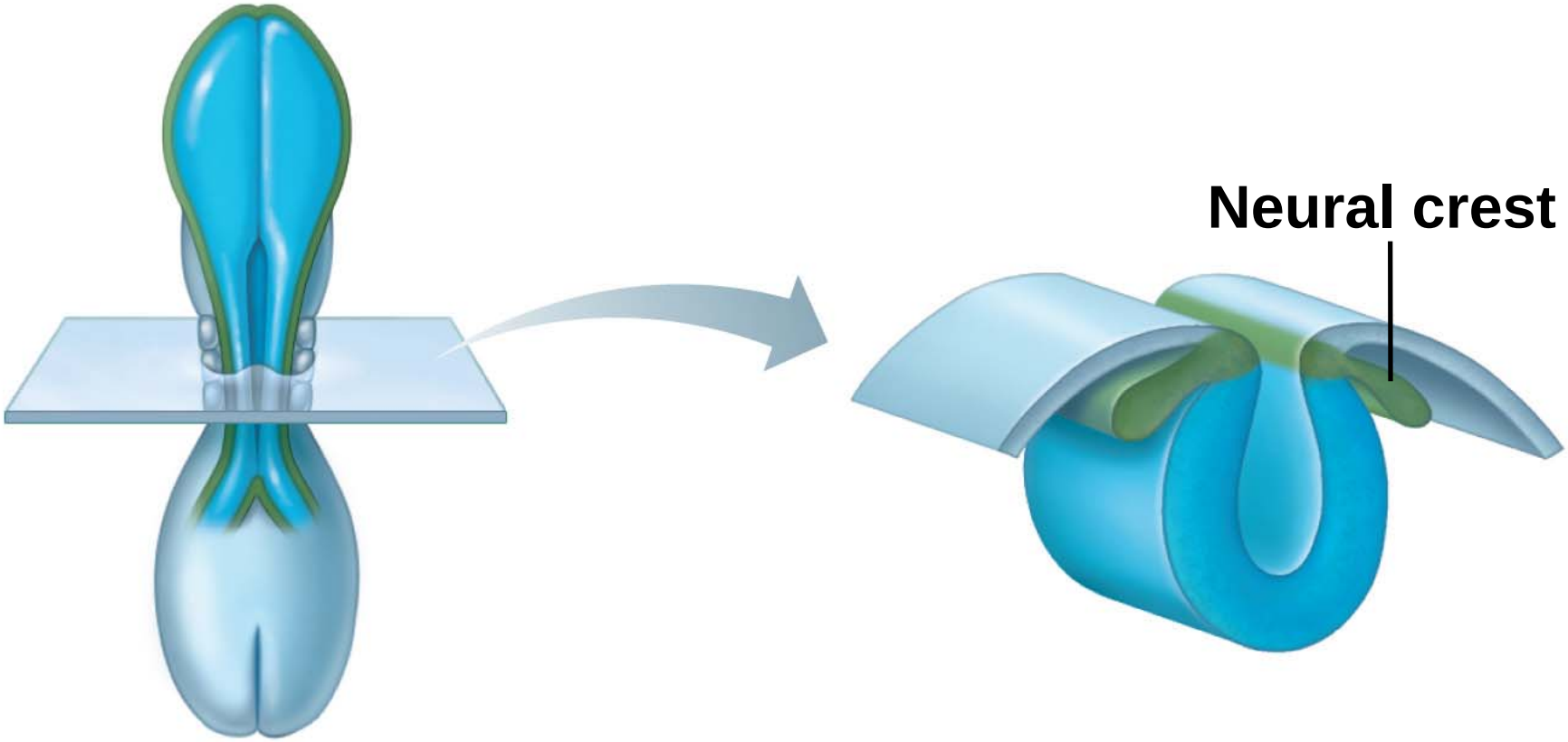


② The neural plate invaginates, forming the neural groove, flanked by neural folds.

Figure 12.1, step 2

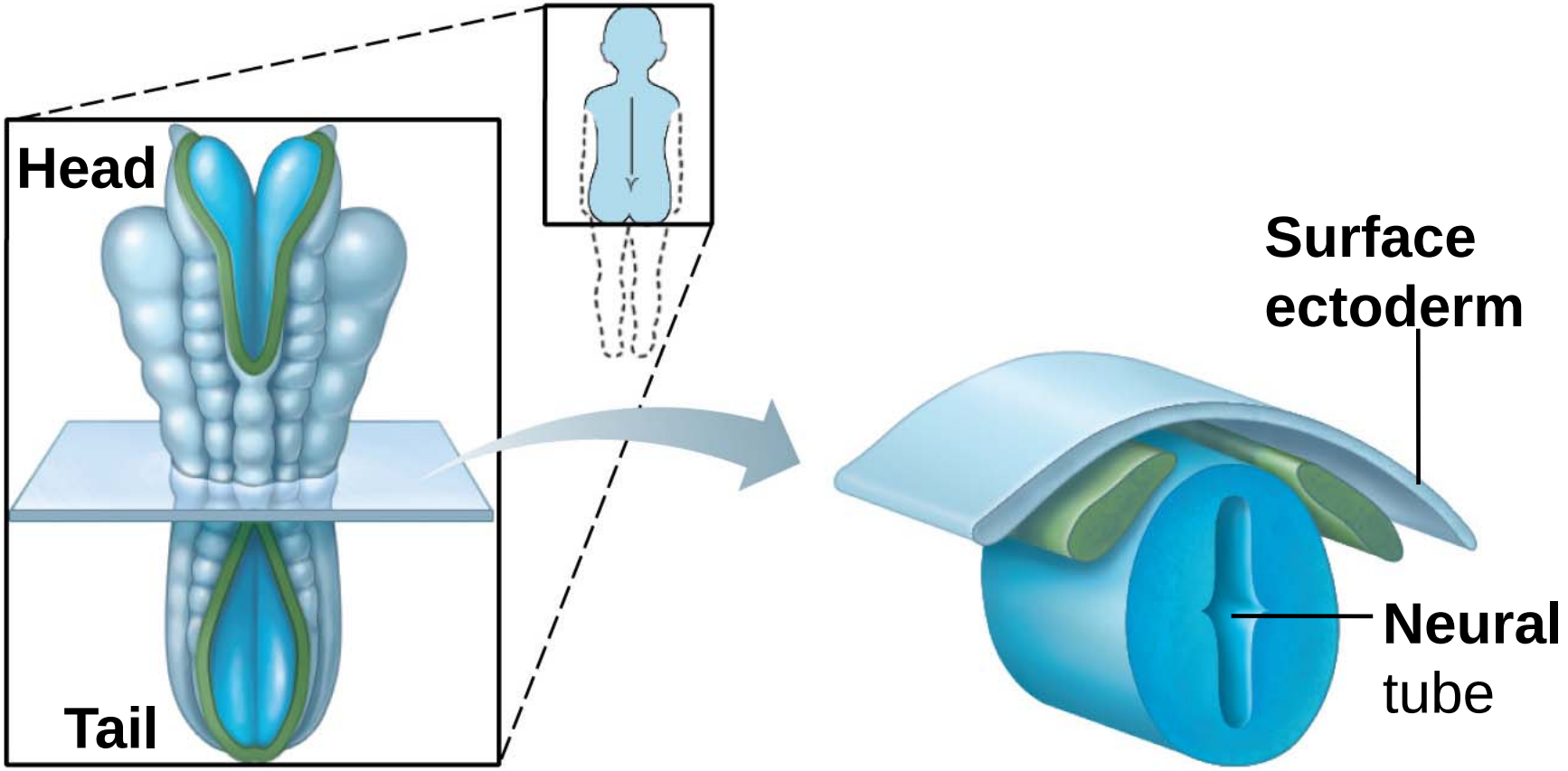
Embryonic Development

- Neural groove fuses dorsally to form the neural tube
- Neural tube gives rise to the brain and spinal cord



③ Neural fold cells migrate to form the neural crest, which will form much of the PNS and many other structures.

Figure 12.1, step 3



④ **The neural groove becomes the neural tube, which will form CNS structures.**

Figure 12.1, step 4

Embryonic Development

- Anterior end of the neural tube gives rise to three primary brain vesicles
  - Prosencephalon—forebrain
  - Mesencephalon—midbrain
  - Rhombencephalon—hindbrain

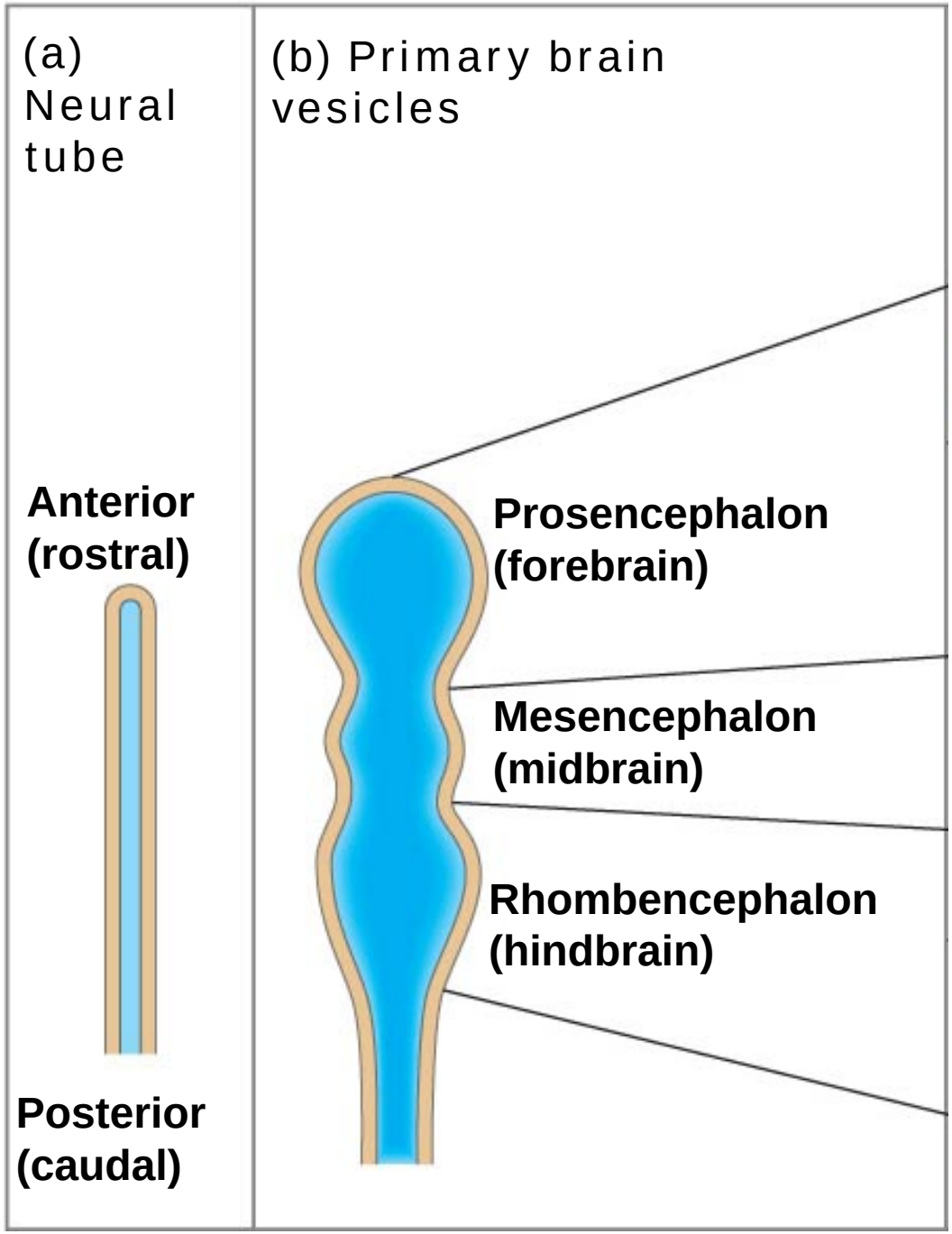


Figure 12.2a-b

Embryonic Development

- Primary vesicles give rise to five secondary brain vesicles
  - Telencephalon and diencephalon arise from the forebrain
  - Mesencephalon remains undivided
  - Metencephalon and myelencephalon arise from the hindbrain

Embryonic Development

- Telencephalon $\rightarrow$ cerebrum (two hemispheres with cortex, white matter, and basal nuclei)
- Diencephalon $\rightarrow$ thalamus, hypothalamus, epithalamus, and retina

Embryonic Development

- Mesencephalon $\rightarrow$ brain stem (midbrain)
- Metencephalon $\rightarrow$ brain stem (pons) and cerebellum
- Myelencephalon $\rightarrow$ brain stem (medulla oblongata)
- Central canal of the neural tube enlarges to form fluid-filled ventricles

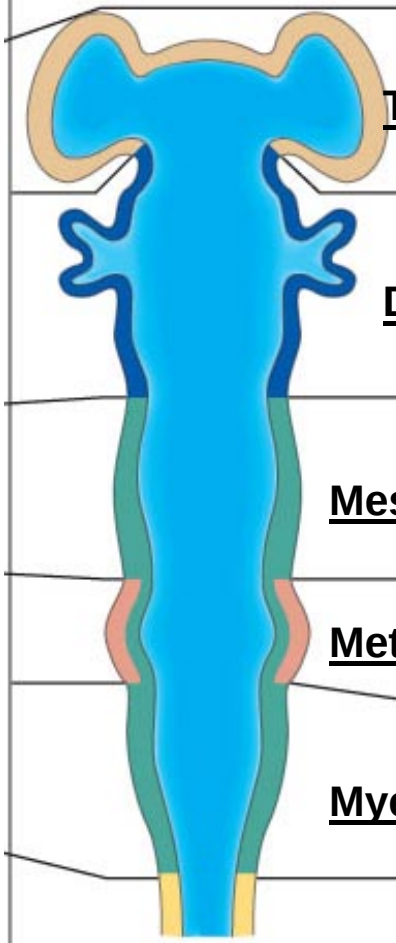
(c) Secondary brain vesicles	(d) Adult brain structures	(e) Adult neural canal regions
 Telencephalon	Cerebrum: cerebral hemispheres (cortex, white matter, basal nuclei)	Lateral ventricles
Diencephalon	Diencephalon (thalamus, hypothalamus, epithalamus), retina	Third ventricle
Mesencephalon	Brain stem: midbrain	Cerebral aqueduct
Metencephalon	Brain stem: pons	Fourth ventricle
	Cerebellum	
Myelencephalon	Brain stem: medulla oblongata	
	Spinal cord	Central canal

Figure 12.2c-e

Effect of Space Restriction on Brain Development

- Midbrain flexure and cervical flexure cause forebrain to move toward the brain stem
- Cerebral hemispheres grow posteriorly and laterally
- Cerebral hemisphere surfaces crease and fold into convolutions

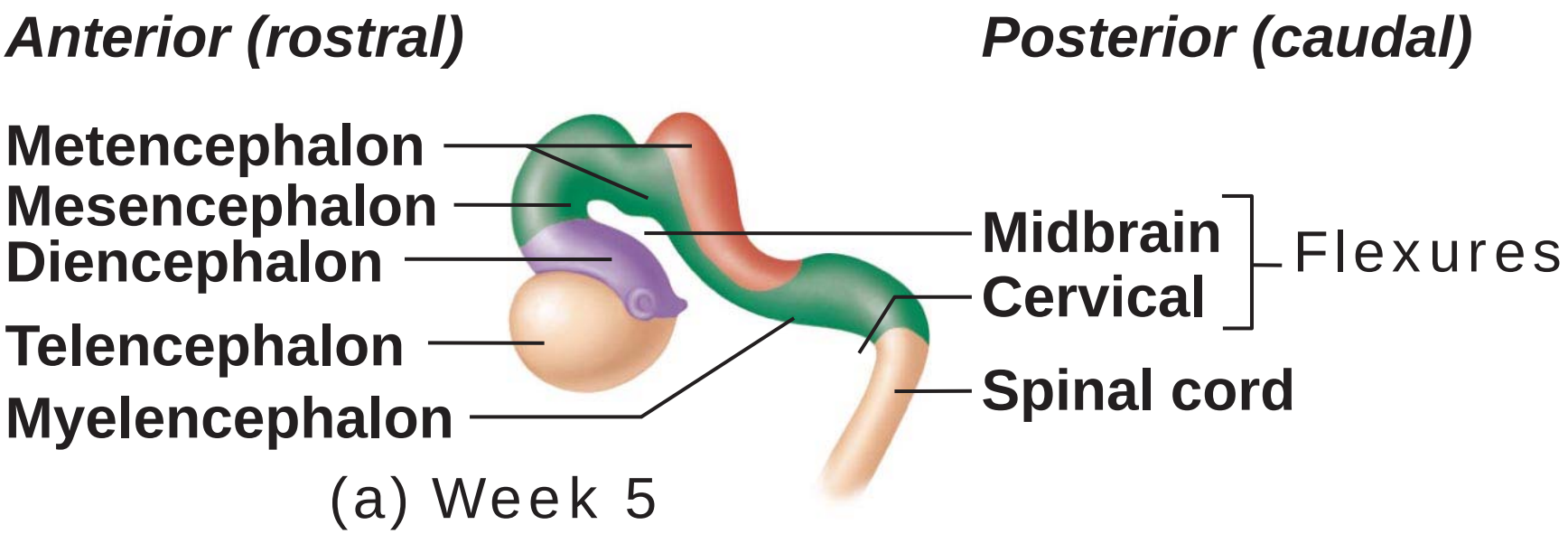

Anterior (rostral)
Posterior (caudal)
Metencephalon
Mesencephalon
Diencephalon
Telencephalon
Myelencephalon
Midbrain
Cervical
Flexures
Spinal cord
(a) Week 5

Figure 12.3a

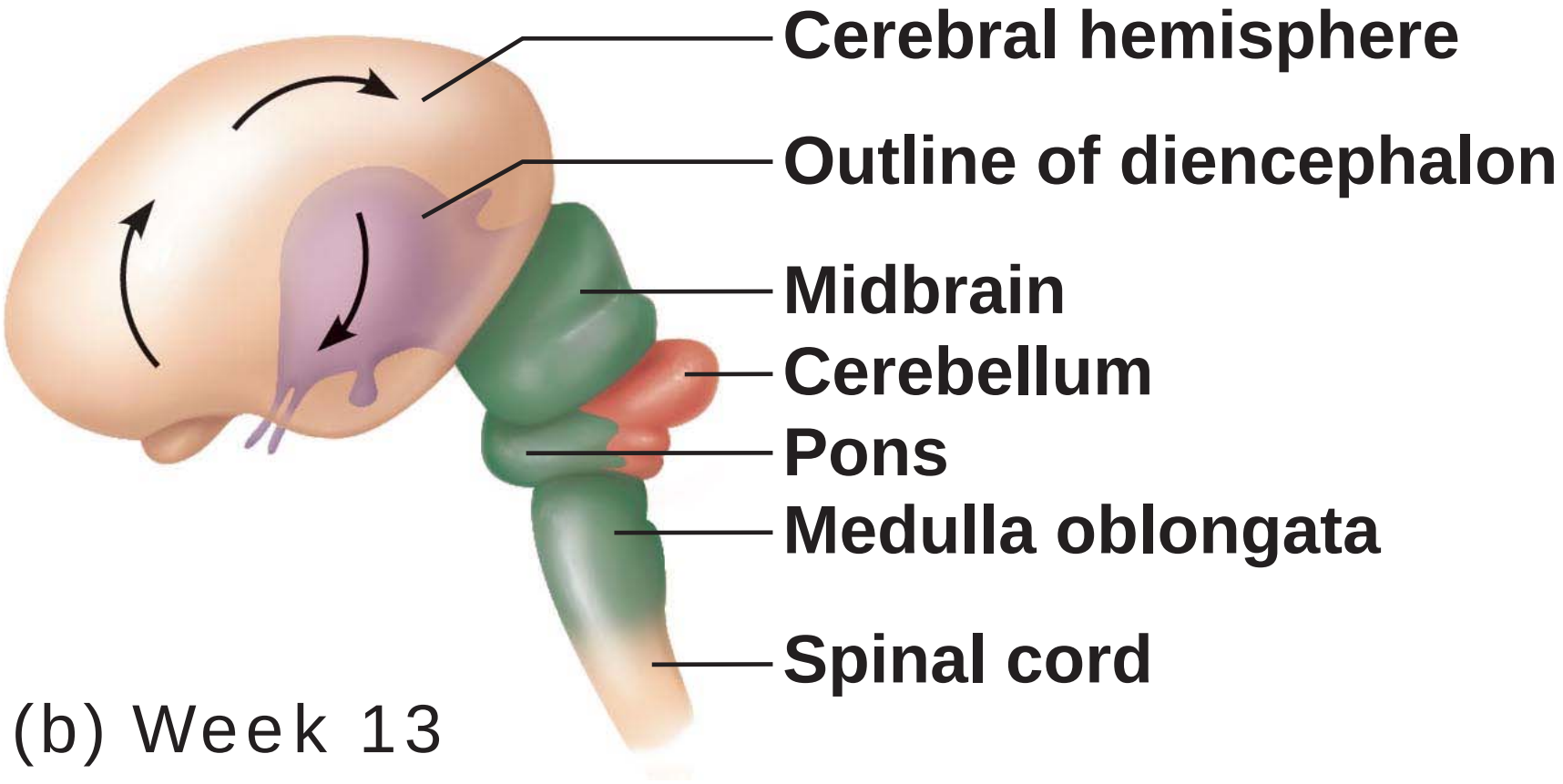

Cerebral hemisphere
Outline of diencephalon
Midbrain
Cerebellum
Pons
Medulla oblongata
Spinal cord
(b) Week 13

Figure 12.3b

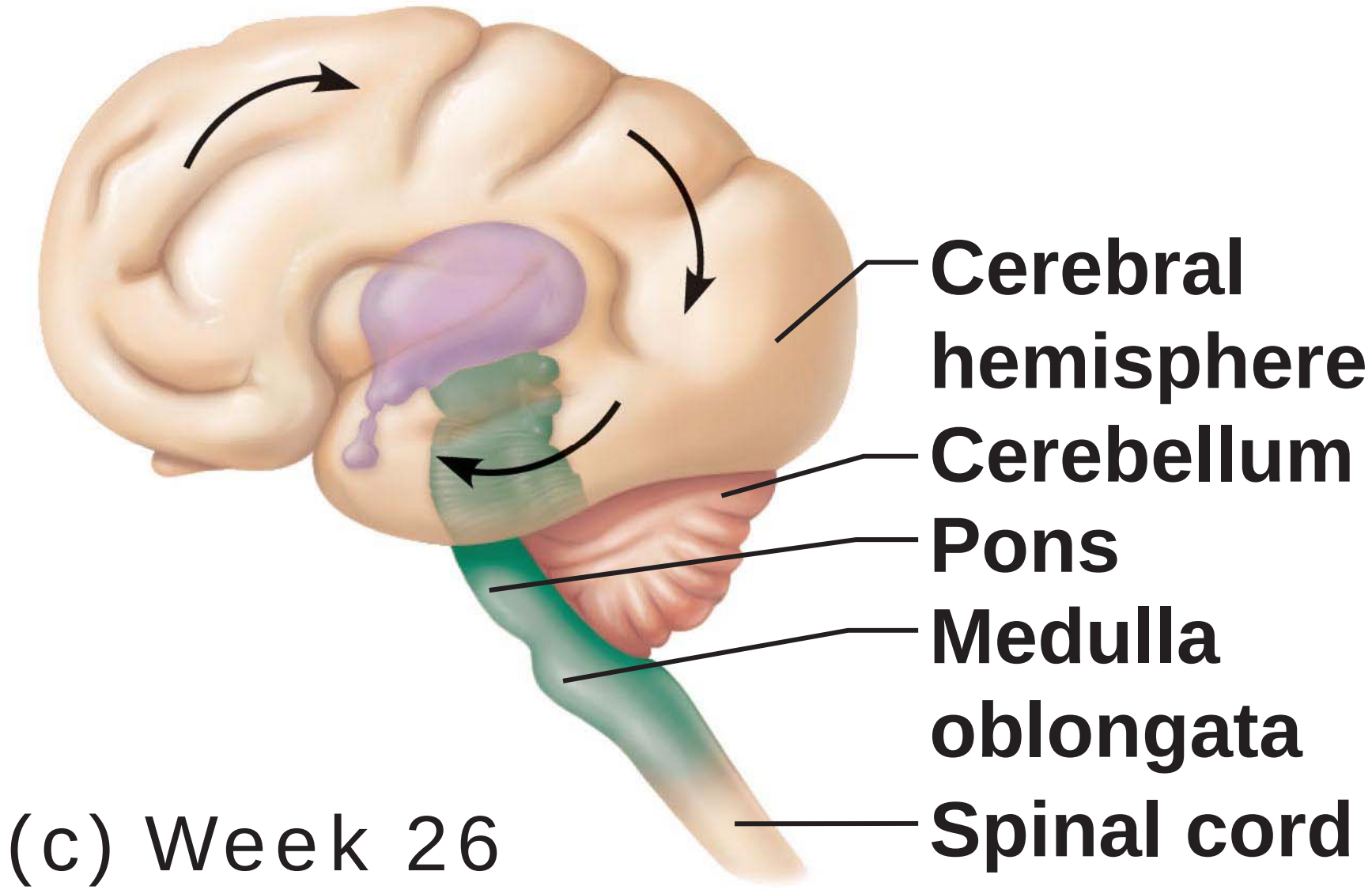
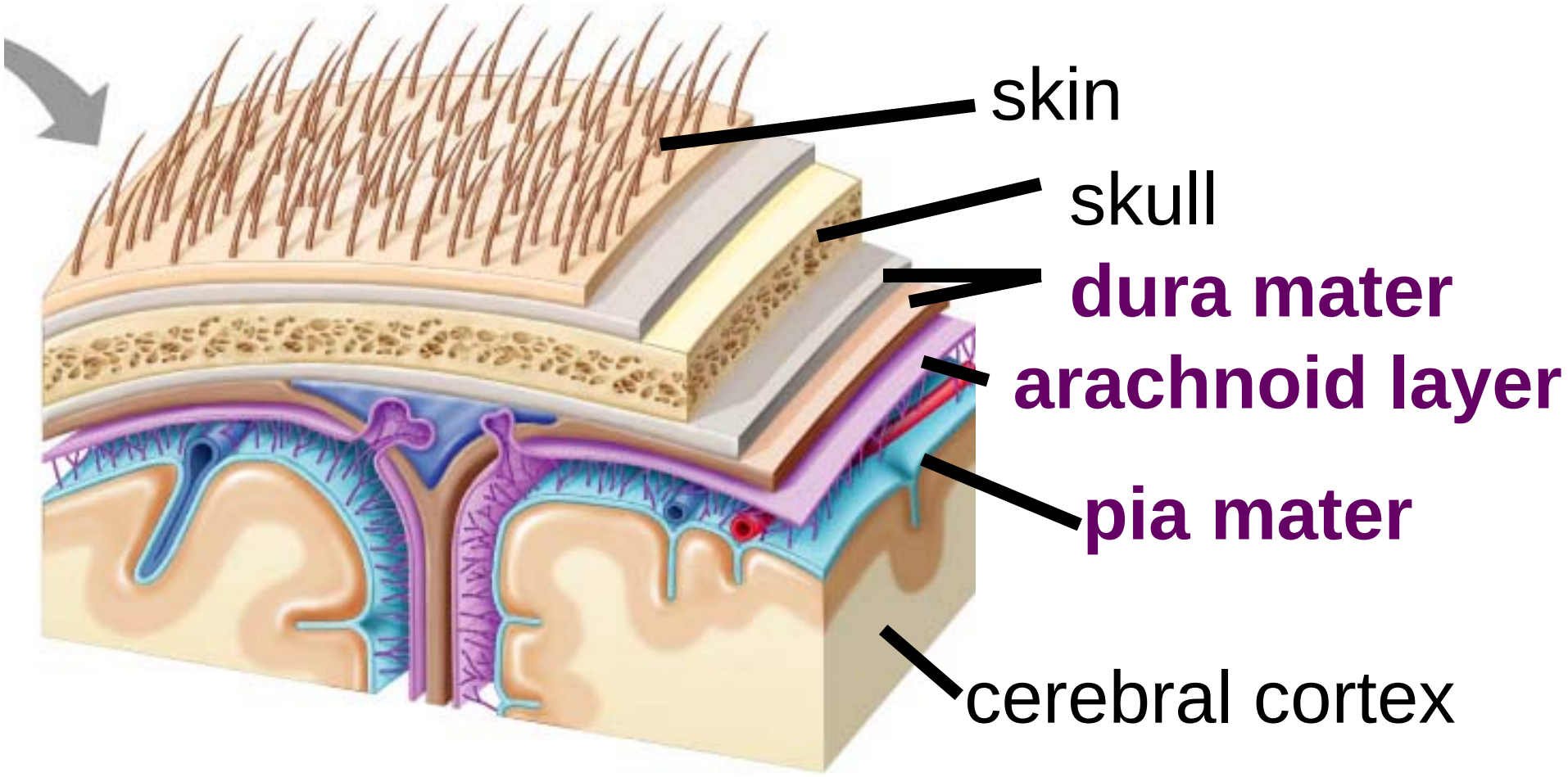

Cerebral hemisphere
Cerebellum
Pons
Medulla oblongata
Spinal cord
(c) Week 26

Figure 12.3c

Coverings of the Brain- Meninges



Menenges:

1. Covers and protects CNS
2. Protects blood vessels and encloses venus sinuses
3. Contains CSF
4. Forms partition within the skull

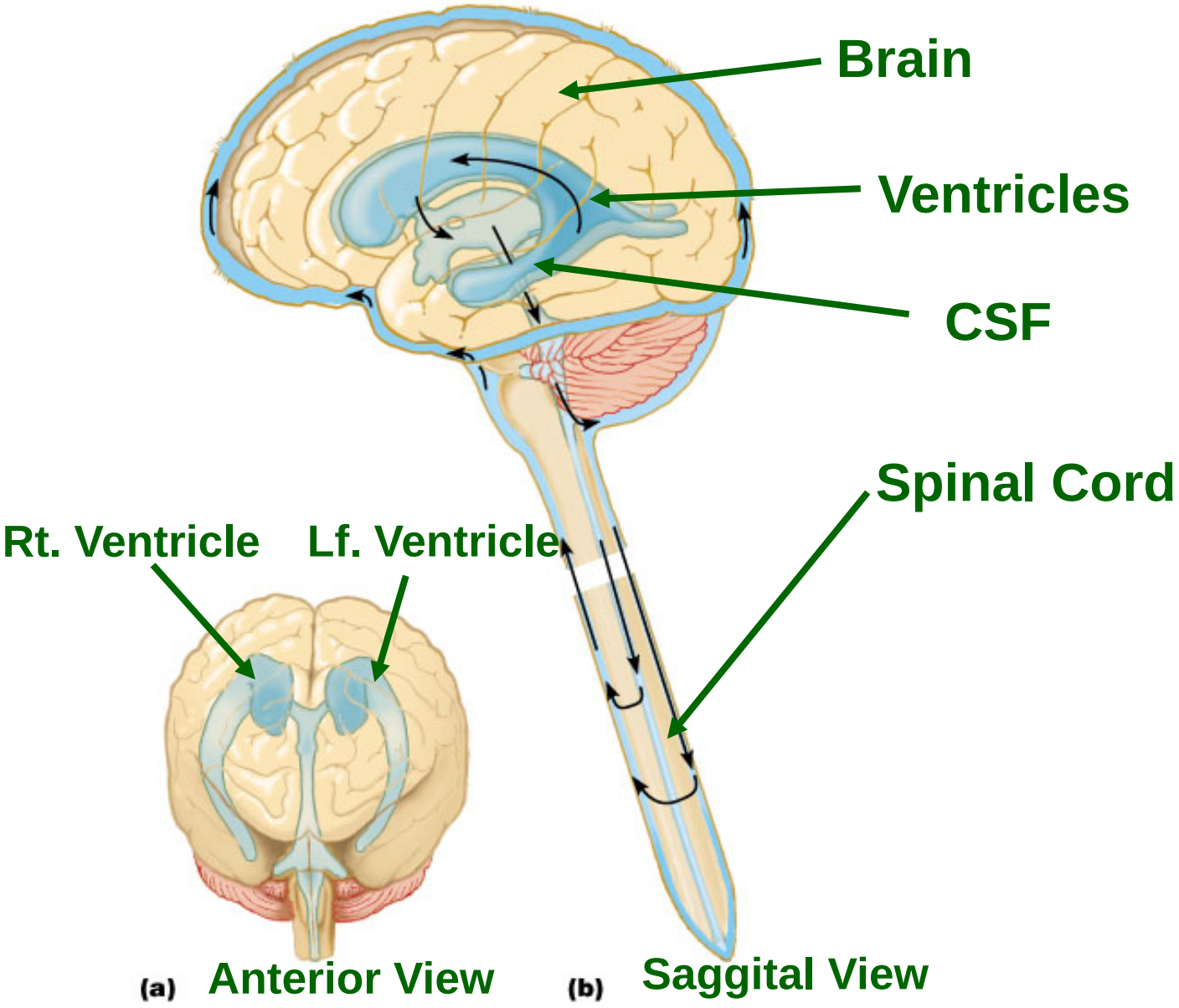
Ventricles of the Brain

- Connected to one another and to the central canal of the spinal cord
- Lined by ependymal cells

Ventricles of the Brain

- Contain cerebrospinal fluid
  - Two C-shaped lateral ventricles in the cerebral hemispheres
  - Third ventricle in the diencephalon
  - Fourth ventricle in the hindbrain, dorsal to the pons, develops from the lumen of the neural tube

Cerebruspinal Fluid



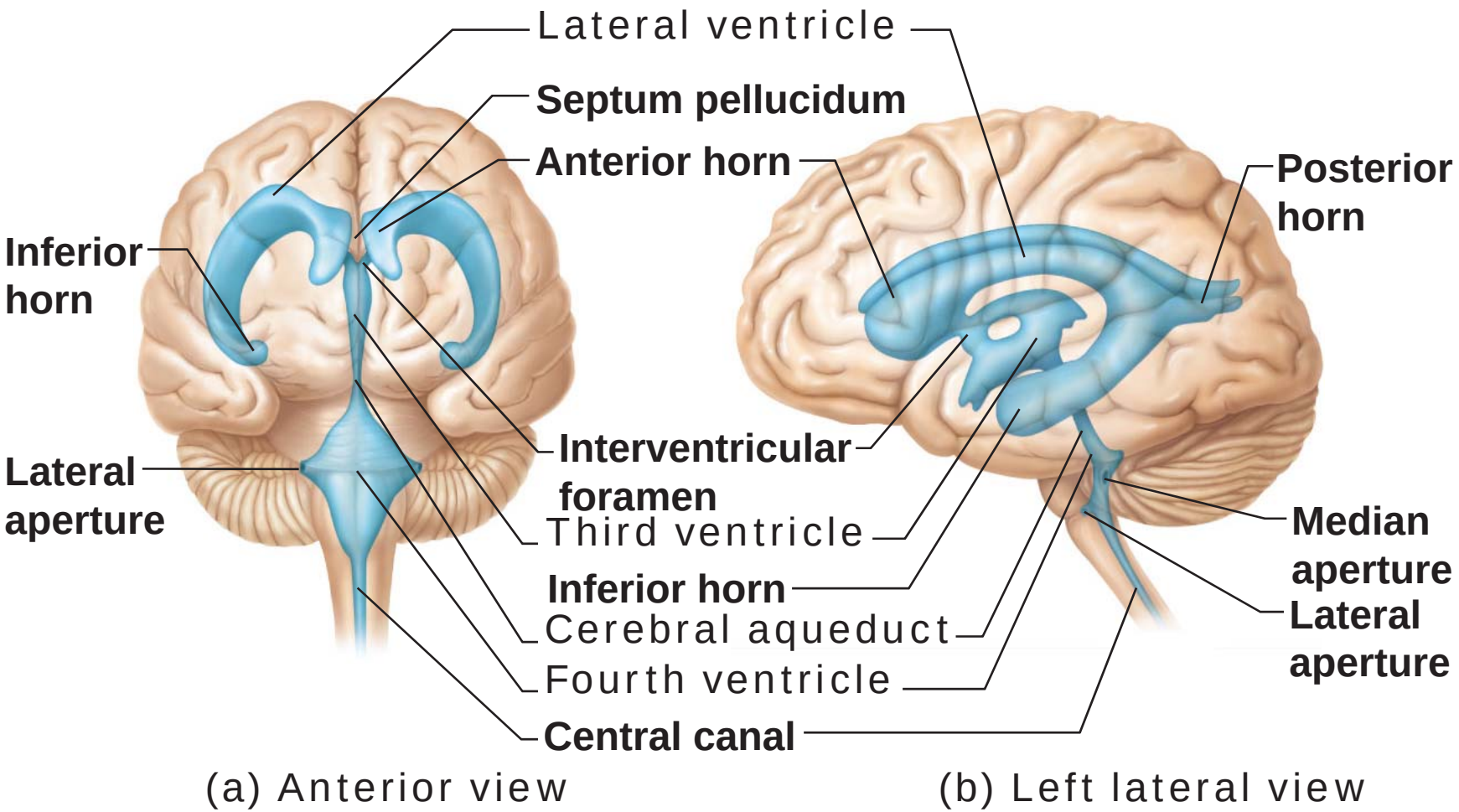

Lateral ventricle
Septum pellucidum
Anterior horn
Inferior horn
Lateral aperture
Interventricular foramen
Third ventricle
Inferior horn
Cerebral aqueduct
Fourth ventricle
Central canal
Posterior horn
Median aperture
Lateral aperture
(a) Anterior view
(b) Left lateral view

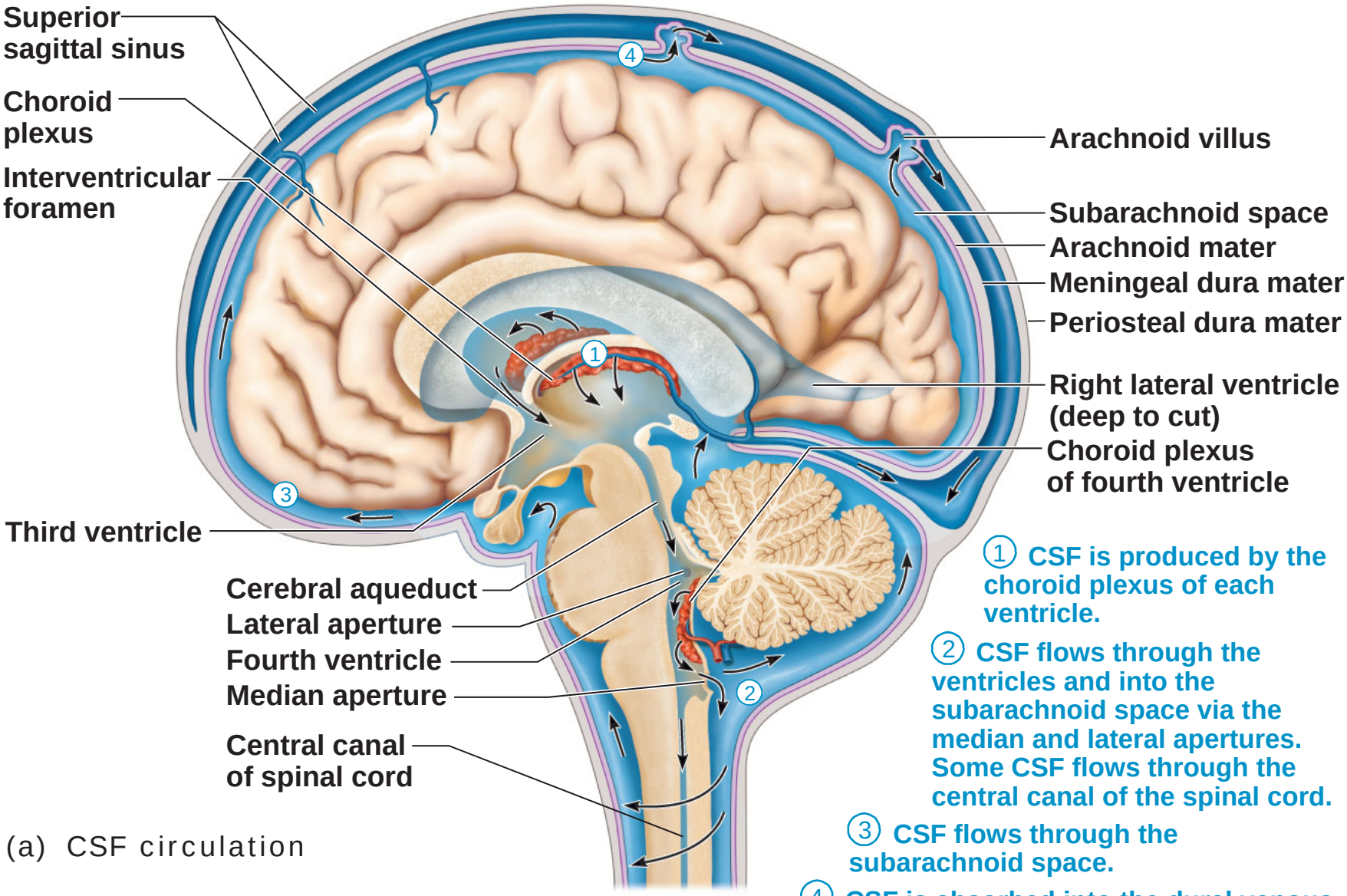
Figure 12.5

CSF

- 150 ml in adult
- contains: glucose, proteins,lactic acid, urea, cations, anions, WBC

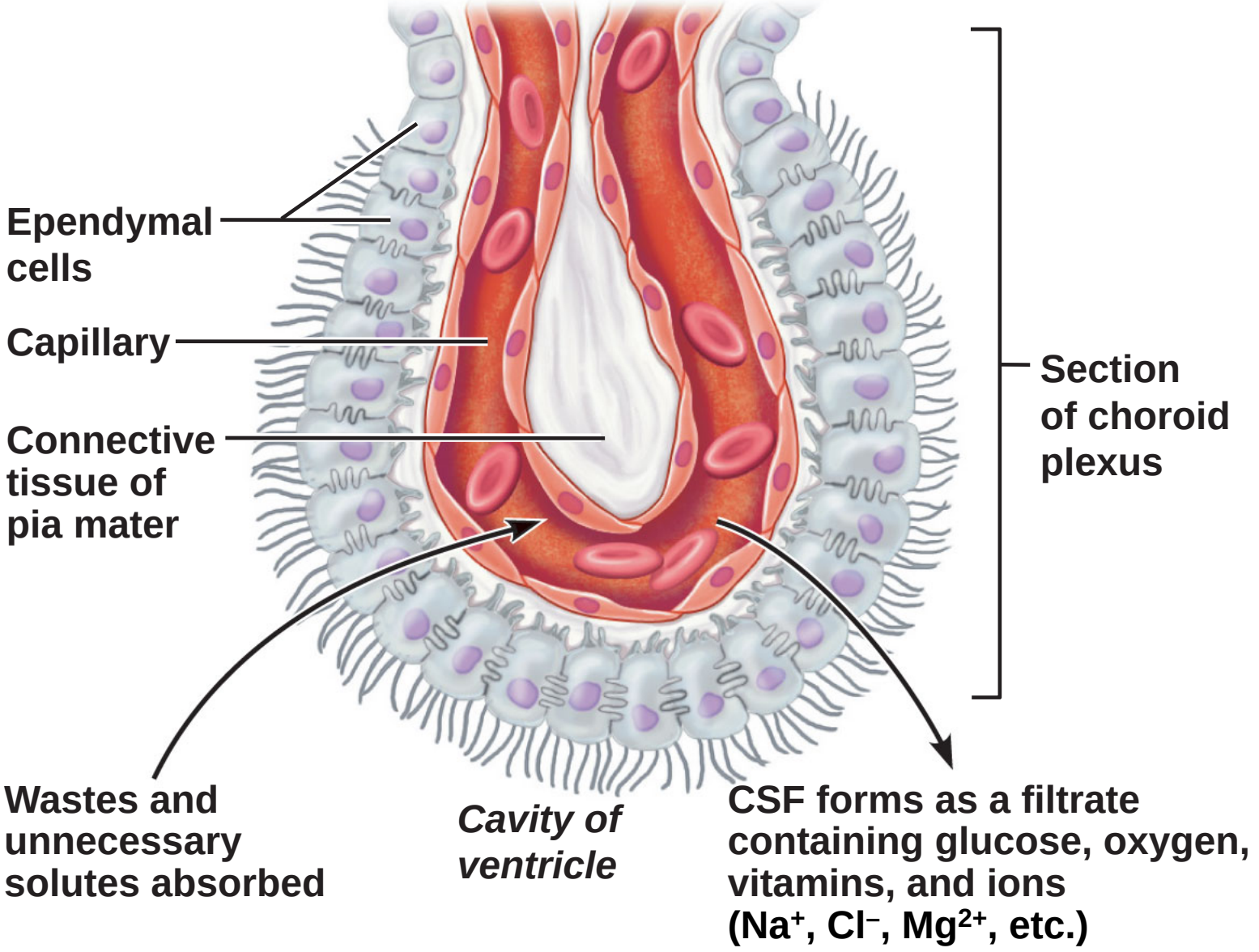
Functions:

1. Reduces wt. of brain by 97%
2. Prevents head injury
3. Supplies brain with nutrition
4. Transports hormones along ventricular channels



(a) CSF circulation

Figure 12.26a



(b) CSF formation by choroid plexuses

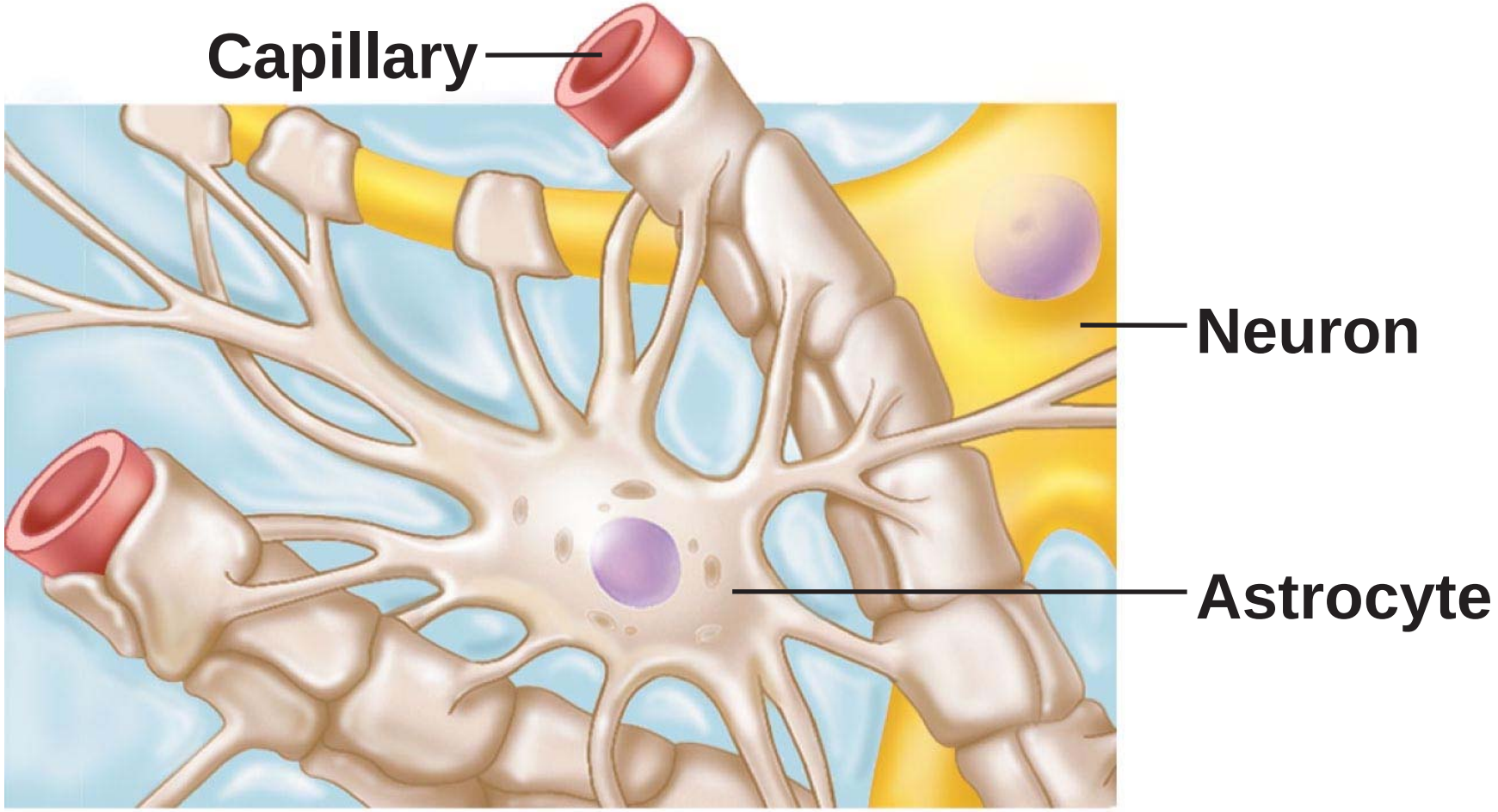
Figure 12.26b

Blood-Brain Barrier

1. **Protects the brain from "foreign substances"** in the blood that may injure the brain.
2. **Protects the brain from hormones and neurotransmitters** in the rest of the body.
3. **Maintains a constant environment** for the brain.

Blood-Brain Barrier

- Composition
  - Continuous endothelium of capillary walls
  - Basal lamina
  - Feet of astrocytes
    - Provide signal to endothelium for the formation of tight junctions



(a) Astrocytes are the most abundant CNS neuroglia.

Figure 11.3a

Blood-Brain Barrier: Functions

- Selective barrier
  - Allows nutrients to move by facilitated diffusion
  - Allows any fat-soluble substances to pass, including alcohol, nicotine, and anesthetics
- Absent in some areas, hypothalamus, pitutary, pineal body and vomiting center

The BBB can be broken down by

1. **Hypertension (high blood pressure)**: high blood pressure opens the BBB.
2. **Development**: the BBB is not fully formed at birth.
3. **Hyperosmolitity**: a high concentration of a substance in the blood can open the BBB.
4. **Microwaves**: exposure to microwaves can open the BBB.
5. **Radiation**: exposure to radiation can open the BBB.
6. **Infection**: exposure to infectious agents can open the BBB.
7. **Trauma, Ischemia, Inflammation, Pressure**: injury to the brain can open the BBB.

Cerebral Hemispheres

- Surface markings
  - Ridges (gyri), shallow grooves (sulci), and deep grooves (fissures)
  - Five lobes
    - Frontal
    - Parietal
    - Temporal
    - Occipital
    - Insula

Cerebral Hemispheres

- Surface markings
  - Central sulcus
    - Separates the precentral gyrus of the frontal lobe and the postcentral gyrus of the parietal lobe
  - Longitudinal fissure
    - Separates the two hemispheres
  - Transverse cerebral fissure
    - Separates the cerebrum and the cerebellum

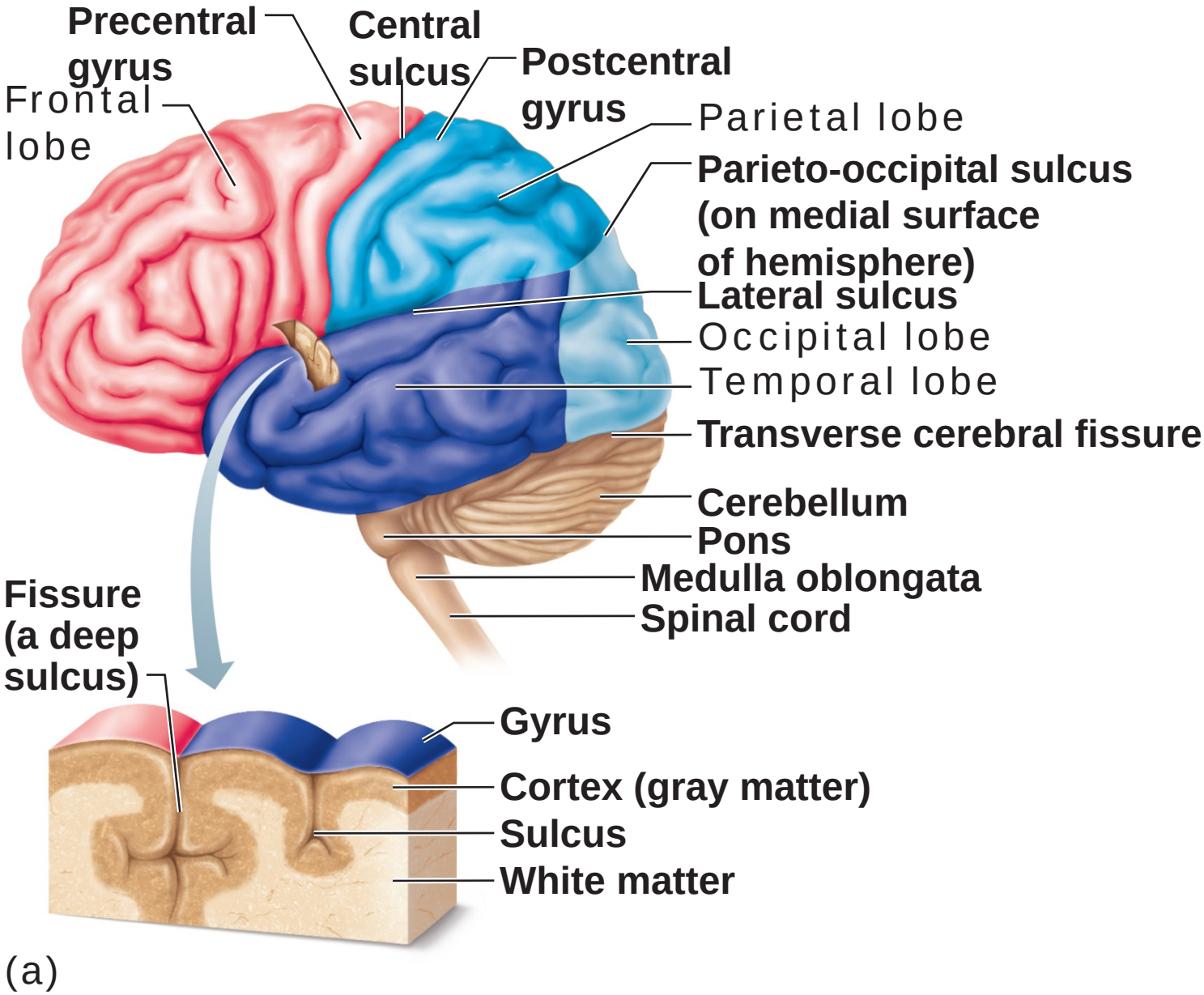

Precentral gyrus
Central sulcus
Postcentral gyrus
Frontal lobe
Parietal lobe
Parieto-occipital sulcus (on medial surface of hemisphere)
Lateral sulcus
Occipital lobe
Temporal lobe
Transverse cerebral fissure
Cerebellum
Pons
Medulla oblongata
Spinal cord
Fissure (a deep sulcus)
Gyrus
Cortex (gray matter)
Sulcus
White matter
(a)

Figure 12.6a

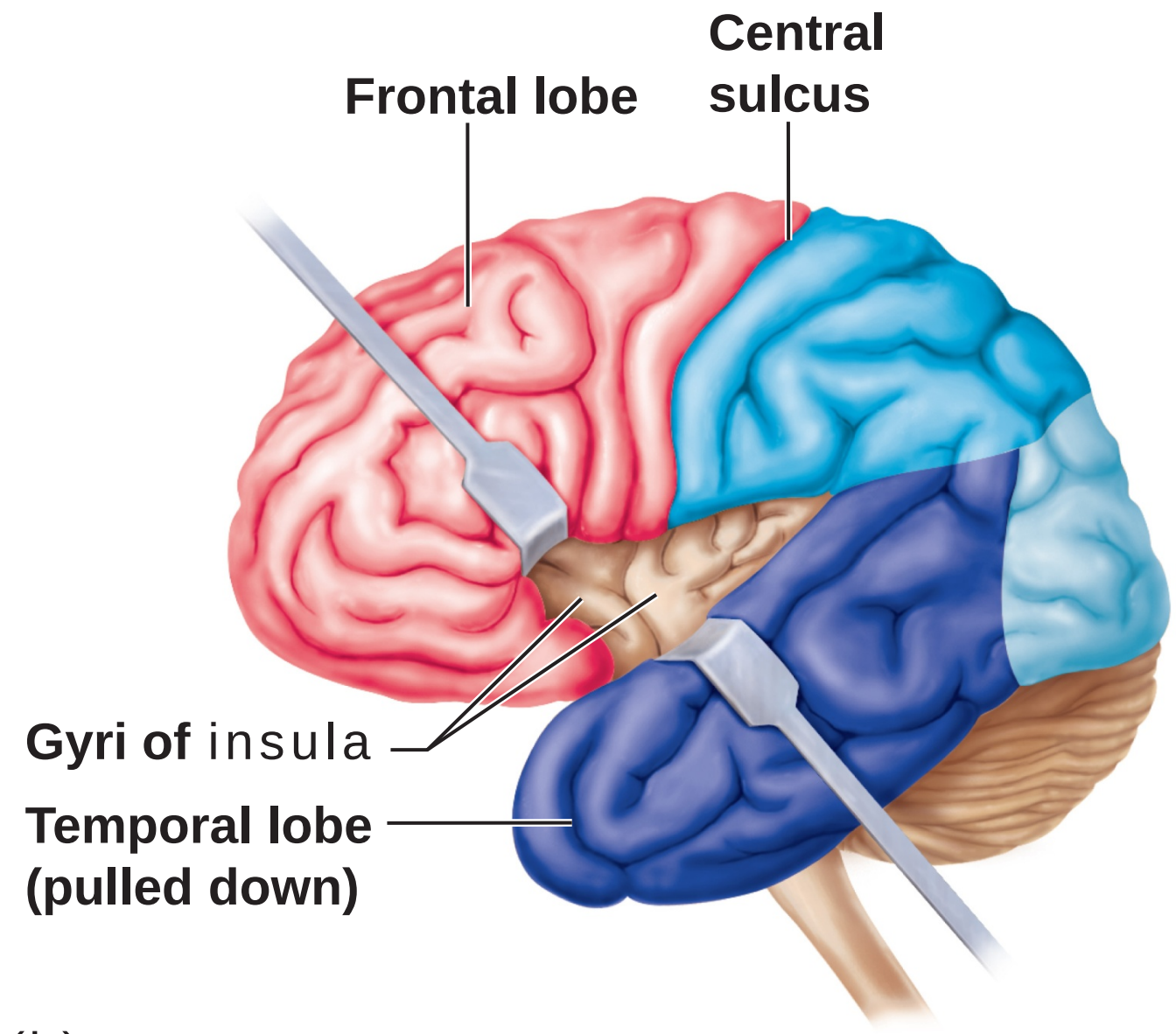

Central sulcus
Frontal lobe
Gyri of insula
Temporal lobe (pulled down)
(b)

Figure 12.6b

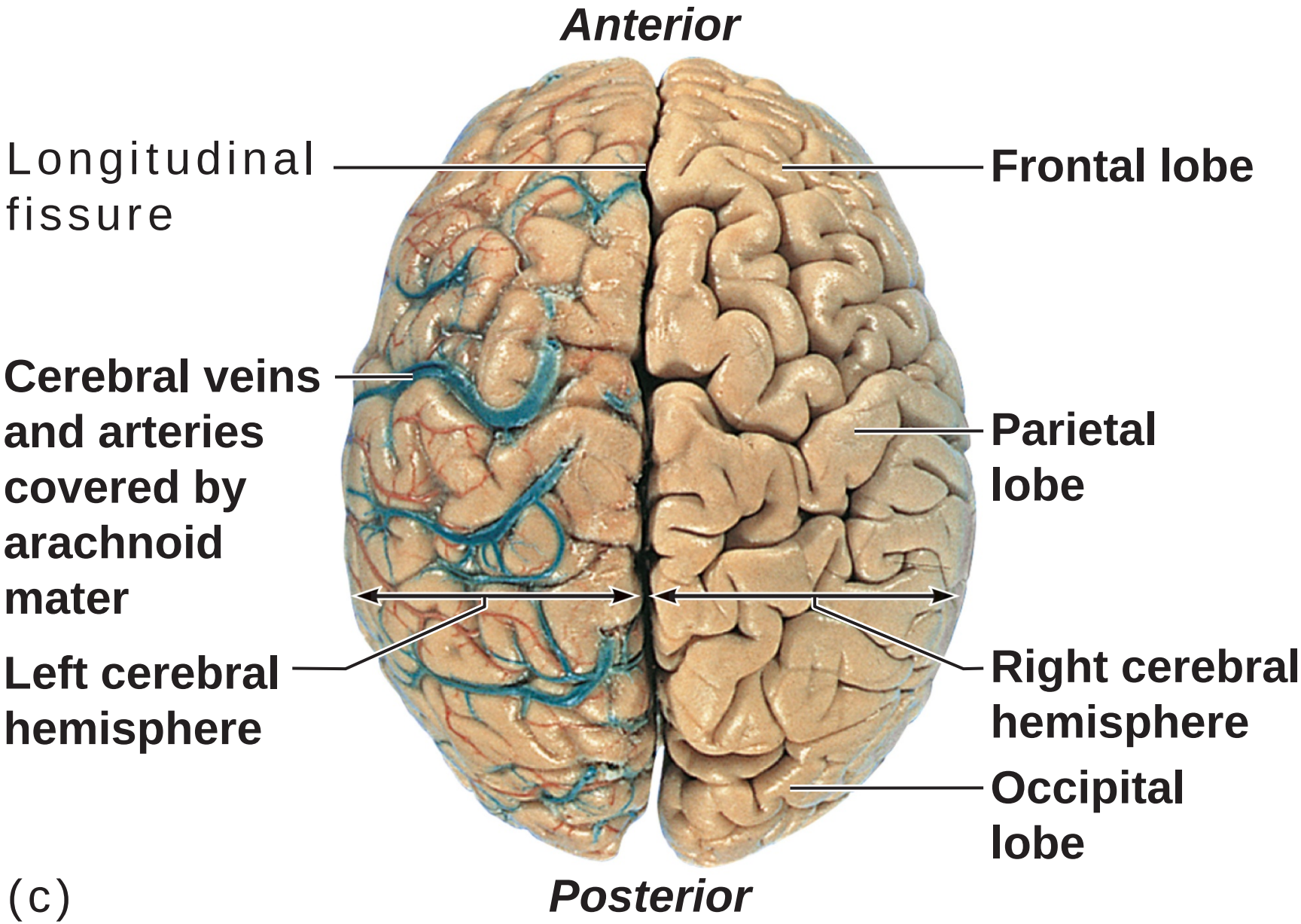

Anterior
Longitudinal fissure
Frontal lobe
Cerebral veins and arteries covered by arachnoid mater
Parietal lobe
Left cerebral hemisphere
Right cerebral hemisphere
Occipital lobe
(c)
Posterior

Figure 12.6c

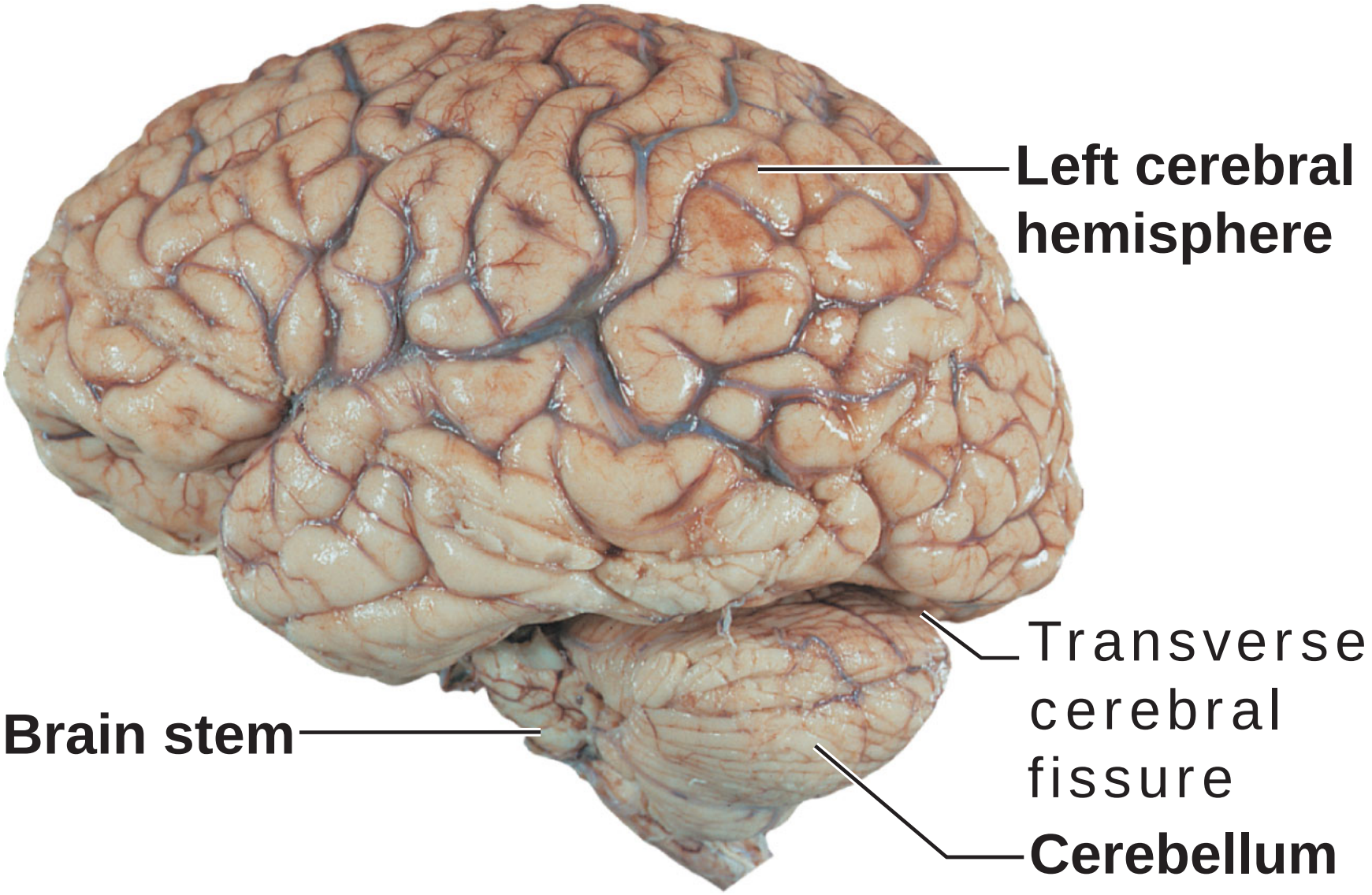

Left cerebral hemisphere
Transverse cerebral fissure
Cerebellum
Brain stem
(d)

Figure 12.6d

Cerebral Cortex

- Thin (2–4 mm) superficial layer of gray matter
- 40% of the mass of the brain
- Site of conscious mind: awareness, sensory perception, voluntary motor initiation, communication, memory storage, understanding
- Each hemisphere connects to contralateral side of the body
- There is lateralization of cortical function in the hemispheres

Functional Areas of the Cerebral Cortex

- The three types of functional areas are:
  - Motor areas—control voluntary movement
  - Sensory areas—conscious awareness of sensation
  - Association areas—integrate diverse information
- Conscious behavior involves the entire cortex

Motor Areas

- Primary (somatic) motor cortex
- Premotor cortex
- Broca’s area
- Frontal eye field

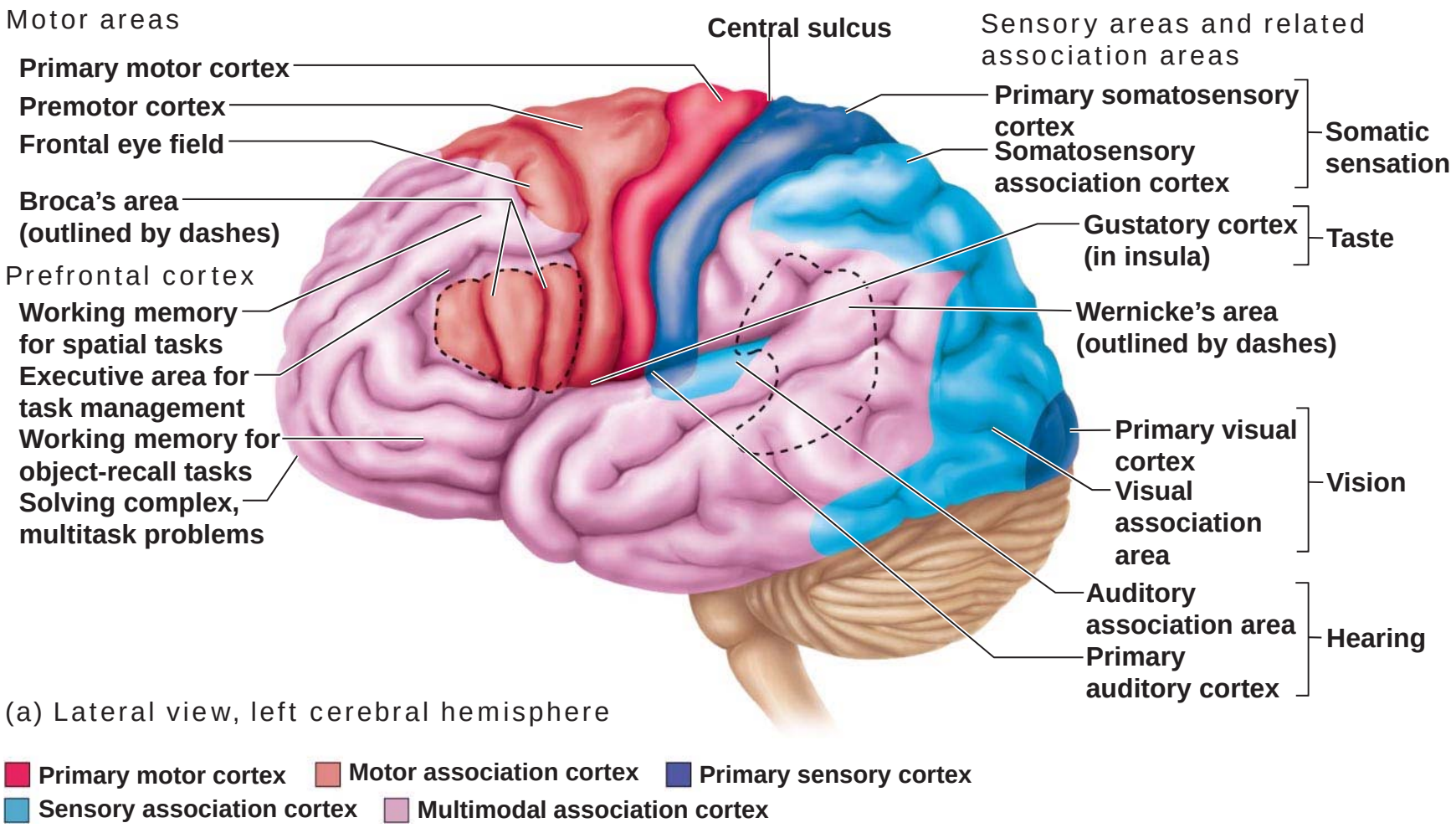

Motor areas
Primary motor cortex
Premotor cortex
Frontal eye field
Broca's area
(outlined by dashes)
Prefrontal cortex
Working memory
for spatial tasks
Executive area for
task management
Working memory for
object-recall tasks
Solving complex,
multitask problems
Central sulcus
Sensory areas and related
association areas
Primary somatosensory
cortex
Somatosensory
association cortex
Somatic
sensation
Gustatory cortex
(in insula)
Taste
Wernicke's area
(outlined by dashes)
Primary visual
cortex
Visual
association
area
Vision
Auditory
association area
Primary
auditory cortex
Hearing
(a) Lateral view, left cerebral hemisphere
Primary motor cortex
Motor association cortex
Primary sensory cortex
Sensory association cortex
Multimodal association cortex

Figure 12.8a

Primary Motor Cortex

- Large pyramidal cells of the precentral gyri
- Long axons $\rightarrow$ pyramidal (corticospinal) tracts
- Allows conscious control of precise, skilled, voluntary movements
- Motor homunculi: upside-down caricatures representing the motor innervation of body regions

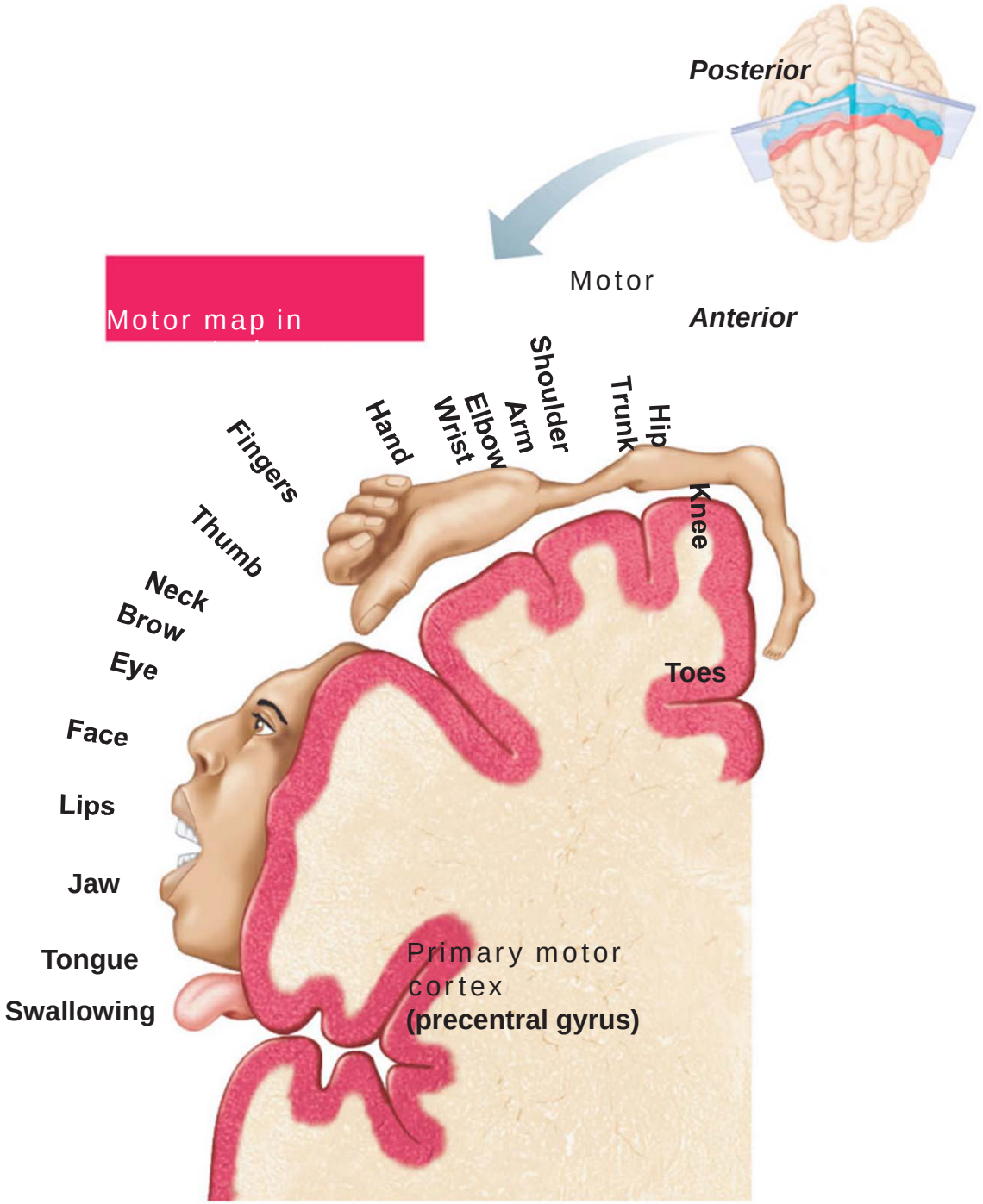

Posterior
Motor
Anterior
Motor map in
Shoulder
Arm
Elbow
Wrist
Hand
Fingers
Thumb
Neck
Brow
Eye
Face
Lips
Jaw
Tongue
Swallowing
Trunk
Hip
Knee
Toes
Primary motor cortex
(precentral gyrus)

Figure 12.9

Premotor Cortex

- Anterior to the precentral gyrus
- Controls learned, repetitious, or patterned motor skills
- Coordinates simultaneous or sequential actions
- Involved in the planning of movements that depend on sensory feedback

Broca’s Area

- Anterior to the inferior region of the premotor area
- Present in one hemisphere (usually the left)
- A motor speech area that directs muscles of the tongue
- Is active as one prepares to speak

Frontal Eye Field

- Anterior to the premotor cortex and superior to Broca’s area
- Controls voluntary eye movements

Sensory Areas

- Primary somatosensory cortex
- Somatosensory association cortex
- Visual areas
- Auditory areas
- Olfactory cortex
- Gustatory cortex
- Visceral sensory area
- Vestibular cortex

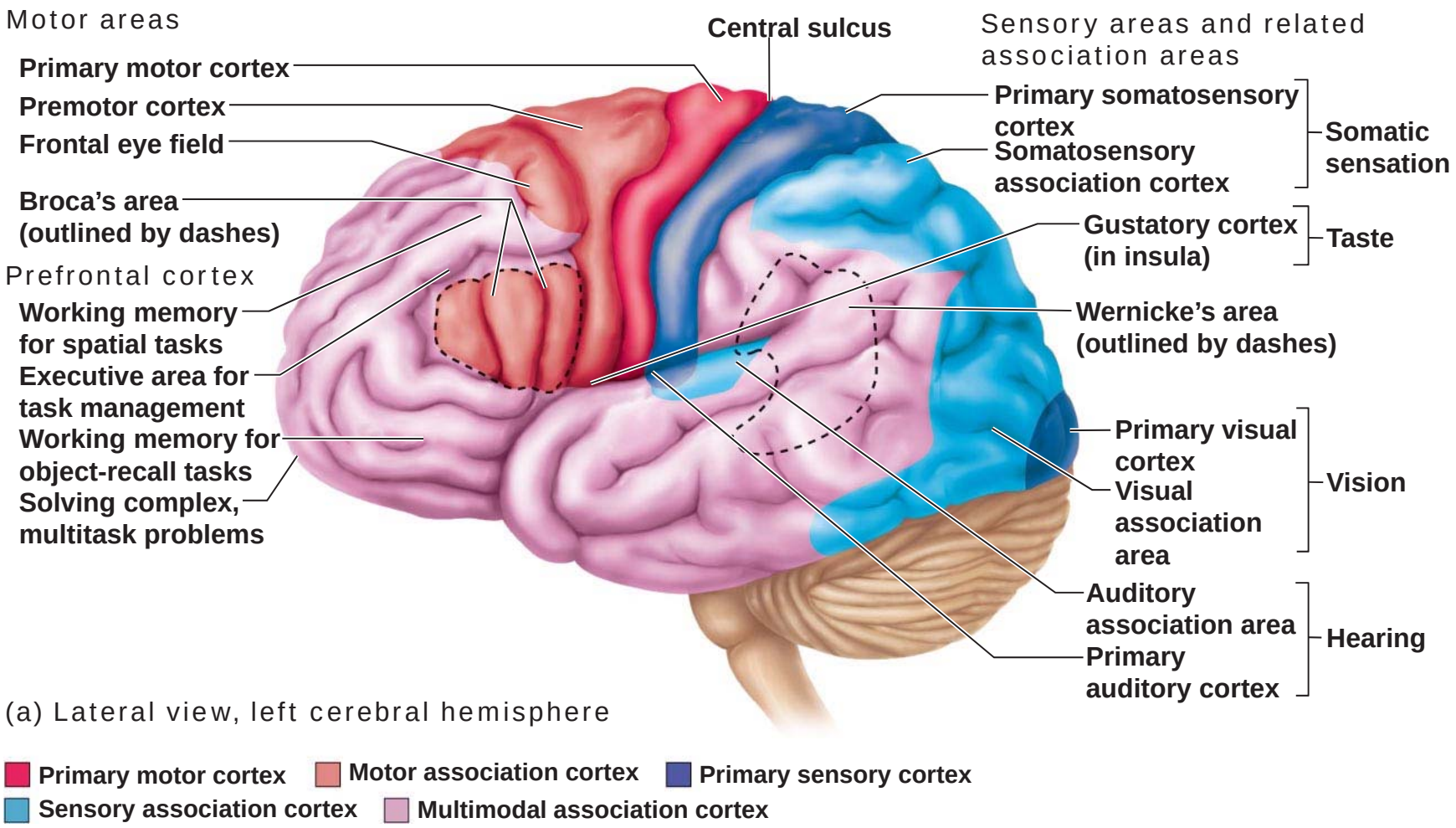
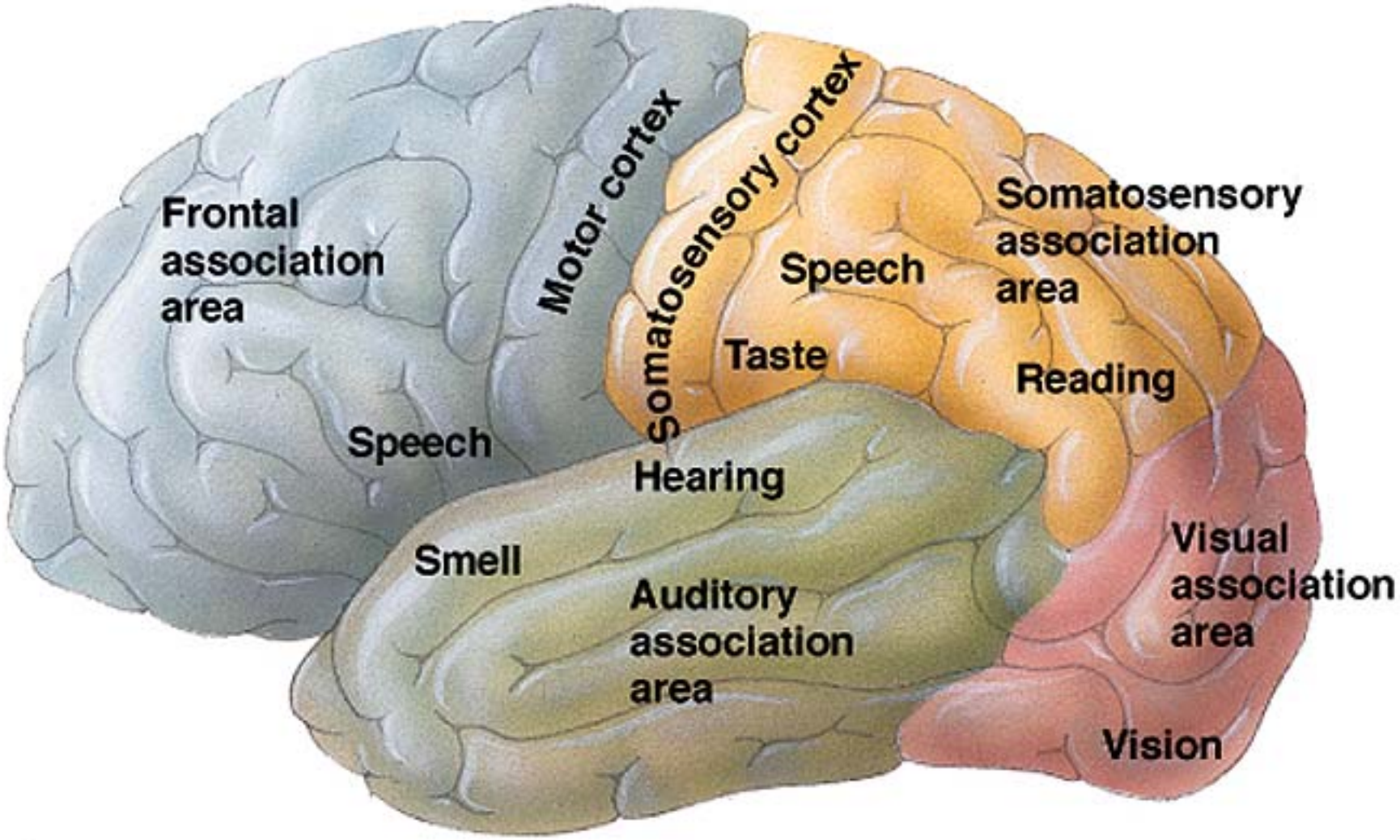

Motor areas
Primary motor cortex
Premotor cortex
Frontal eye field
Broca's area
(outlined by dashes)
Prefrontal cortex
Working memory
for spatial tasks
Executive area for
task management
Working memory for
object-recall tasks
Solving complex,
multitask problems
Central sulcus
Sensory areas and related
association areas
Primary somatosensory
cortex
Somatosensory
association cortex
Somatic
sensation
Gustatory cortex
(in insula)
Taste
Wernicke's area
(outlined by dashes)
Primary visual
cortex
Visual
association
area
Vision
Auditory
association area
Primary
auditory cortex
Hearing
(a) Lateral view, left cerebral hemisphere
Primary motor cortex
Motor association cortex
Primary sensory cortex
Sensory association cortex
Multimodal association cortex

Figure 12.8a

Motor, Sensory & Association Cortex



Primary Somatosensory Cortex

- In the postcentral gyri
- Receives sensory information from the skin, skeletal muscles, and joints
- Capable of spatial discrimination: identification of body region being stimulated

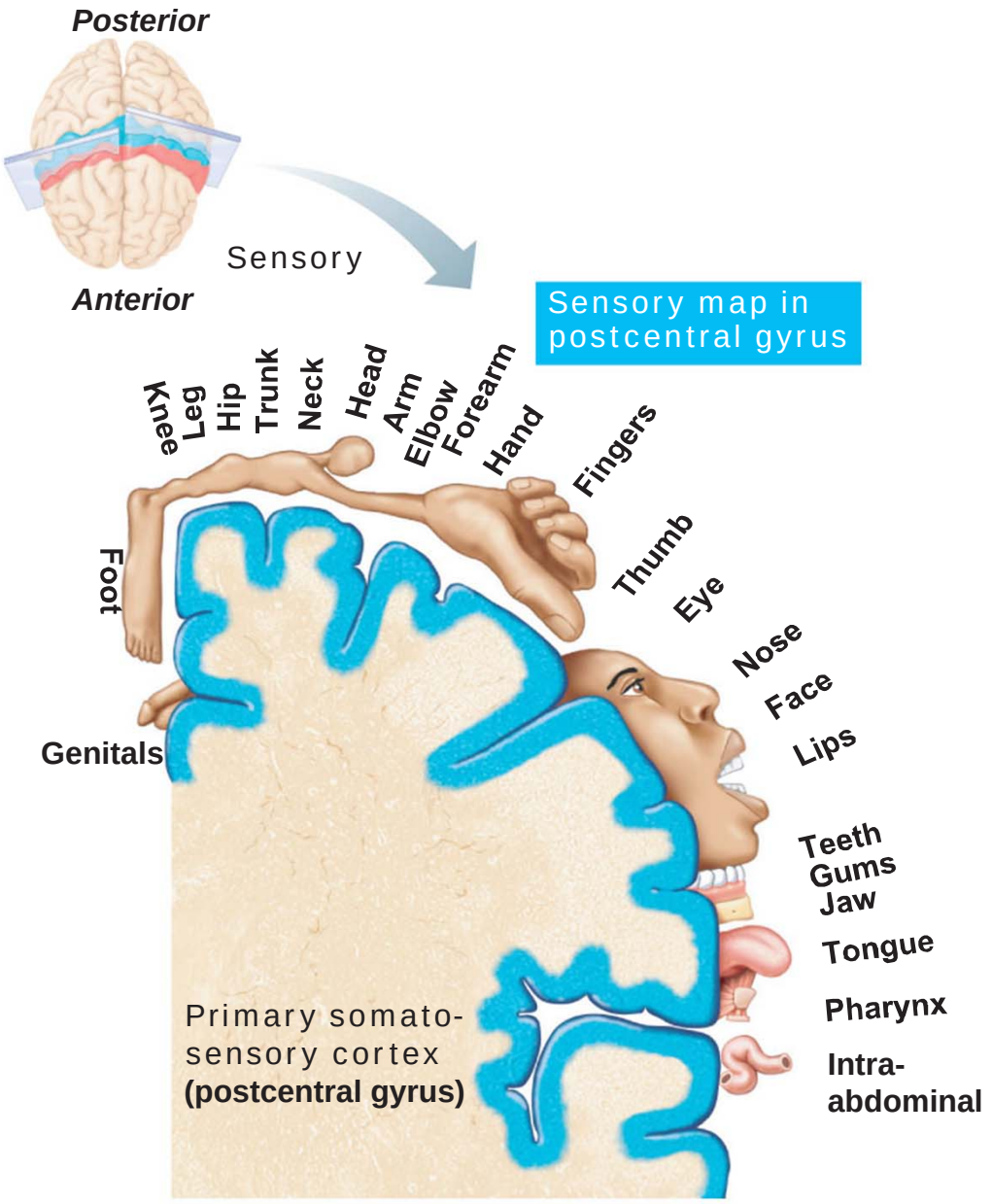

Posterior
Anterior
Sensory
Sensory map in postcentral gyrus
Knee
Leg
Hip
Trunk
Neck
Head
Arm
Elbow
Forearm
Hand
Fingers
Thumb
Eye
Nose
Face
Lips
Teeth
Gums
Jaw
Tongue
Pharynx
Intra-abdominal
Foot
Genitals
Primary somato-sensory cortex
(postcentral gyrus)

Figure 12.9

Somatosensory Association Cortex

- Posterior to the primary somatosensory cortex
- Integrates sensory input from primary somatosensory cortex
- Determines size, texture, and relationship of parts of objects being felt

Visual Areas

- Primary visual (striate) cortex
  - Extreme posterior tip of the occipital lobe
  - Most of it is buried in the calcarine sulcus
  - Receives visual information from the retinas

Visual Areas

- Visual association area
  - Surrounds the primary visual cortex
  - Uses past visual experiences to interpret visual stimuli (e.g., color, form, and movement)
  - Complex processing involves entire posterior half of the hemispheres

Auditory Areas

- Primary auditory cortex
  - Superior margin of the temporal lobes
  - Interprets information from inner ear as pitch, loudness, and location
- Auditory association area
  - Located posterior to the primary auditory cortex
  - Stores memories of sounds and permits perception of sounds

Olfactory Cortex

- Medial aspect of temporal lobes (in piriform lobes)
- Part of the primitive rhinencephalon, along with the olfactory bulbs and tracts
  - (Remainder of the rhinencephalon in humans is part of the limbic system)
- Region of conscious awareness of odors

Gustatory Cortex

- In the insula
- Involved in the perception of taste

Visceral Sensory Area

- Posterior to gustatory cortex
- Conscious perception of visceral sensations, e.g., upset stomach or full bladder

Vestibular Cortex

- Posterior part of the insula and adjacent parietal cortex
- Responsible for conscious awareness of balance (position of the head in space)

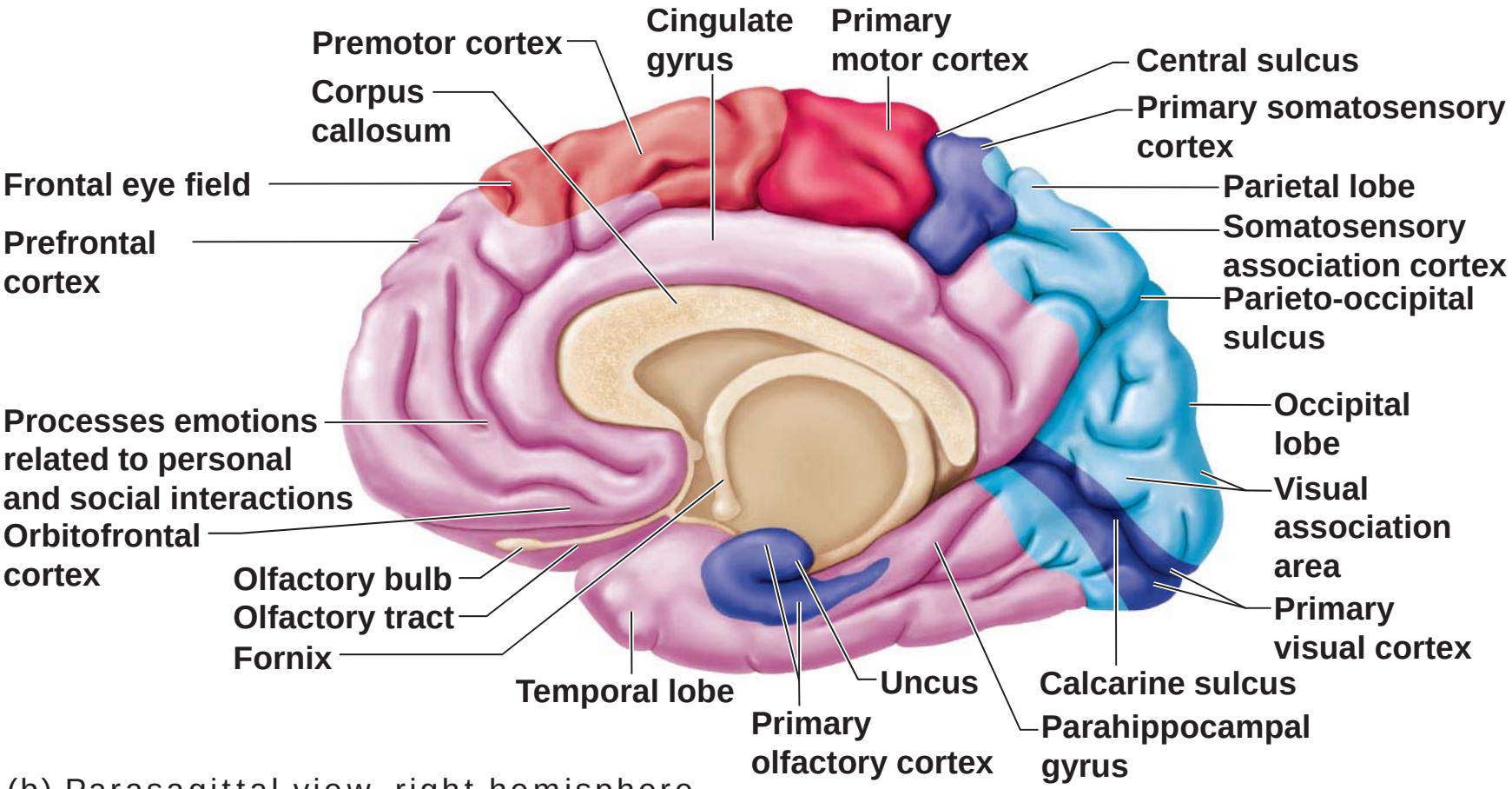

Premotor cortex
Cingulate gyrus
Primary motor cortex
Central sulcus
Corpus callosum
Primary somatosensory cortex
Frontal eye field
Parietal lobe
Prefrontal cortex
Somatosensory association cortex
Parieto-occipital sulcus
Processes emotions related to personal and social interactions
Occipital lobe
Orbitofrontal cortex
Visual association area
Olfactory bulb
Olfactory tract
Primary visual cortex
Fornix
Temporal lobe
Uncus
Calcarine sulcus
Primary olfactory cortex
Parahippocampal gyrus
(b) Parasagittal view, right hemisphere
Primary motor cortex
Motor association cortex
Primary sensory cortex
Sensory association cortex
Multimodal association cortex

Figure 12.8b

Multimodal Association Areas

- Receive inputs from multiple sensory areas
- Send outputs to multiple areas, including the premotor cortex
- Allow us to give meaning to information received, store it as memory, compare it to previous experience, and decide on action to take

Multimodal Association Areas

- Three parts
  - Anterior association area (prefrontal cortex)
  - Posterior association area
  - Limbic association area

Anterior Association Area (Prefrontal Cortex)

- Most complicated cortical region
- Involved with intellect, cognition, recall, and personality
- Contains working memory needed for judgment, reasoning, persistence, and conscience
- Development depends on feedback from social environment

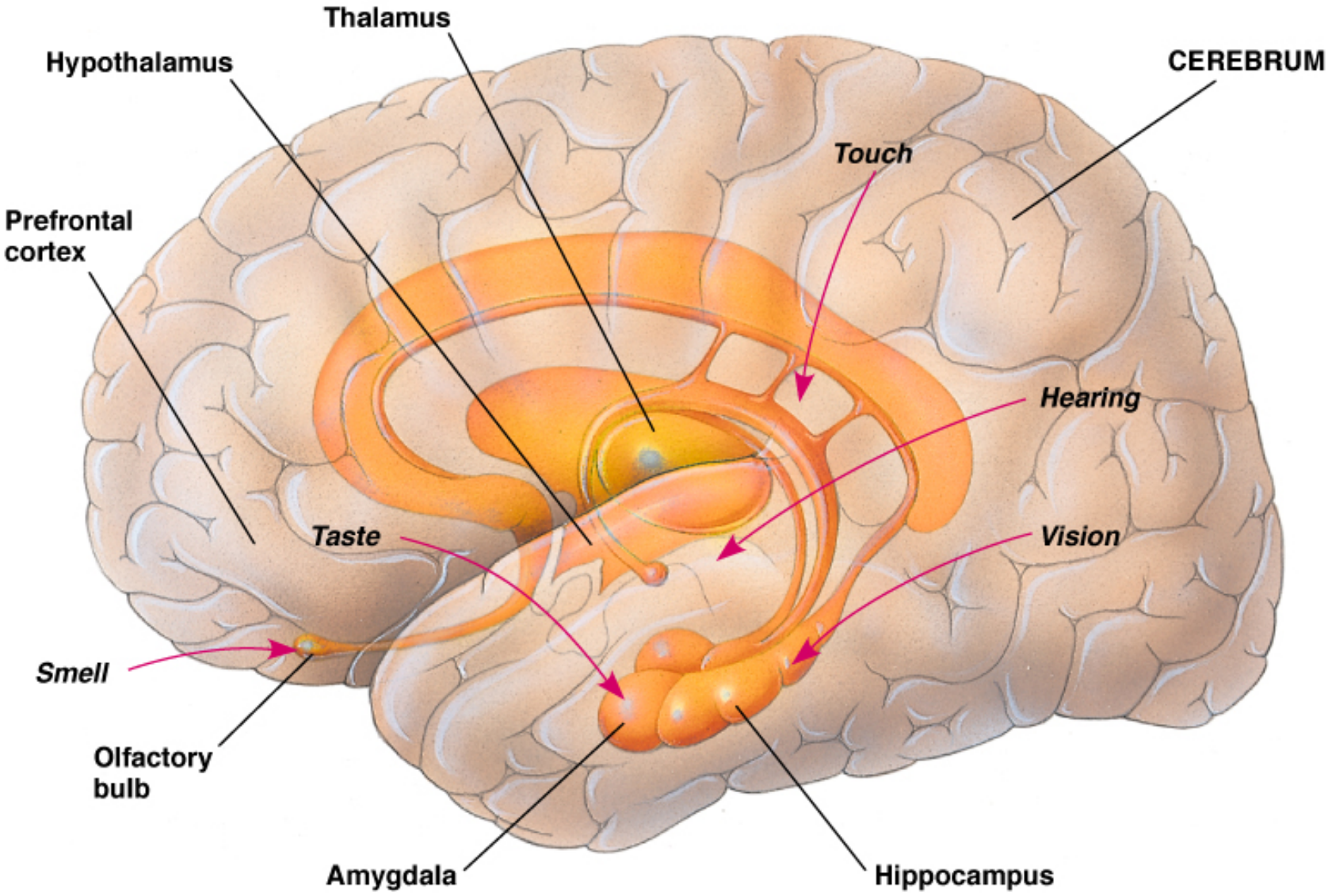
Posterior Association Area

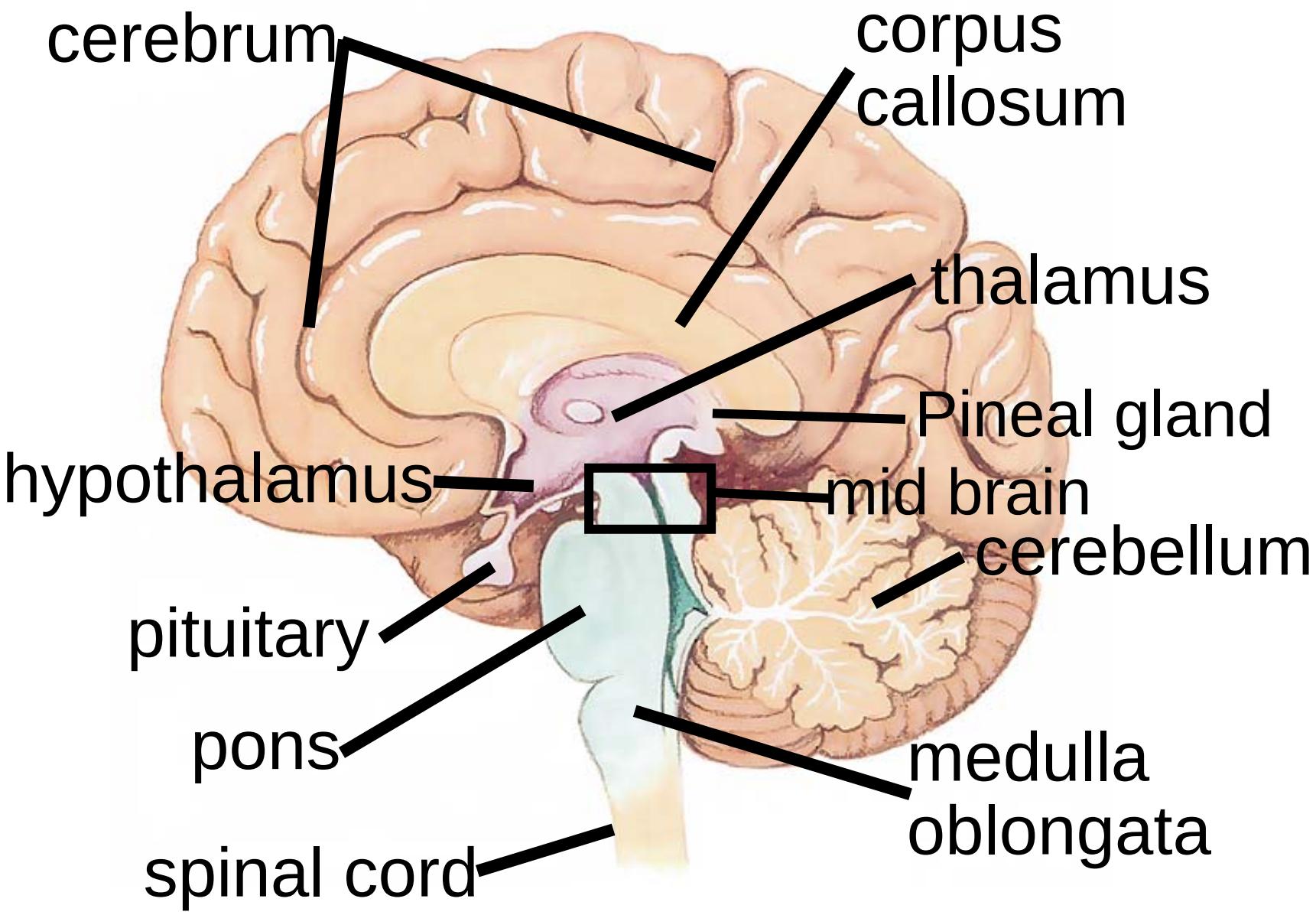
- Large region in temporal, parietal, and occipital lobes
- Plays a role in recognizing patterns and faces and localizing us in space
- Involved in understanding written and spoken language (Wernicke’s area)

Limbic Association Area

- Part of the limbic system
- Provides emotional impact that helps establish memories

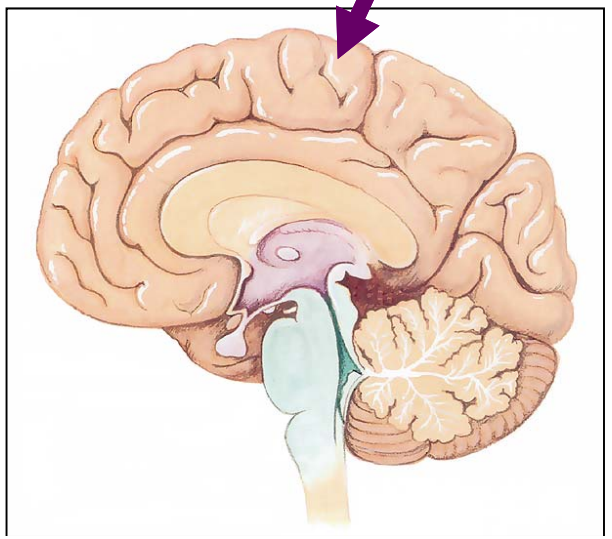
The Limbic System



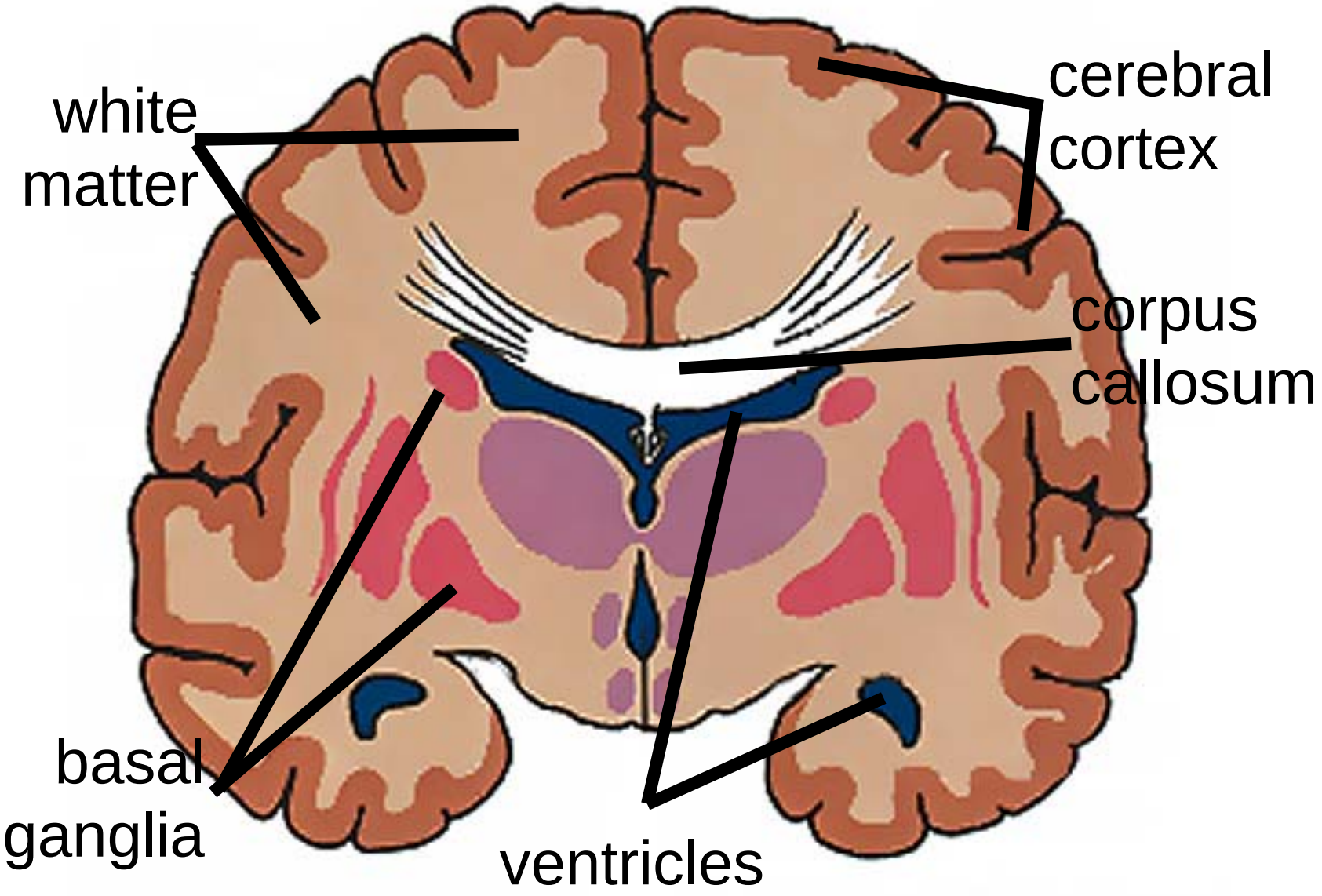

cerebrum
corpus callosum
thalamus
Pineal gland
hypothalamus
mid brain
cerebellum
pituitary
pons
medulla oblongata
spinal cord

Cerebrum

- Involved with higher brain functions.
- Processes sensory information.
- Initiates motor functions.
- Integrates information.



Cerebrum Cross-Section



Right-Left Specialization of the Cerebrum

left side

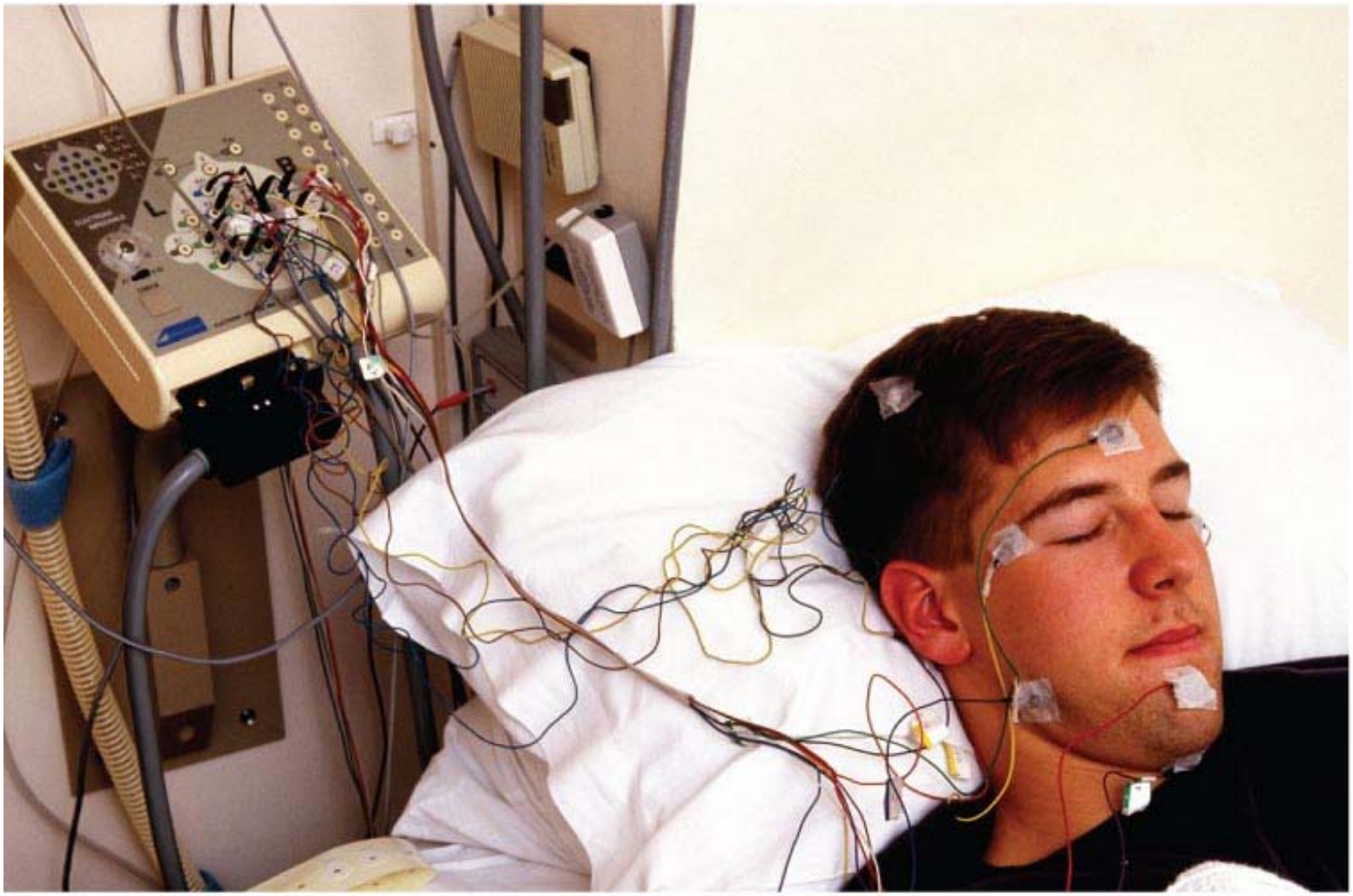
- language development
- mathematical & learning capabilities
- sequential thought processes

right side

- visual spatial skills
- musical and artistic activities
- intuitive abilities

Electroencephalogram (EEG)

- Records electrical activity that accompanies brain function
- Measures electrical potential differences between various cortical areas



(a) Scalp electrodes are used to record brain wave activity (EEG).

Figure 12.20a

Brain Waves

- Patterns of neuronal electrical activity
- Generated by synaptic activity in the cortex
- Each person’s brain waves are unique
- Can be grouped into four classes based on frequency measured as Hertz (Hz)

Types of Brain Waves

Alpha waves:

- 8-13 Hz
- awake or resting w/eyes closed
- disappear during sleep

Beta Waves:

- 14-30 Hz
- sensory input and mental activity

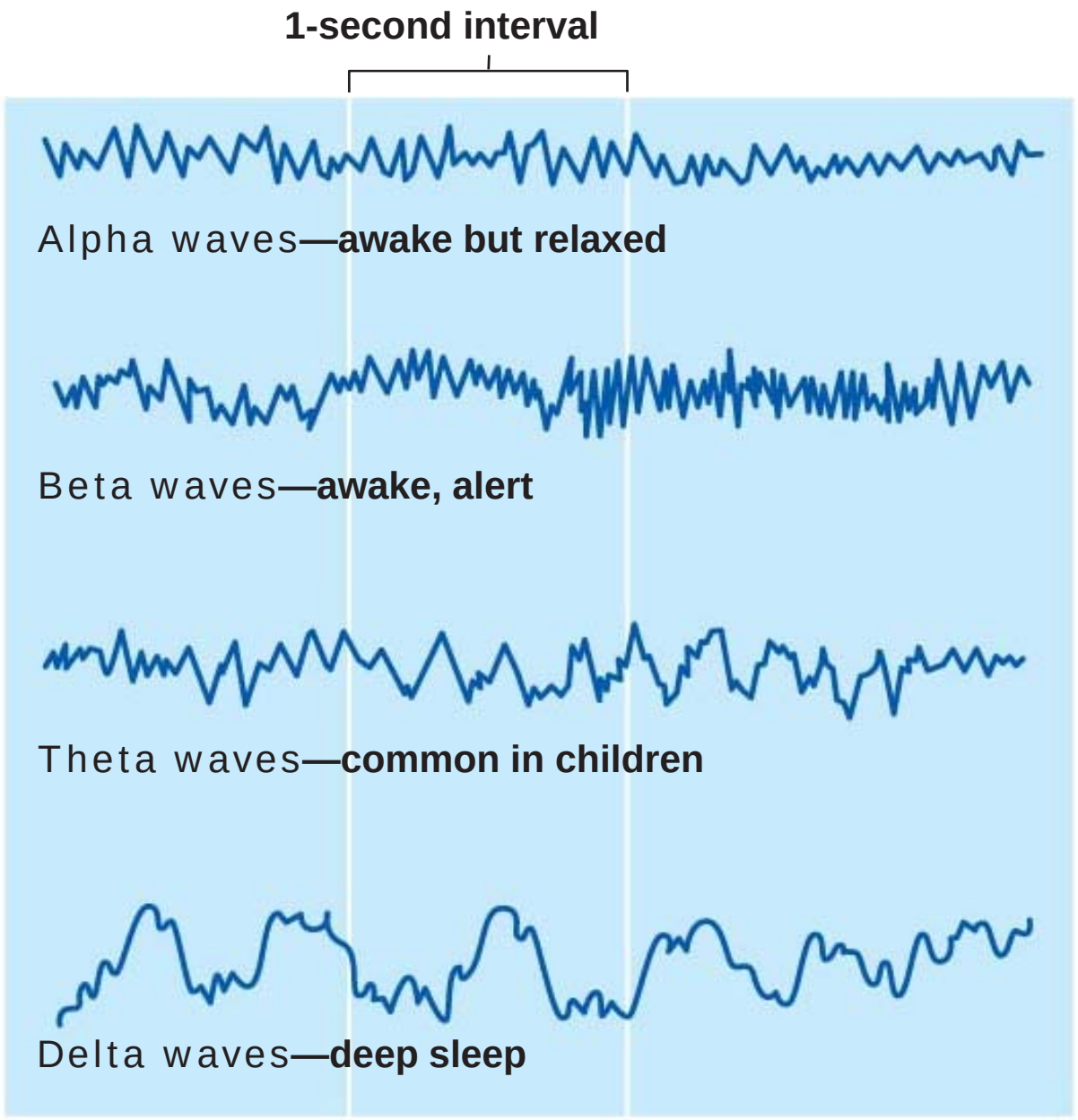
Brain Waves

Theta Waves:

- 4-7 Hz
- emotional stress

Delta Waves:

- 1-5 Hz
- deep sleep in adults
- normal in awake infants



(b) Brain waves shown in EEGs fall into four general classes.

Figure 12.20b

Brain Waves: State of the Brain

- Change with age, sensory stimuli, brain disease, and the chemical state of the body
- EEGs used to diagnose and localize brain lesions, tumors, infarcts, infections, abscesses, and epileptic lesions
- A flat EEG (no electrical activity) is clinical evidence of death

Epilepsy

- A victim of epilepsy may lose consciousness, fall stiffly, and have uncontrollable jerking
- Epilepsy is not associated with intellectual impairments
- Epilepsy occurs in 1% of the population

Epileptic Seizures

- Absence seizures, or petit mal
  - Mild seizures seen in young children where the expression goes blank
- Tonic-clonic (grand mal) seizures
  - Victim loses consciousness, bones are often broken due to intense contractions, may experience loss of bowel and bladder control, and severe biting of the tongue

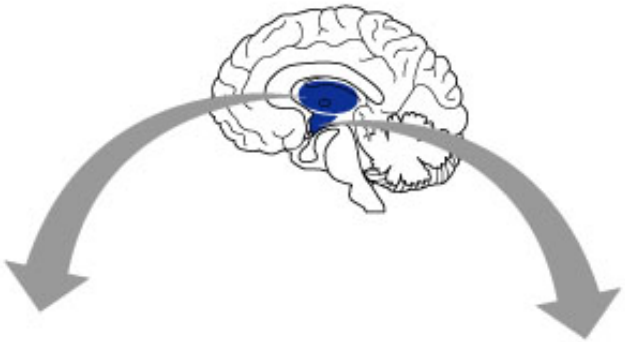
Control of Epilepsy

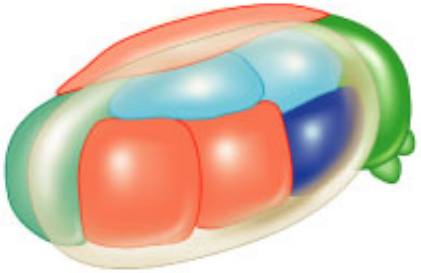
- Anticonvulsive drugs
- Vagus nerve stimulators implanted under the skin of the chest can keep electrical activity of the brain from becoming chaotic

Diencephalon

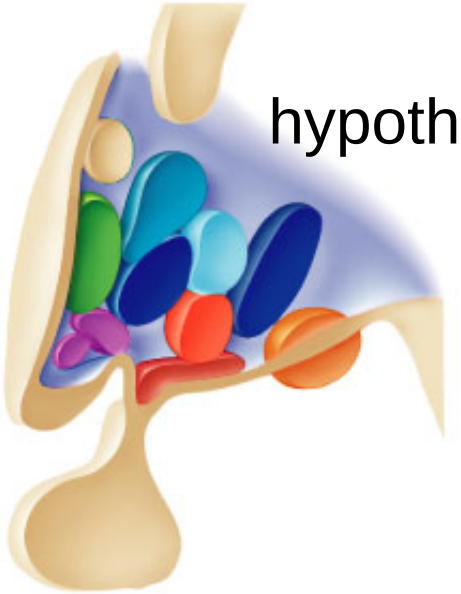
- Thalamus
- Epithalamus:
  - pineal
  - habenular nuclei
- Hypothalamus
- Subthalamus
  - subthalamic nuclei

Diencephalon





thalamus



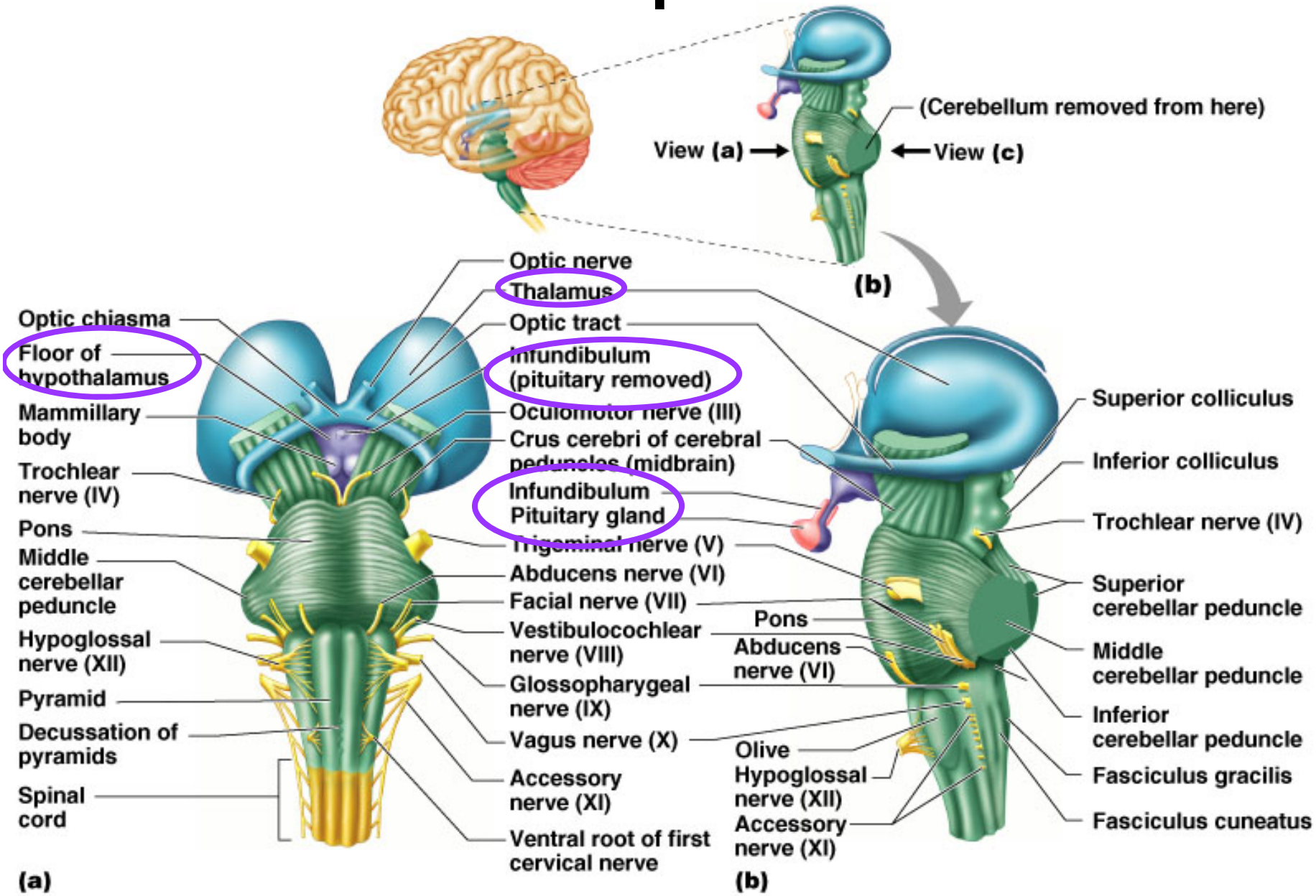
hypothalamus

pituitary

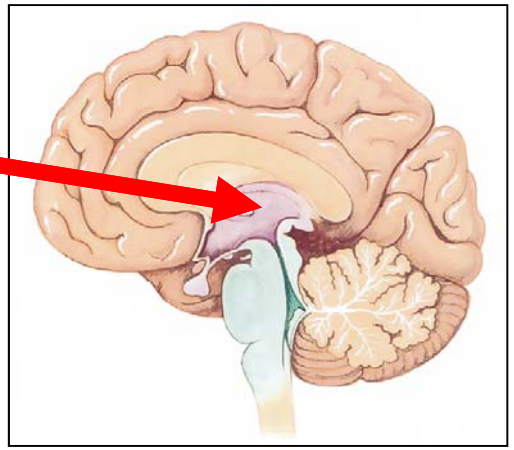
(a)

(b)

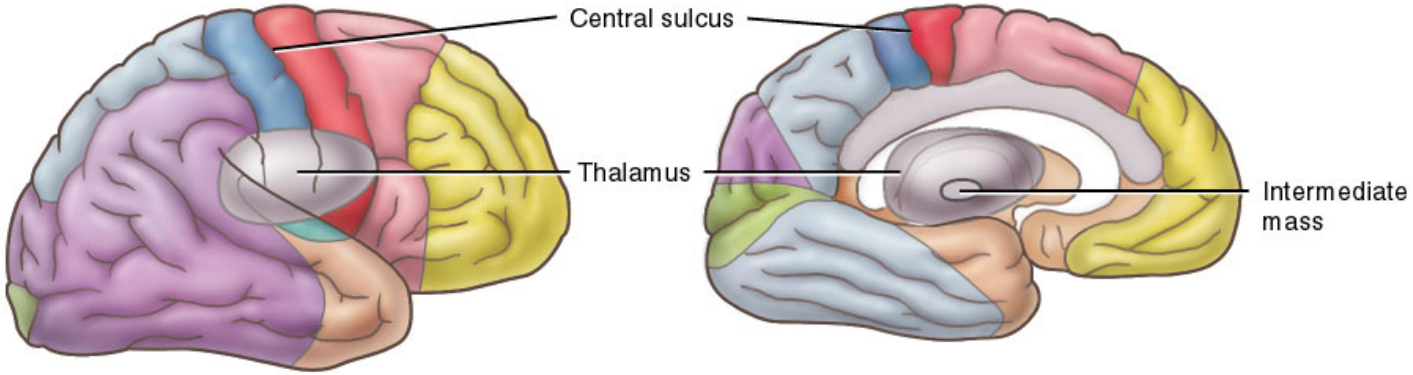
Diencephalon



Thalamus



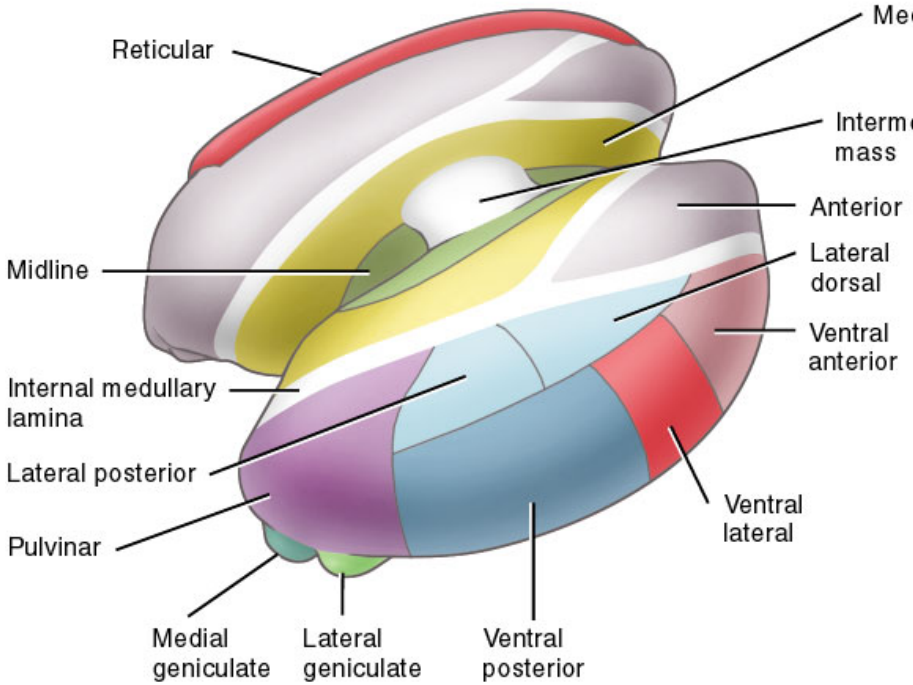
- Relay center for sensory tracts from the spinal cord to the cerebrum.
- Contains centers for sensation of pain, temperature, and touch.
- Involved with emotions and alerting or arousal mechanisms.



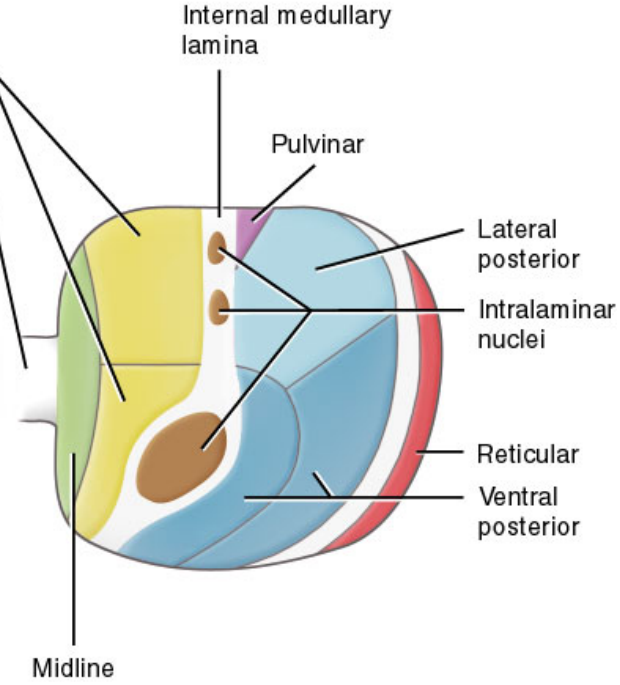
(a) Lateral view of right cerebral hemisphere

(b) Medial view of left cerebral hemisphere

Thalamus

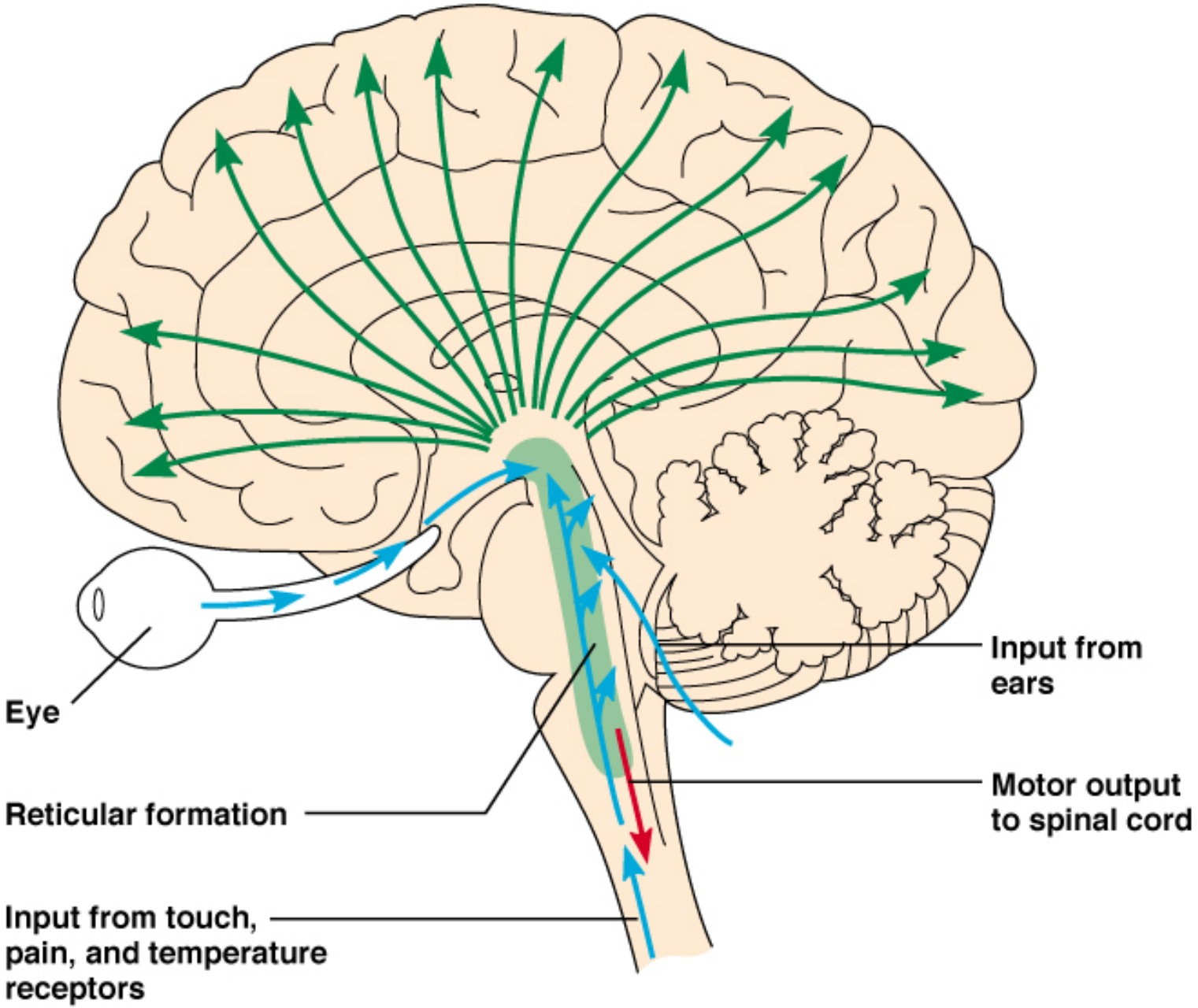


(c) Superolateral view of thalamus showing locations of thalamic nuclei (reticular nucleus is shown on the left side only; all other nuclei are shown on the right side)

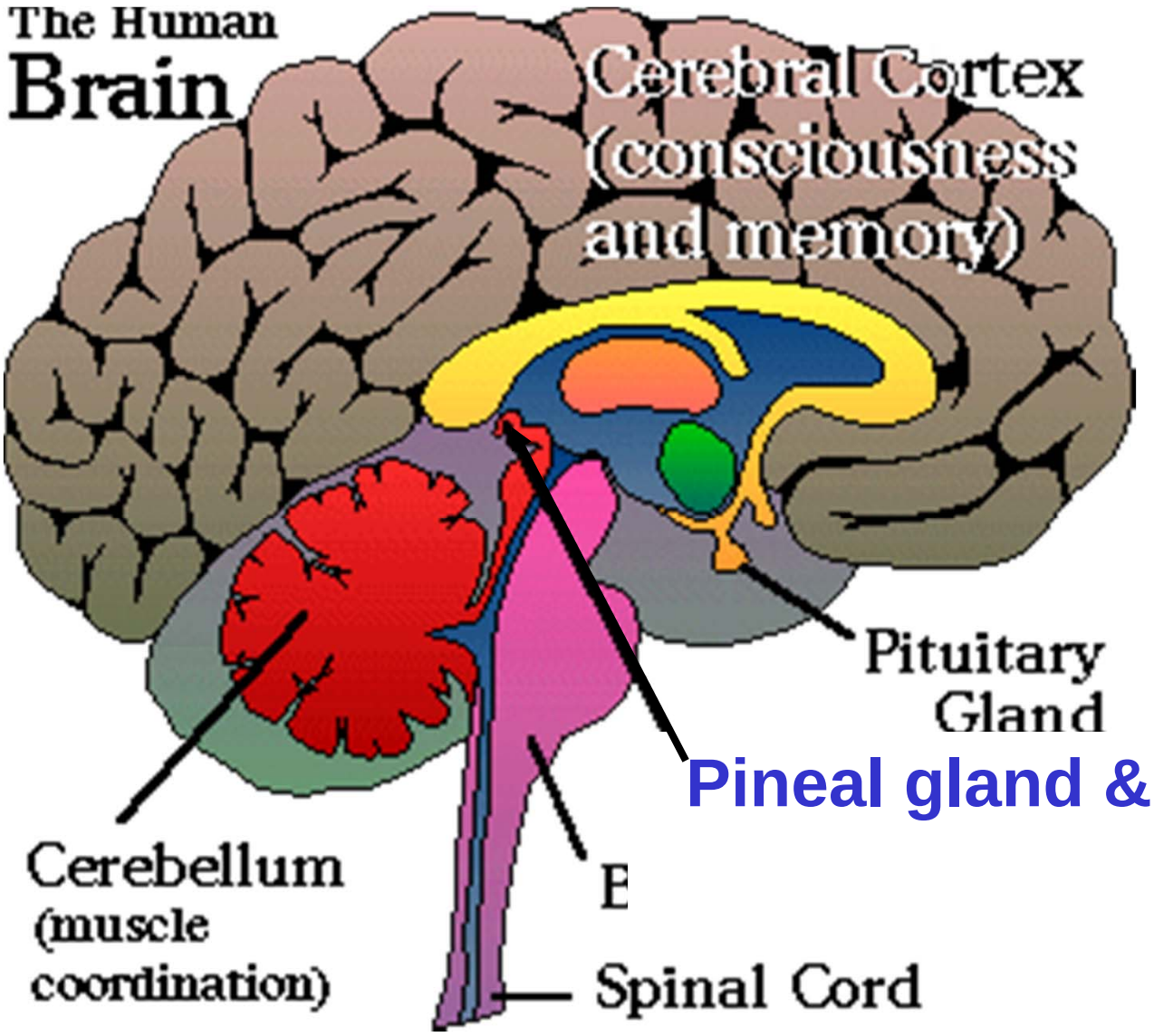


(d) Transverse section of right side of thalamus showing locations of thalamic nuclei

The Reticular Formation



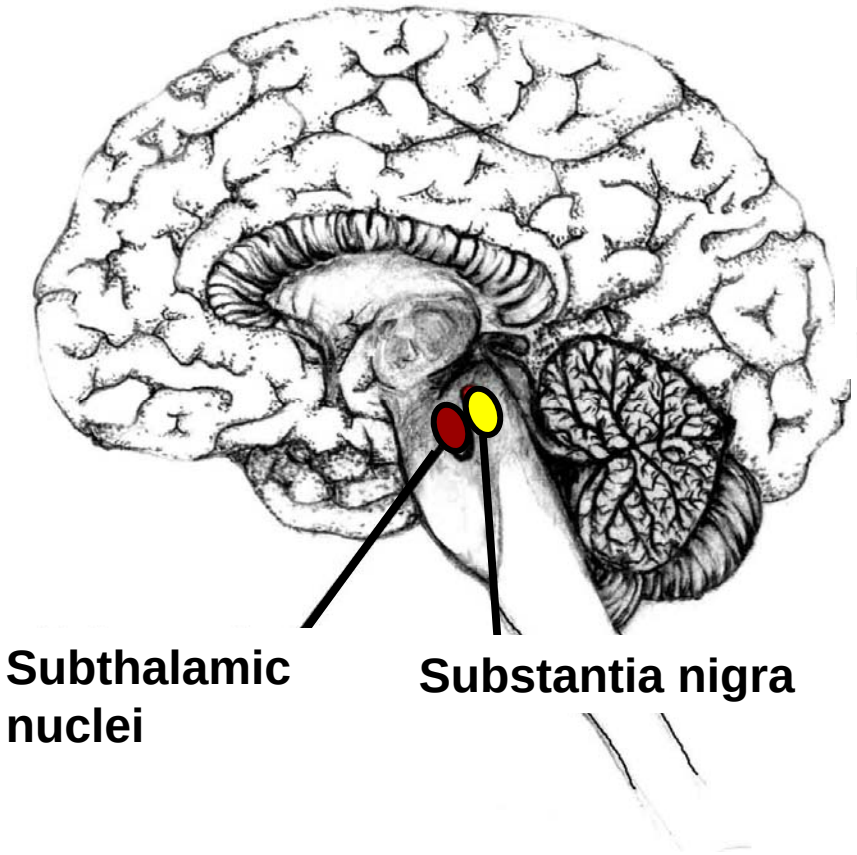
Epithalamus

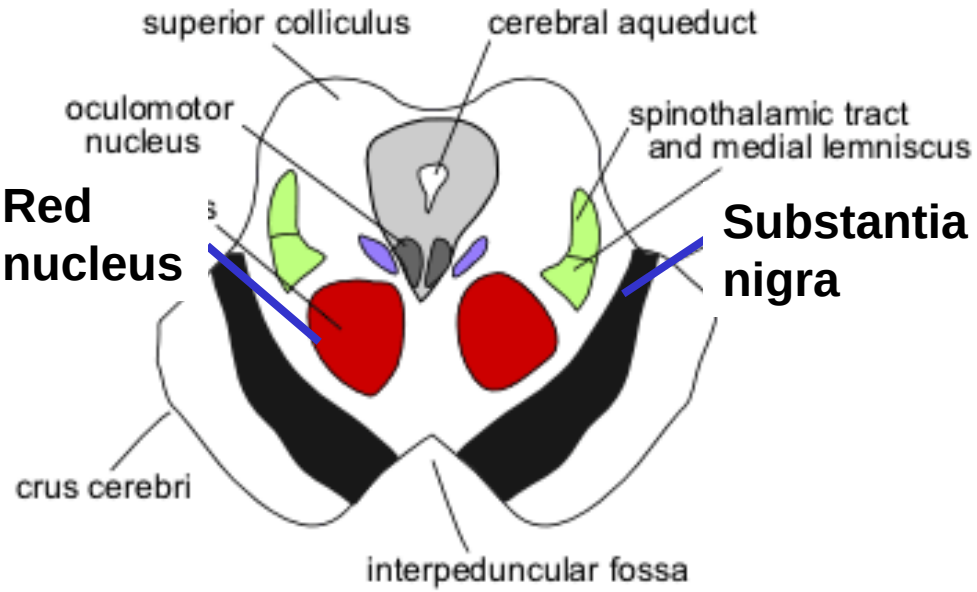


Pineal gland & habenular nuclei

Subthalamus

- Subthalamic nuclei
- Portions of red nucleus
- Portions of substantia nigra (dopamine)

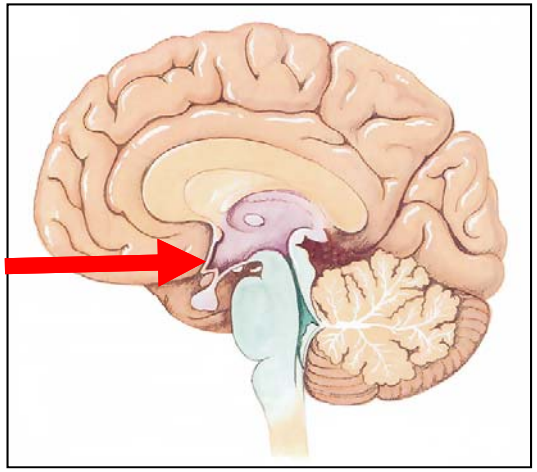




Hypothalamus

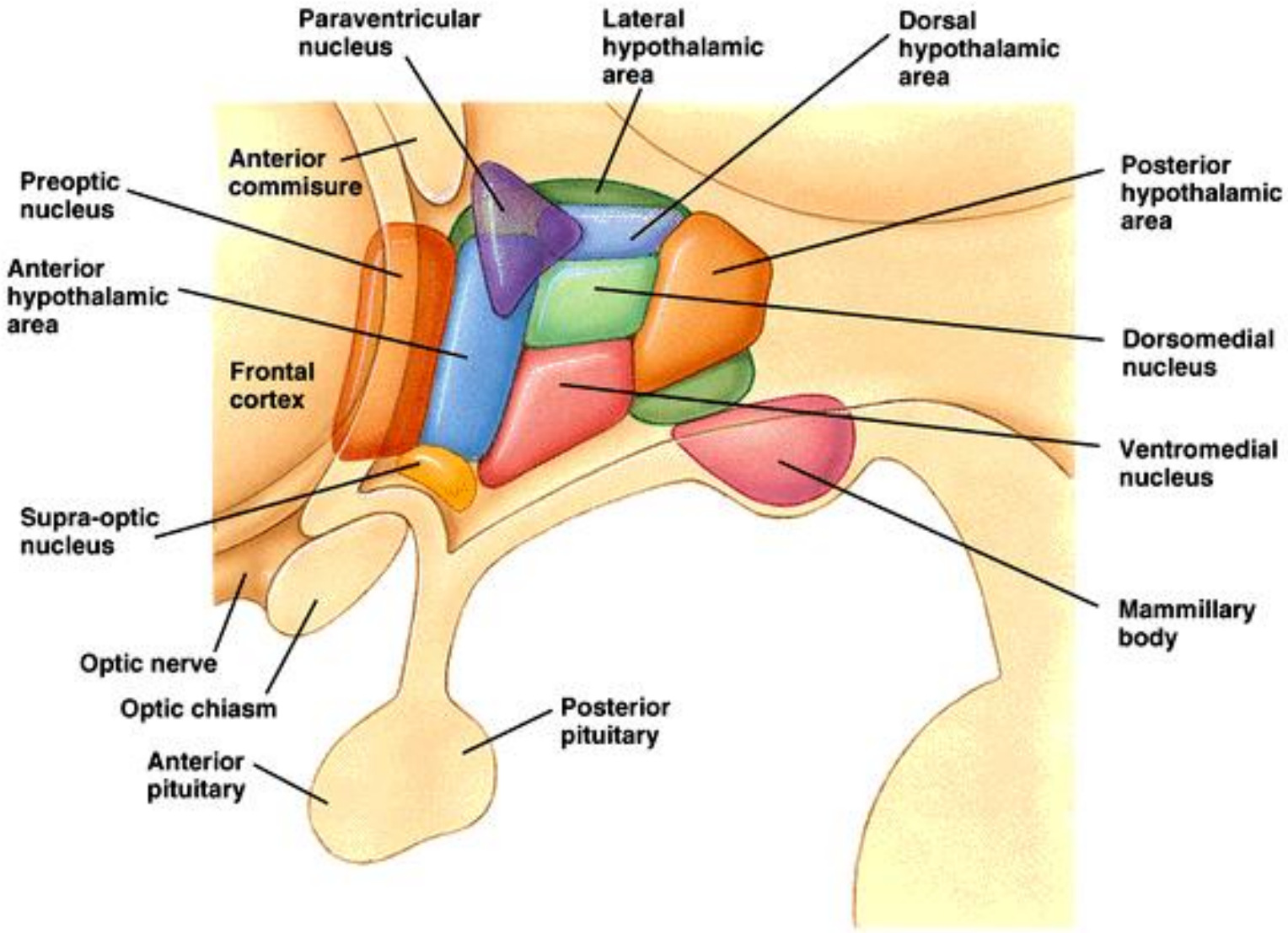
Regulates:

- autonomic control center- blood pressure, rate and force of heart contraction, center for emotional response and behavior
- body temperature
- water balance and thirst
- sleep/wake cycles
- appetite
- sexual arousal
- control of endocrine functioning:

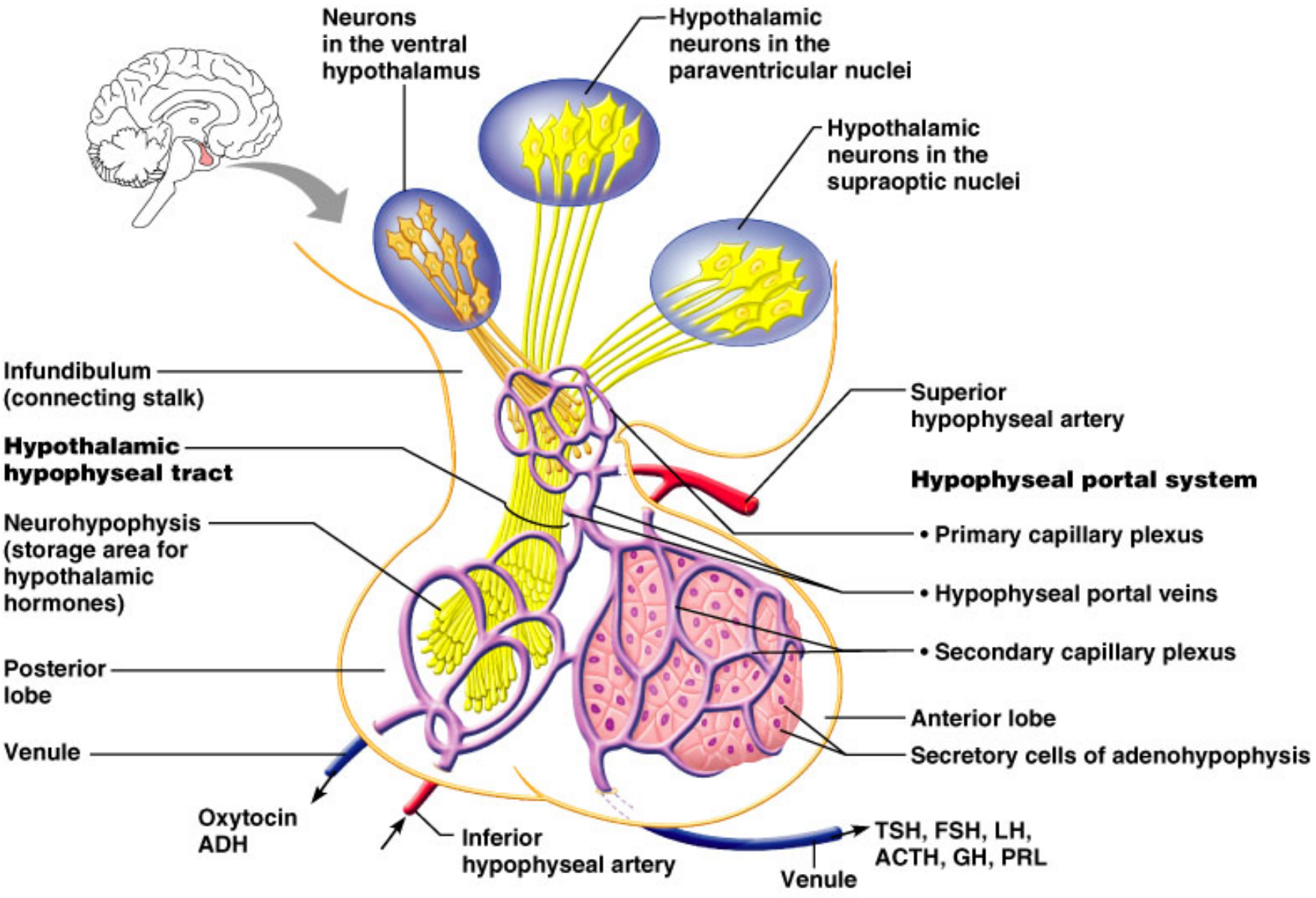


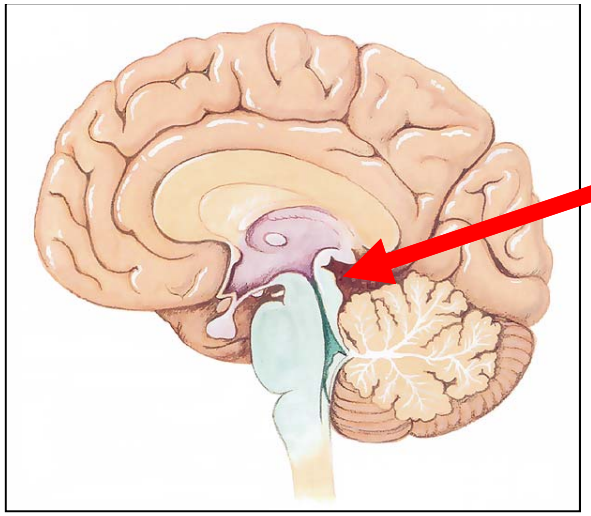
Acts on the pituitary gland through the release of neurosecretions.

Hypothalamus



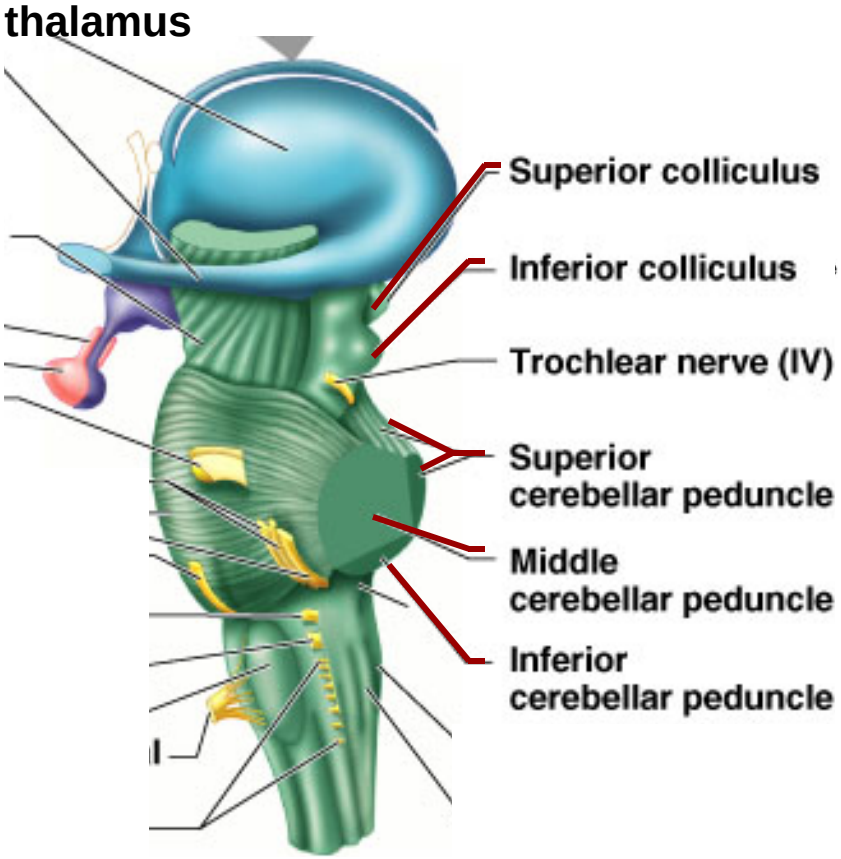
Pituitary

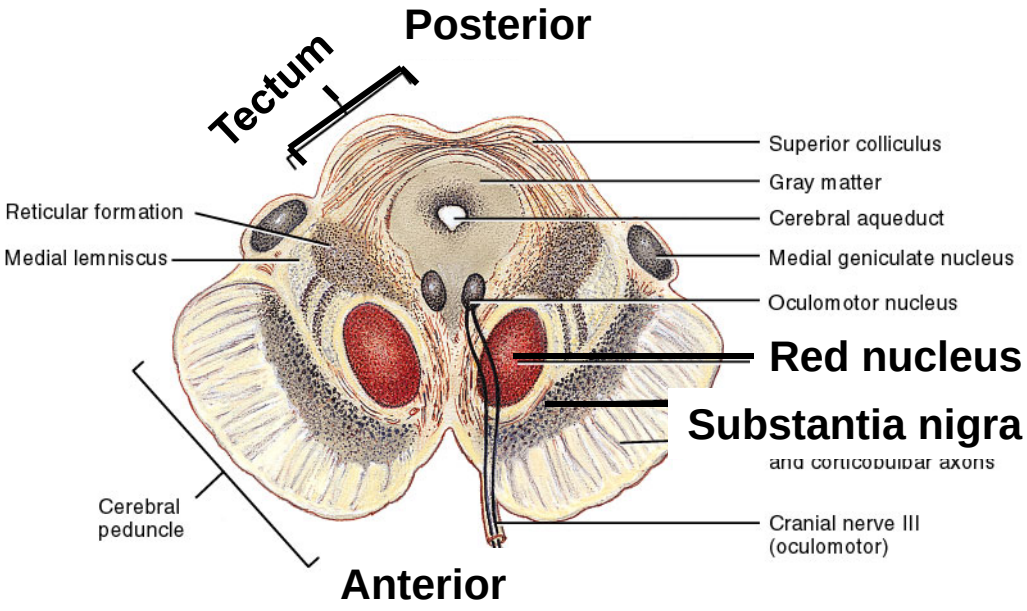




Midbrain

- Cerebellar peduncles
- Tectum
- Superior colliculi
- Inferior colliculi
- Substantia nigra
- Red nuclei





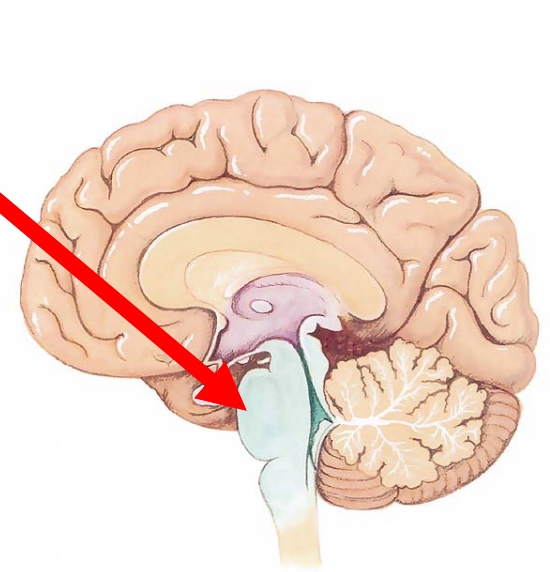
(b) Transverse section of midbrain

14.07b

Midbrain

- Contains ascending and descending tracts to the cerebrum and thalamus.
- Reflex center for eye muscles.
- Also involved with processing visual and auditory information (connects head movements with visual and auditory stimuli).

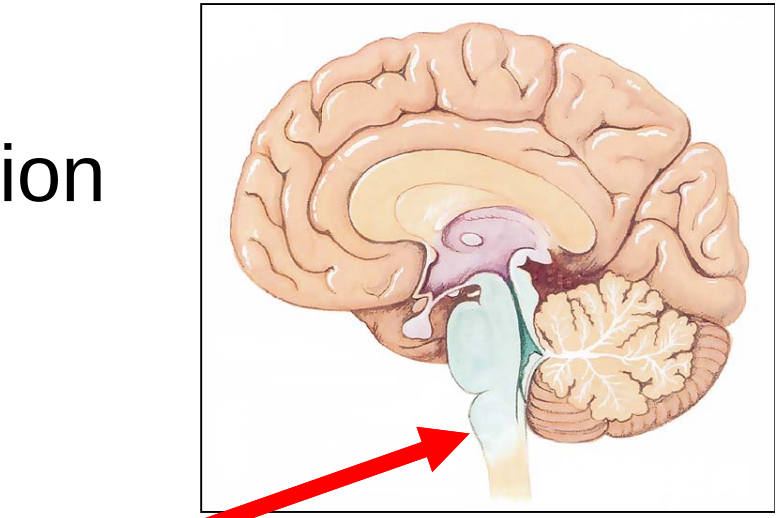
Pons



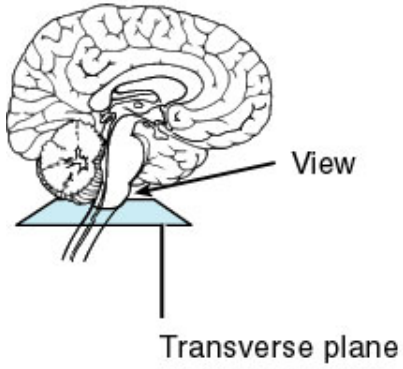
- Connects the two halves of the cerebellum.
- Regulates breathing.
- Associated w/ cranial nerves V, VI, VII, & VIII

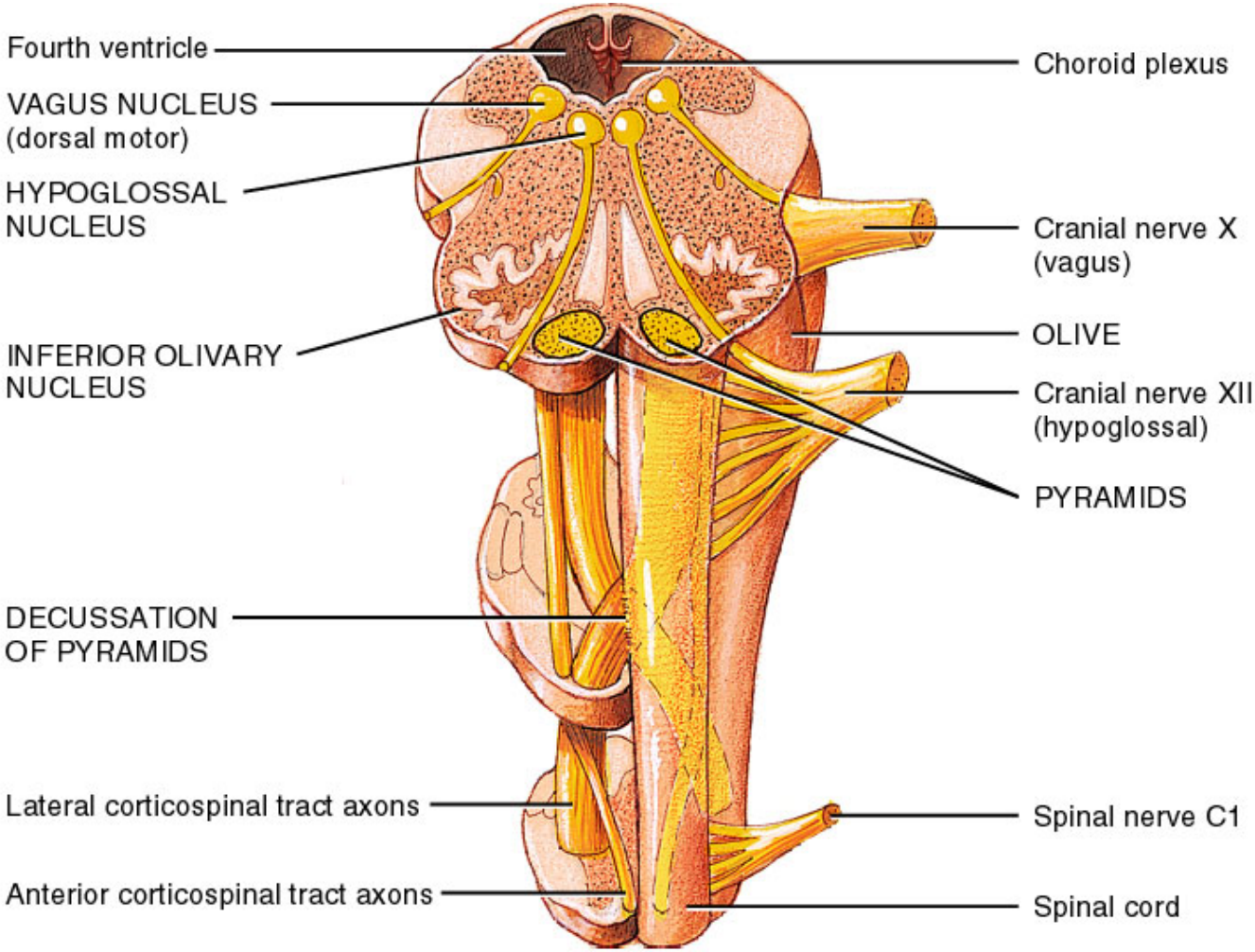
Medulla Oblongata

- Composed of nerve tracts decusate
- An extension of the spinal cord
- Almost all of the cranial nerves arise from this region
- (VIII, IX, X, XI, XII)



Medulla Oblongata





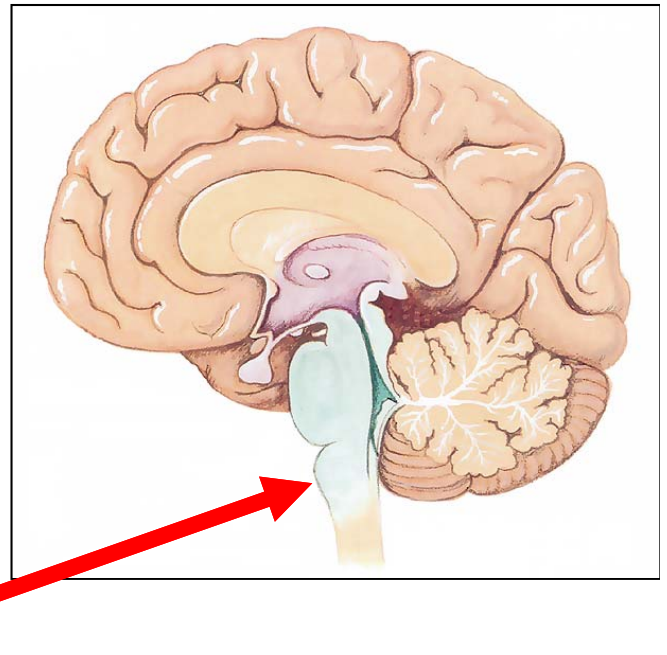
Transverse section and anterior surface of medulla oblongata

14.06

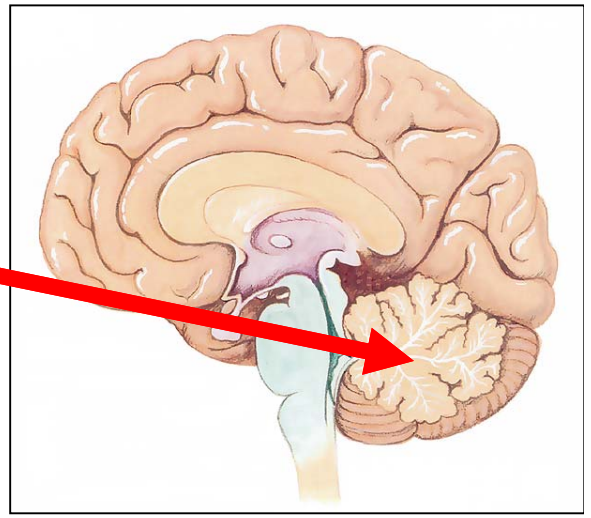
Medulla Oblongata

Contains control centers for many subconscious activities

- Respiratory rate
- Heart rate
- Arteriole constriction
- Swallowing
- Hiccupping
- Coughing
- Sneezing



The Cerebellum



- 11% of brain mass
- Dorsal to the pons and medulla
- Controls fine movement coordination
- Balance and equilibrium
- Muscle tone

Anatomy of the Cerebellum

- Two hemispheres connected by vermis
- Each hemisphere has three lobes
  - Anterior, posterior, and flocculonodular
- Folia—transversely oriented gyri
- Arbor vitae—distinctive treelike pattern of the cerebellar white matter

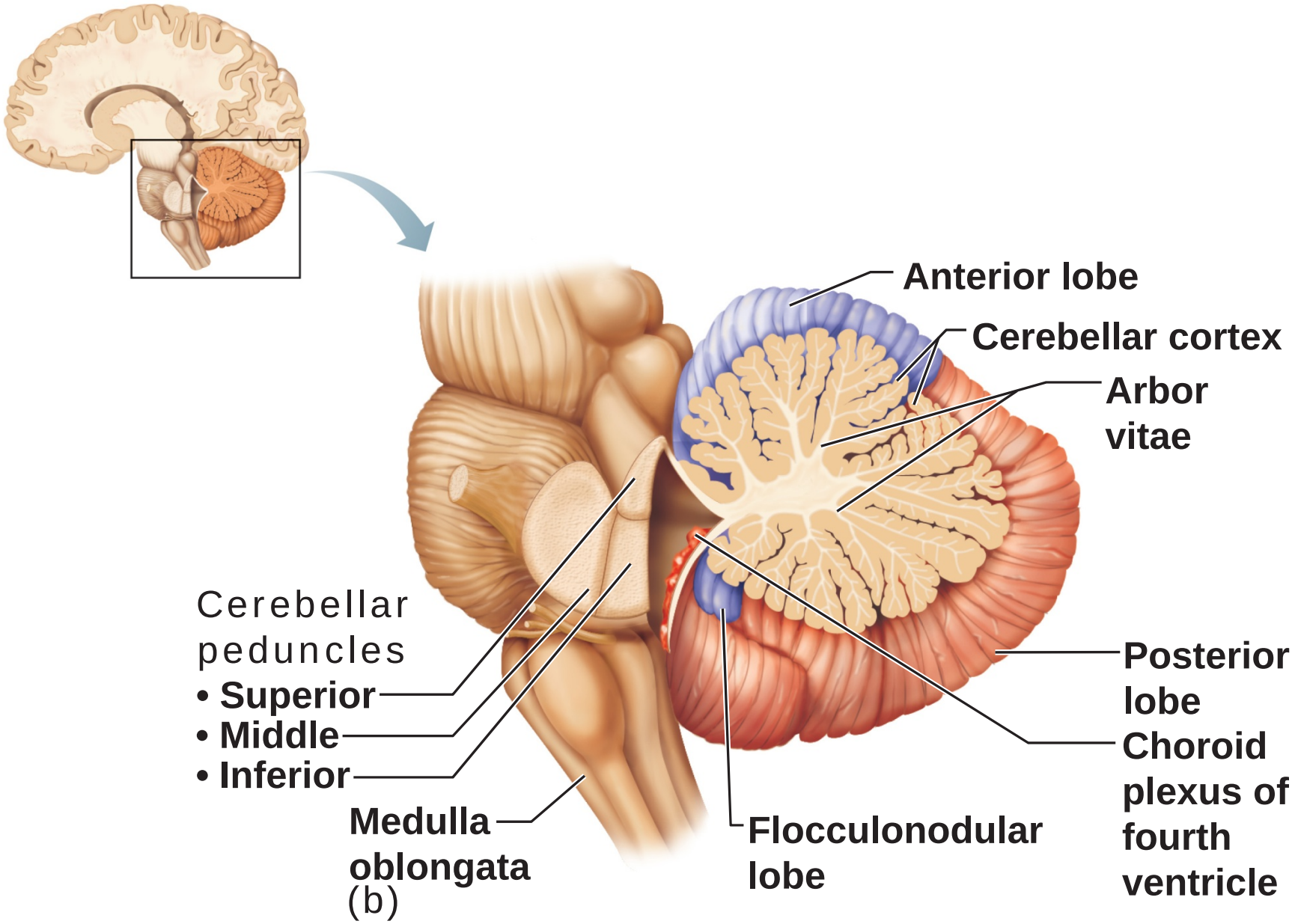
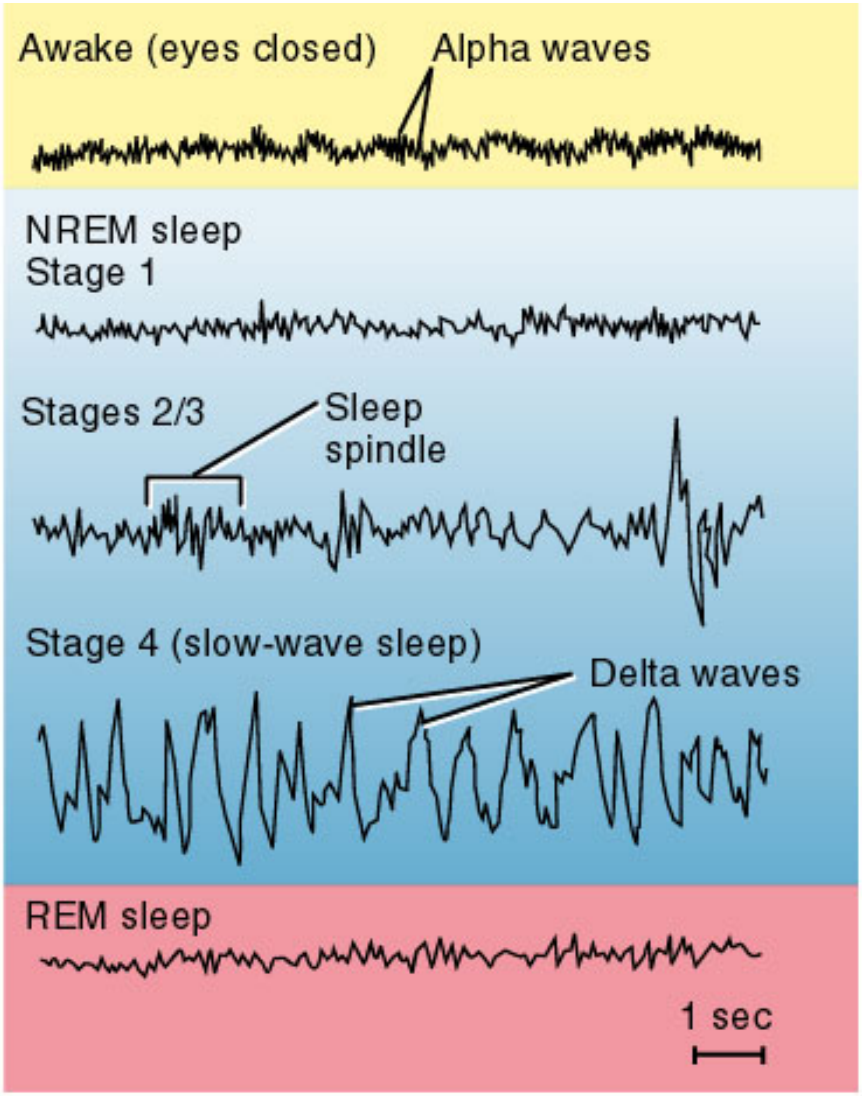


Figure 12.17b

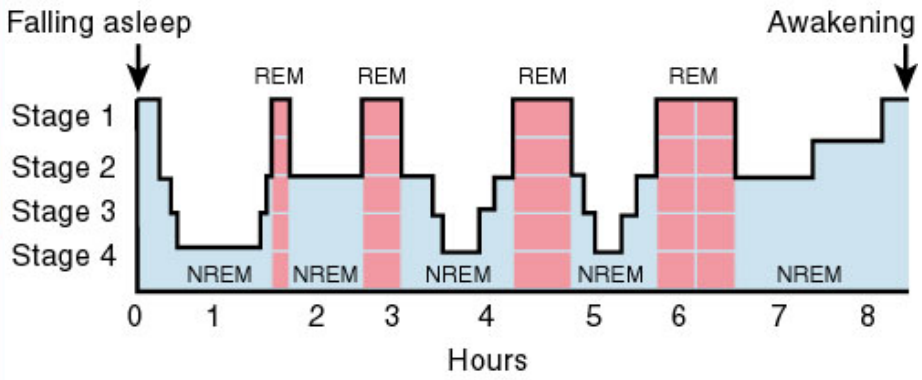
Importance of Sleep

- Slow-wave sleep (NREM stages 3 and 4) is presumed to be the restorative stage
- People deprived of REM sleep become moody and depressed
- REM sleep may be a reverse learning process where superfluous information is purged from the brain
- Daily sleep requirements decline with age
- Stage 4 sleep declines steadily and may disappear after age 60

Stages of Sleep



(a) EEG waves during sleep stages



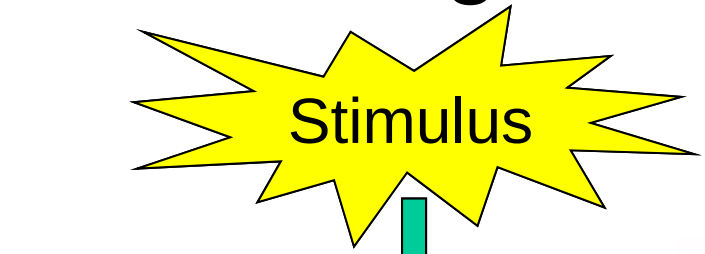
(b) Pattern of NREM and REM sleep over one sleep period

15.11

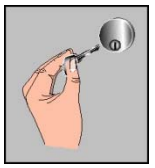
Sleep Disorders

- Narcolepsy
  - Lapsing abruptly into sleep from the awake state
- Insomnia
  - Chronic inability to obtain the amount or quality of sleep needed
- Sleep apnea
  - Temporary cessation of breathing during sleep

Learning & Memory



Sensory organs



perception

Sensory Memory
(millisecond-1)

attention

repetition

Short-Term Memory
Working Memory
(< 1 minute)

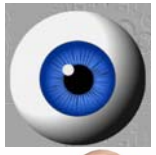
forgetting

Long-Term Memory
(days, months, years)

Learning & Memory

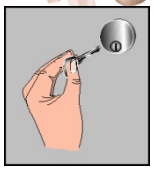
Sensory Memory:

A sensory memory exists for each sensory channel:



iconic memory for visual stimuli

echoic memory for aural stimuli



haptic memory for touch

Information →sensory memory→ short-term memory by attention, thereby filtering the stimuli to only those which are of interest at a given time.

Learning & Memory

Short-term Memory:

- acts as a scratch-pad for temporary recall of the information under process
- can contain at any one time seven, plus or minus two, "chunks" of information
- lasts around twenty seconds.

Short-term Memory Quiz (30 sec)

eggs
drawing
rock
apple
focus
mission
favor
ice

brain
flag
trial
partner
house
life
chair

Learning & Memory

Long-term Memory:

- intended for storage of information over a long time.
- Short-term→long-term (rehearsal)
- Little decay
  - Storage
  - Deletion- decay and interference
  - Retrieval-recall and recognition

Learning & Memory

Long-term Memory:

Why we forget:

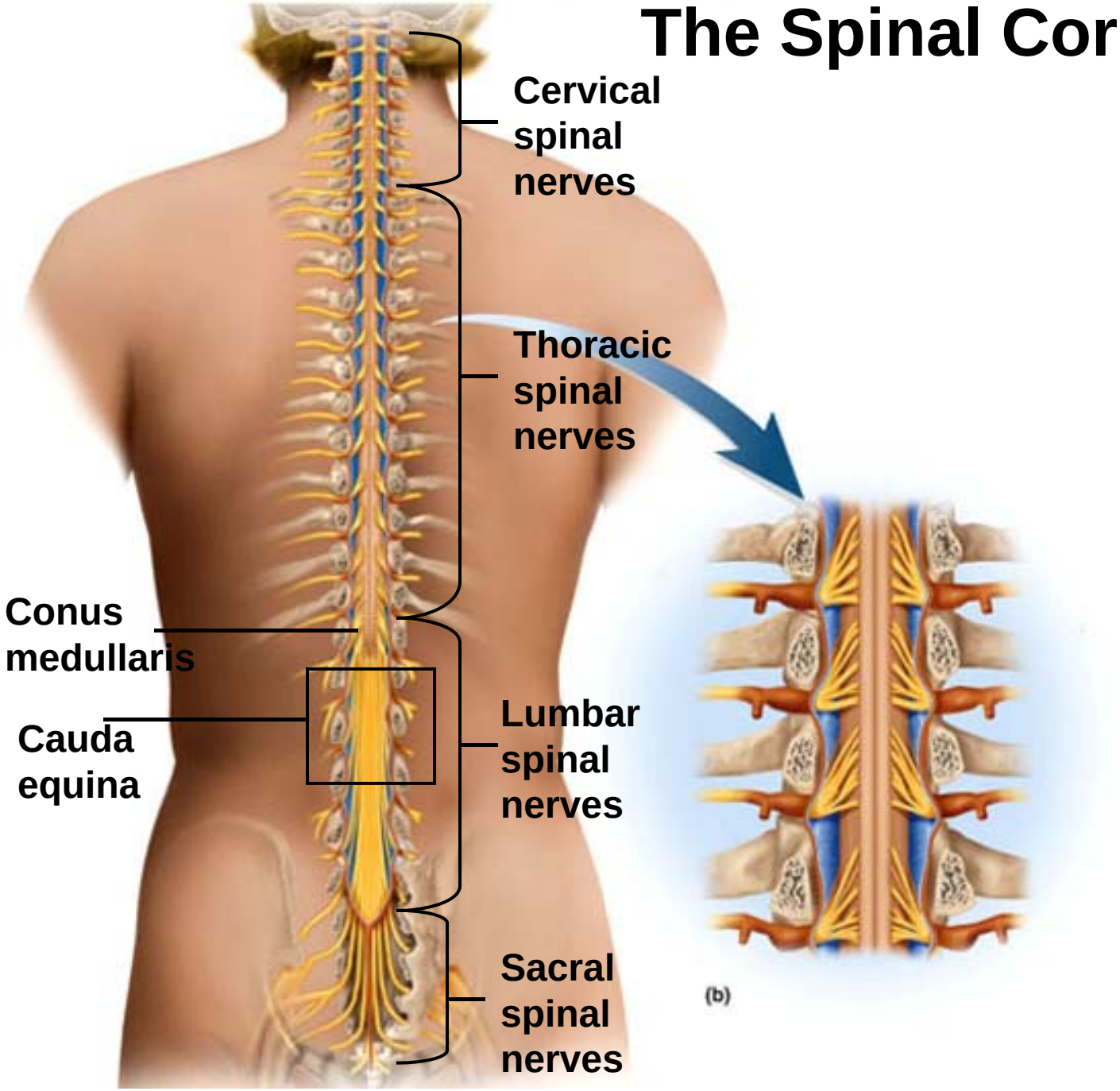
- fading (trace decay) over time
- interference (overlaying new information over the old)
- lack of retrieval cues.

Learning & Memory

Encoding in Long-term Memory:

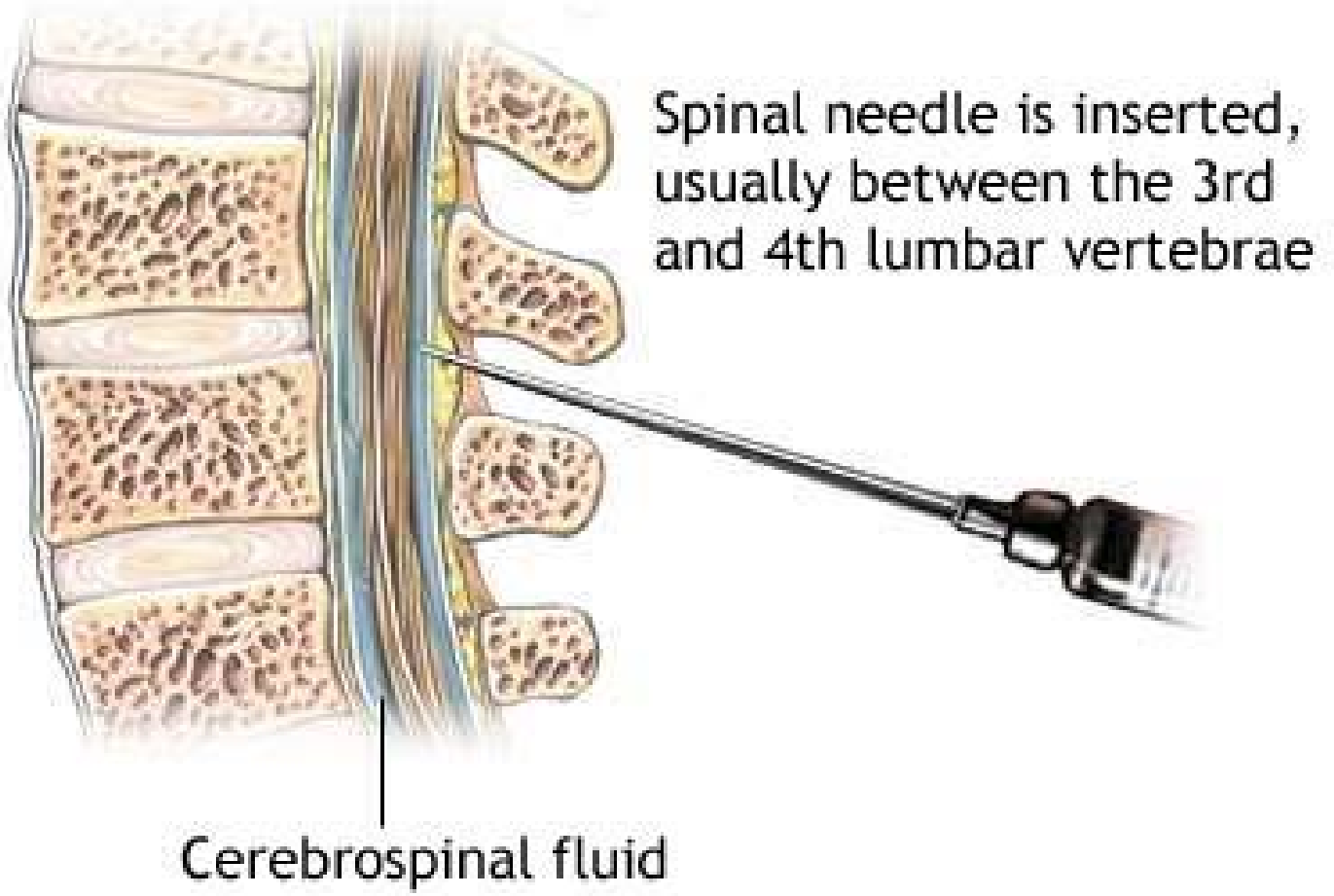
- Organizing
- Practicing
- Spacing
- Making meaning
- Emotionally engaging

The Spinal Cord

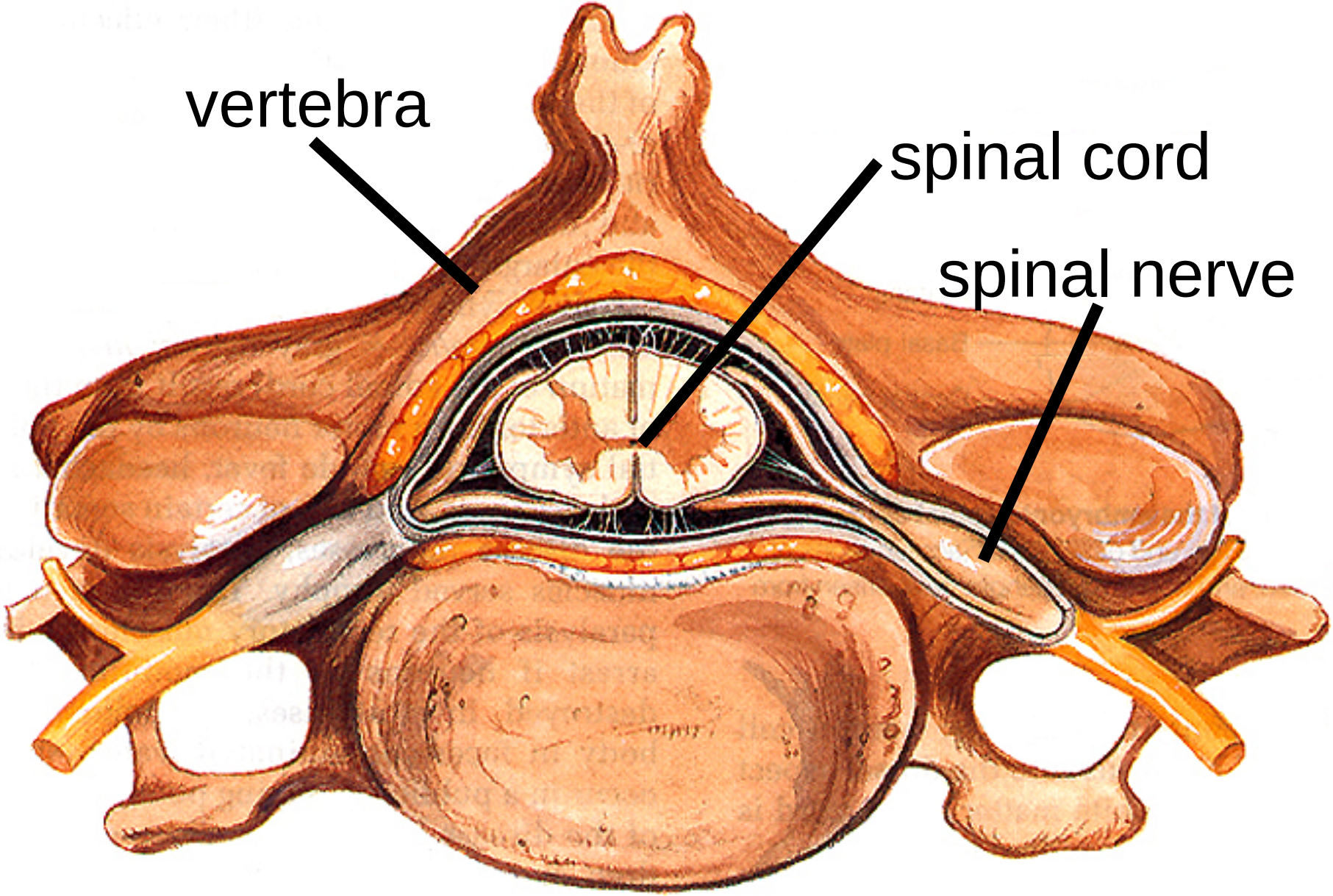


Lumbar Tap

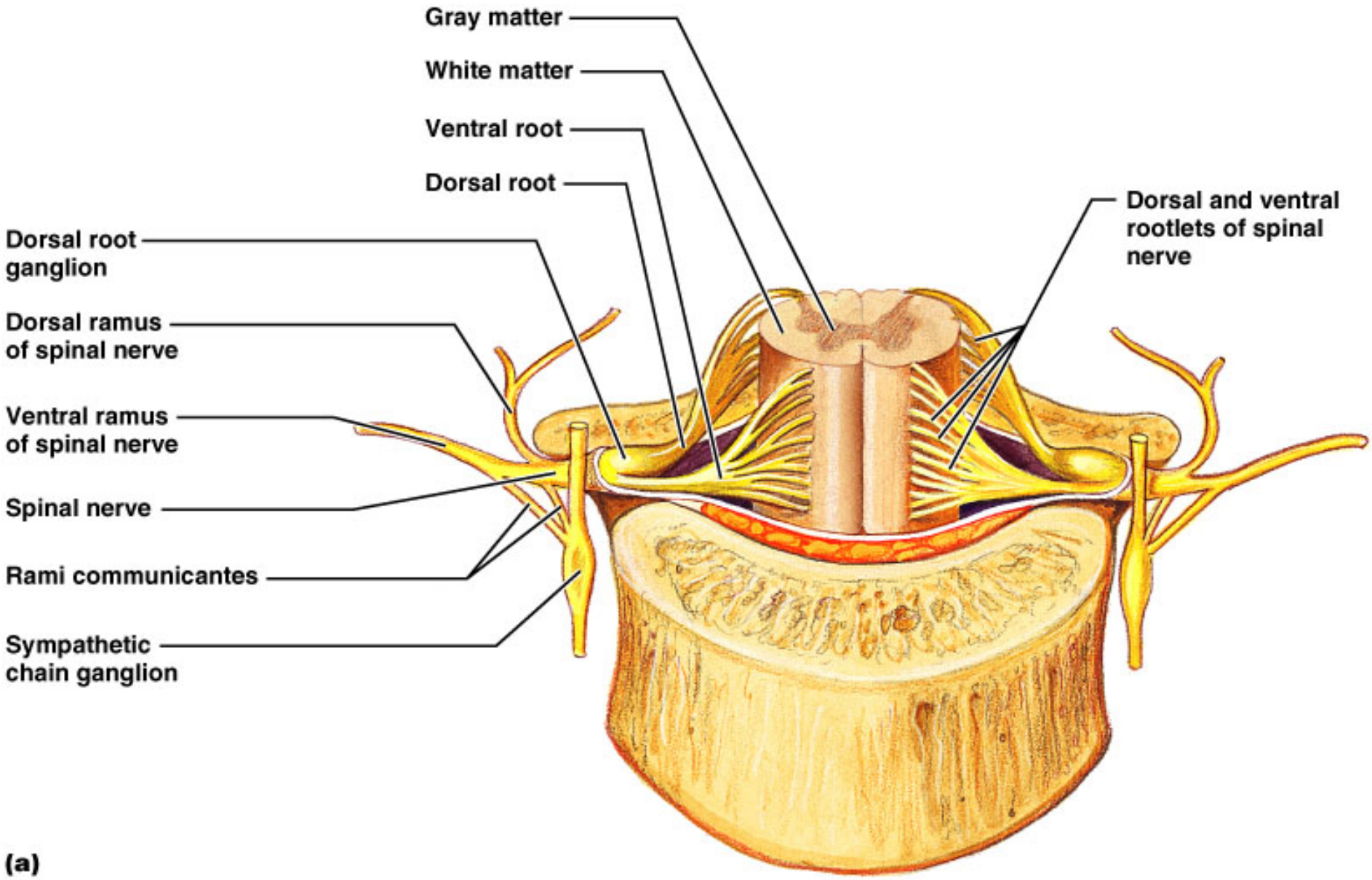
Collect CSF for testing



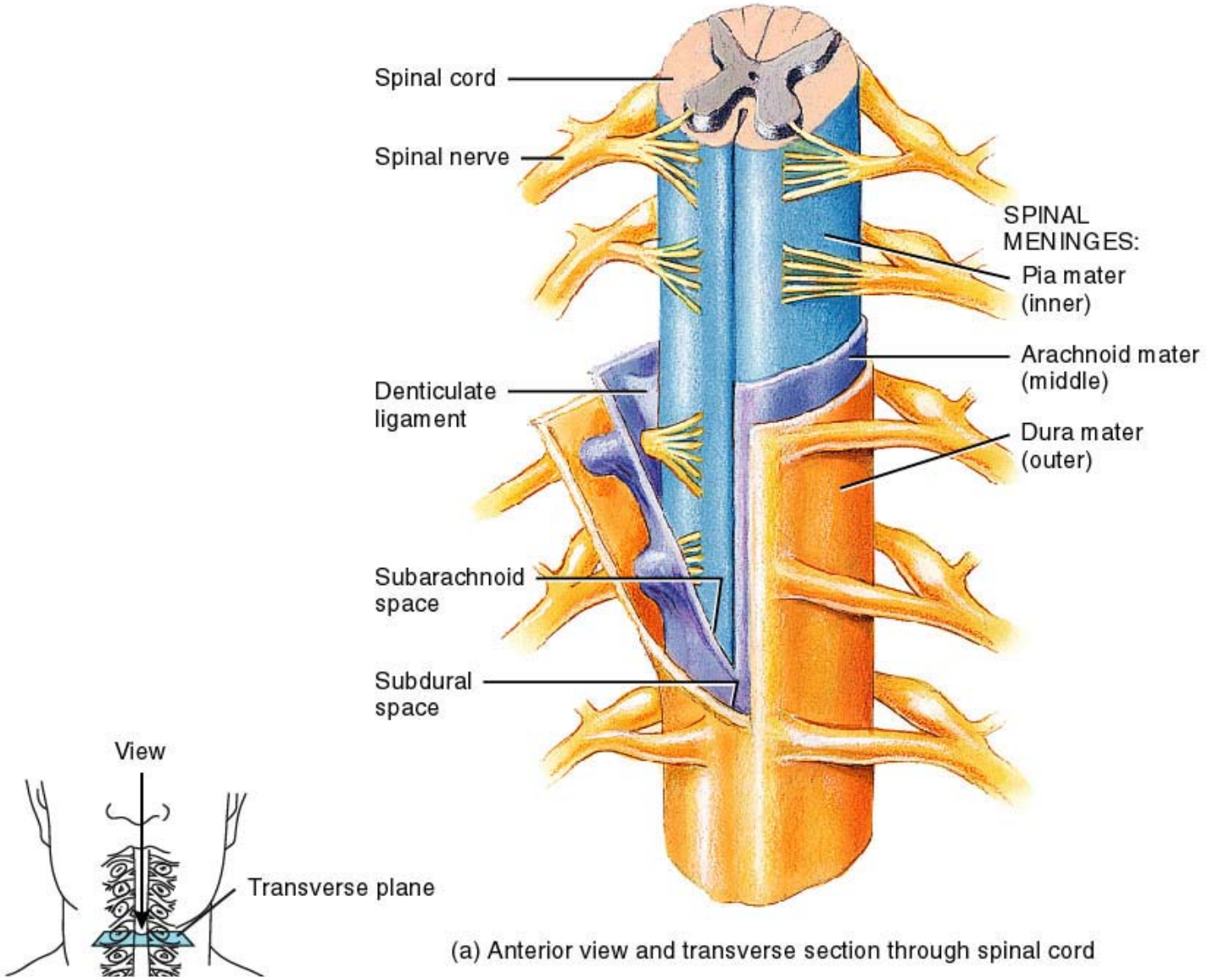
The Spinal Cord



Spinal Nerves

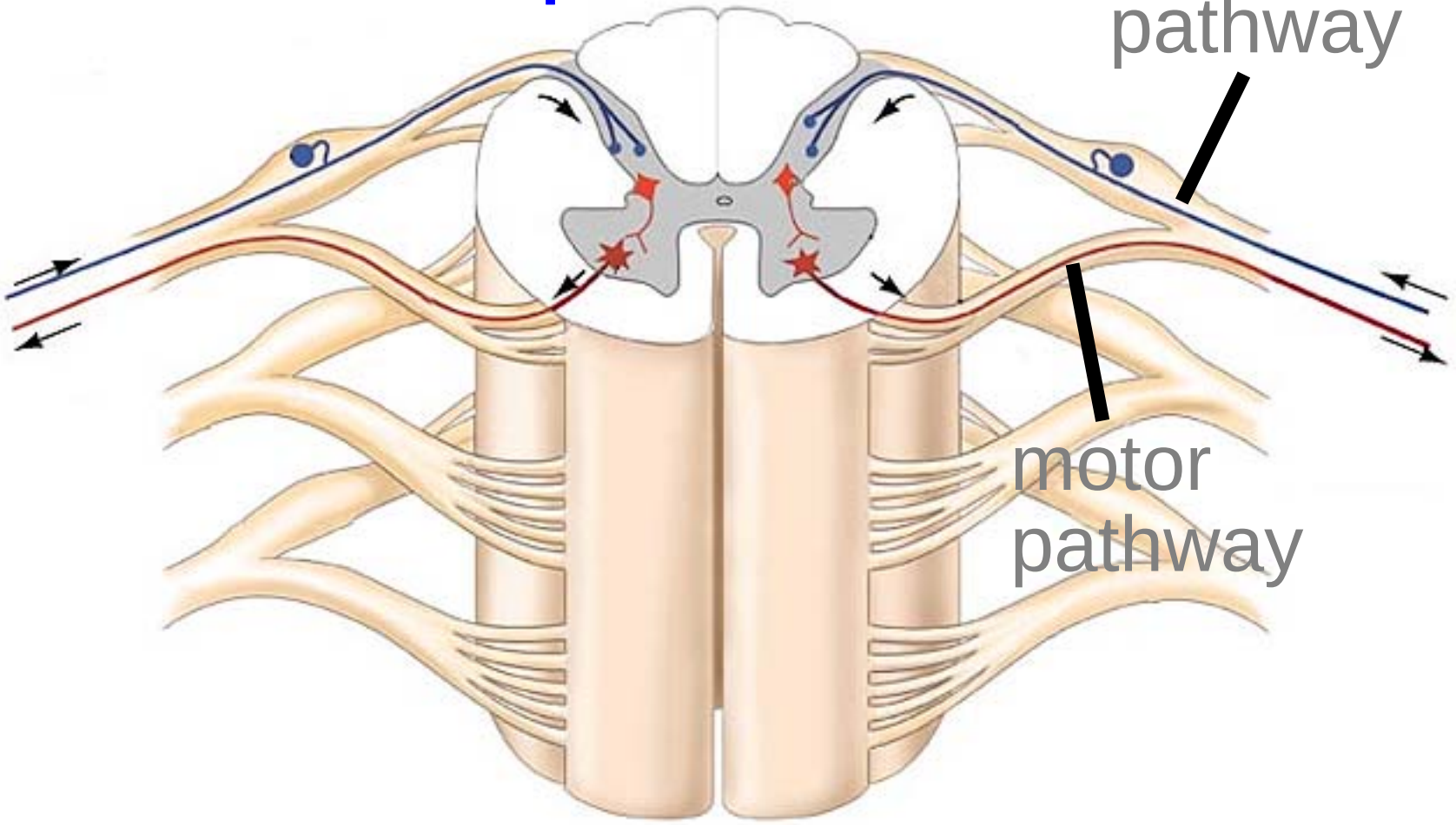


Spinal Cord

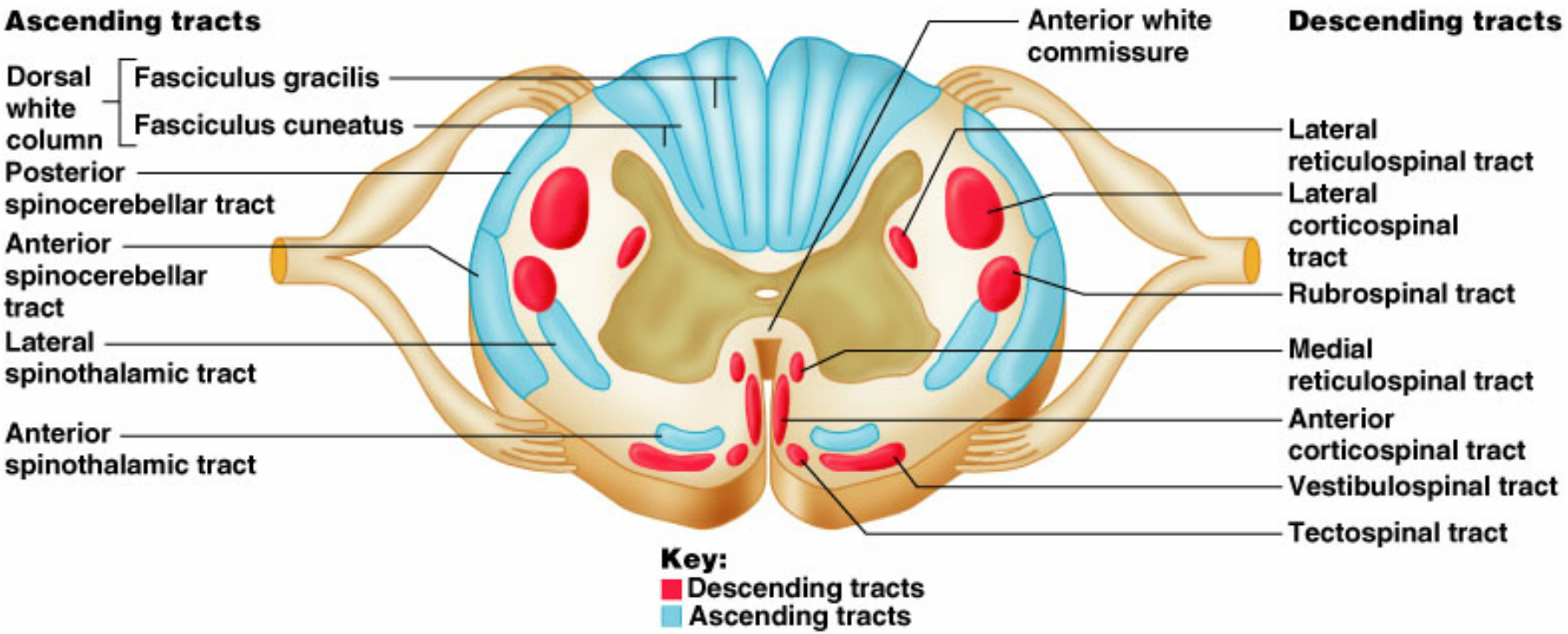


(a) Anterior view and transverse section through spinal cord

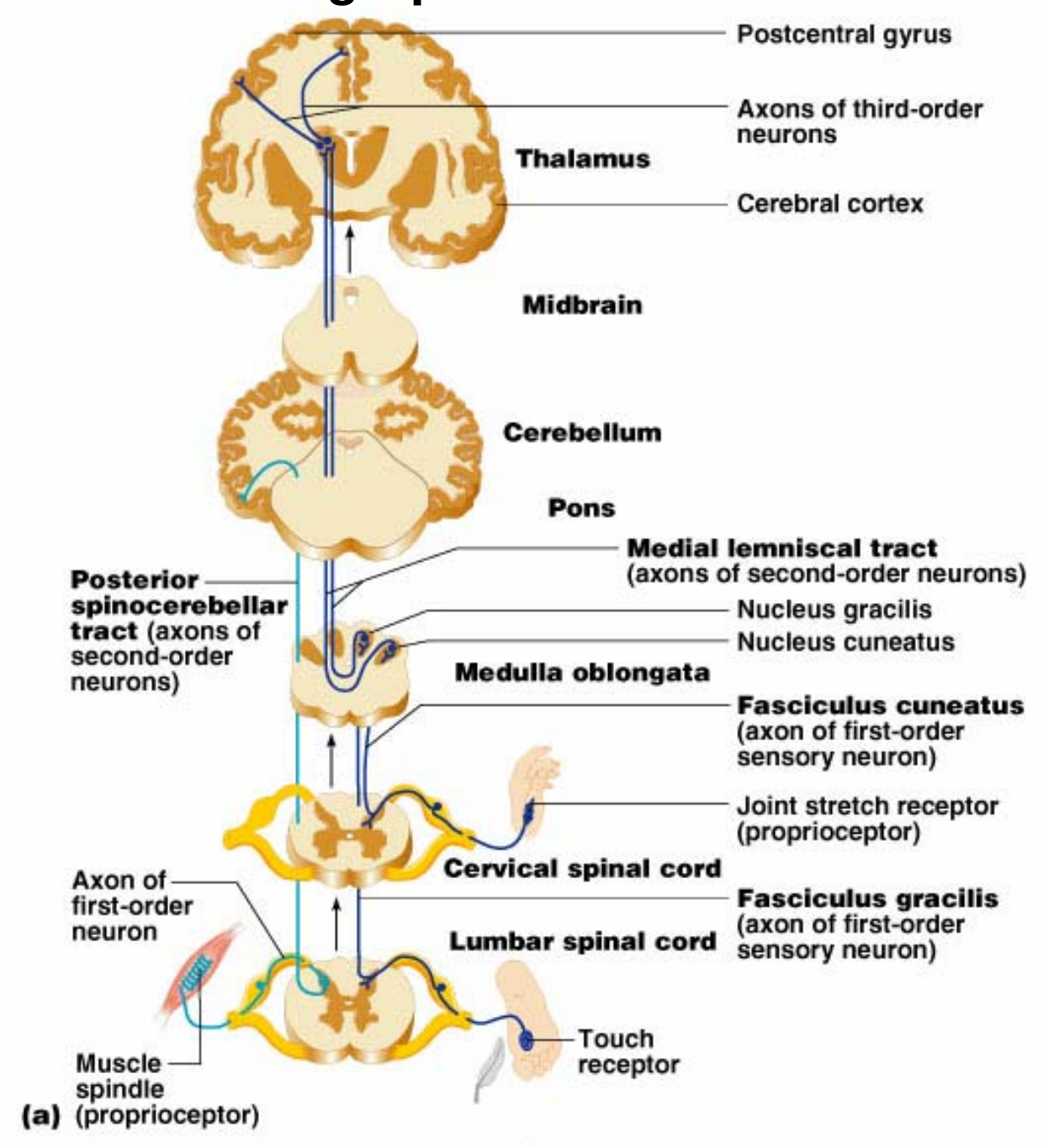
Nerve Pathways into the Spinal Cord



Somatic Sensory Pathway



Ascending Spinal Cord Tract

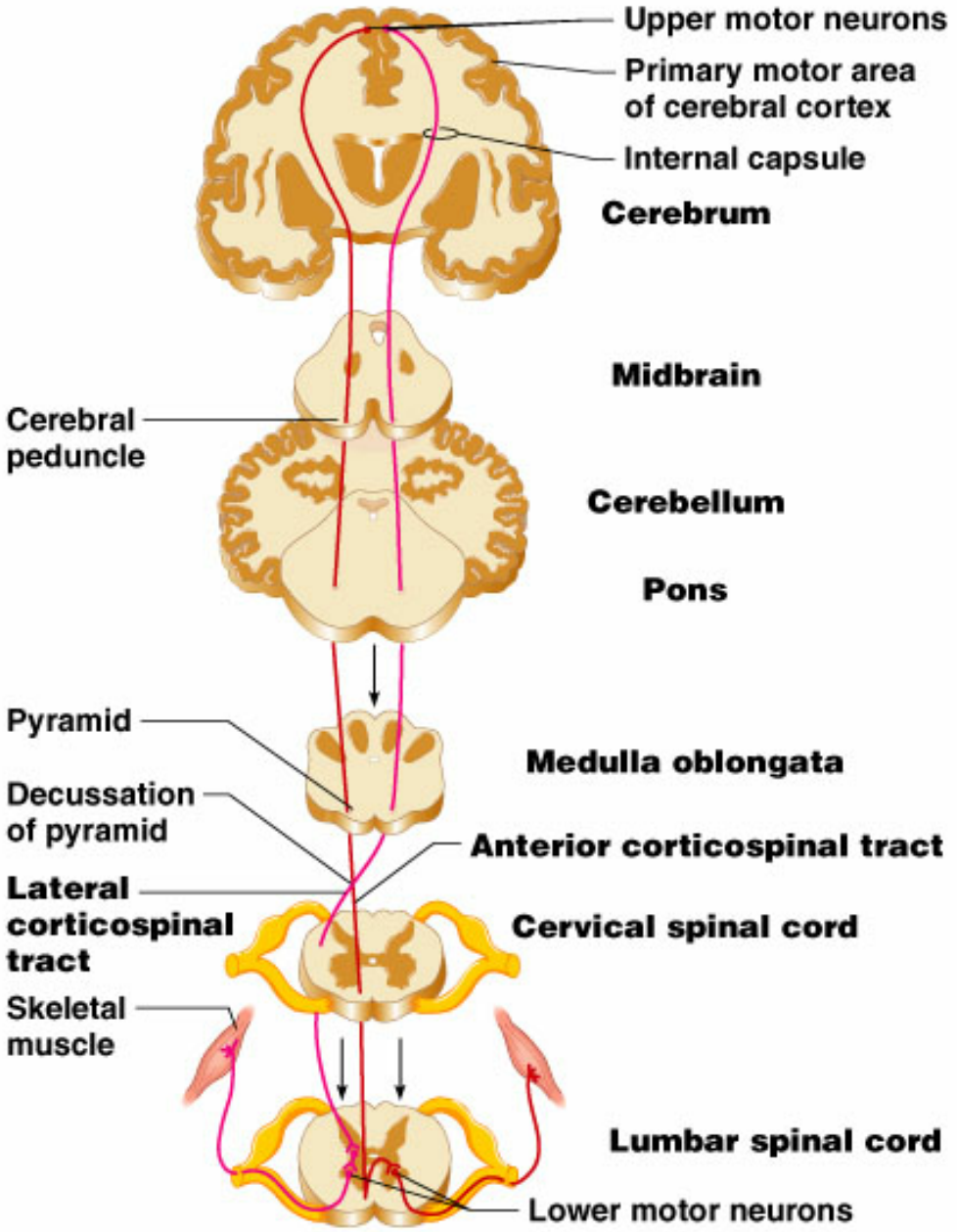


Ascending Spinal Cord Tract

Conducts sensory impulses upward through 3 successive chains of neurons

- **1st order neuron**-cutaneous receptors of skin and proprioceptors → spinal cord or brain stem
- **2nd order neuron**- to thalamus or cerebellum
- **3rd order neuron**- to somatosensory cortex of cerebrum

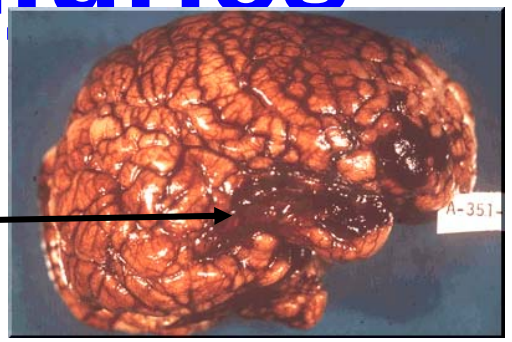
Descending Spinal Cord Tract

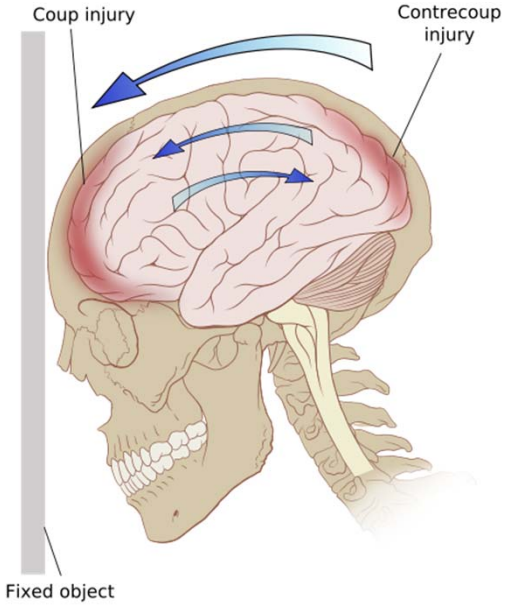


(a) Pyramidal (lateral and anterior corticospinal) tracts

Traumatic Brain Iniuries

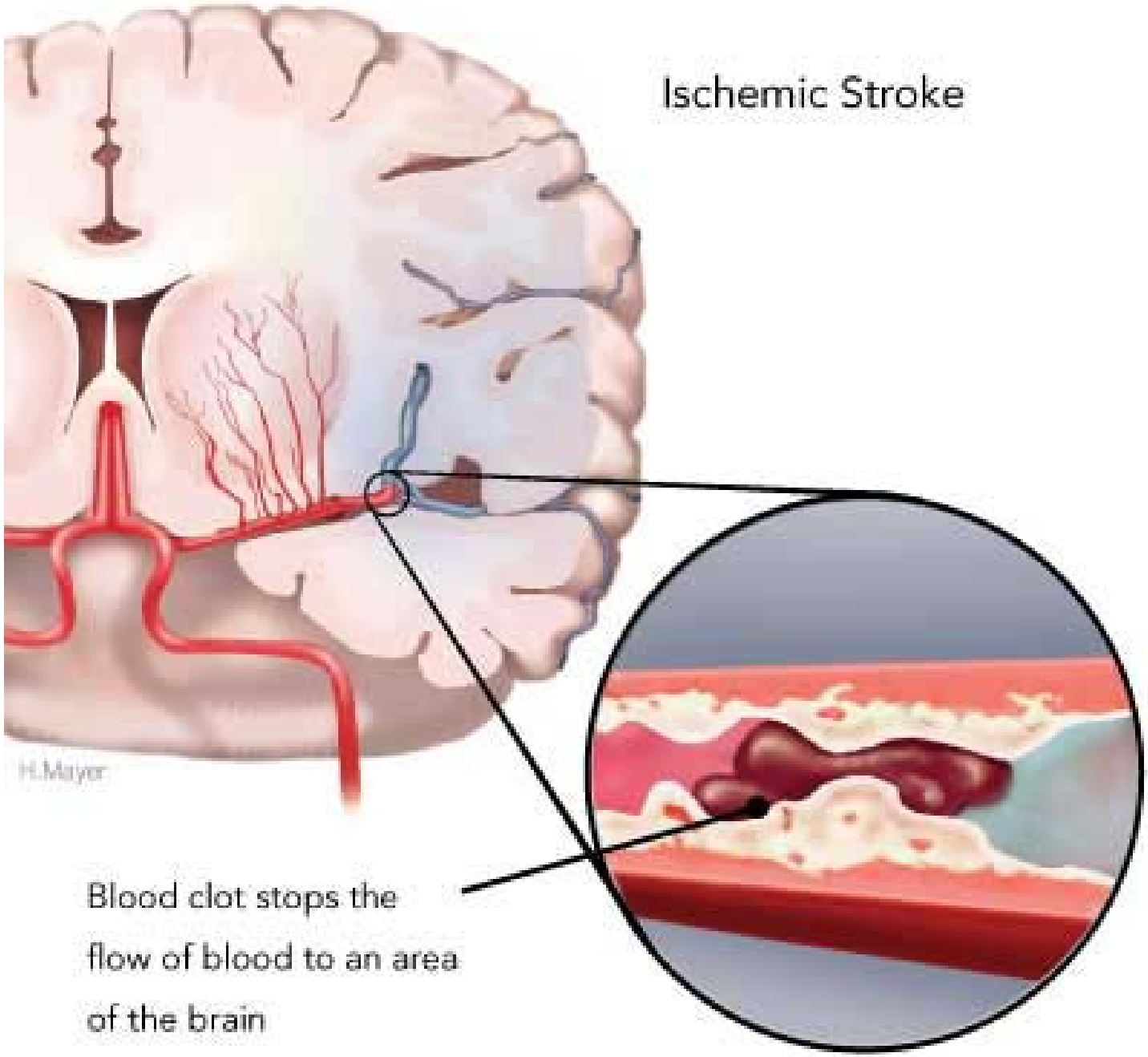
- Concussion
- Contusion
- Subdural or subarachnoid hemorrhage
- Contrecoup injury
- Punch Drunk Syndrome





Cerebrovascular Accidents (CVAs)

- Ischemia
- Thrombus
- Embolism
- Arteriosclerosis
- Stroke



Degenerative brain diseases

- Schizophrenia
- Parkinson’s
- Alzheimer’s
- Down’s
- Huntington’s Chorea
- MS
- Epilepsy

Parkinson’s disease

- Substantia nigra in midbrain
- Dopamine
  - affects brain processes controlling:
    - movement
    - balance
    - walking
    - emotional response
    - ability to experience pleasure and pain.

Parkinson’s disease

Causes:

- Genetics
- Environmental chemicals (e.g., PCBs)
- Thyroid disorders
- Repeated head injury

Symptoms of Parkinson's Disease:

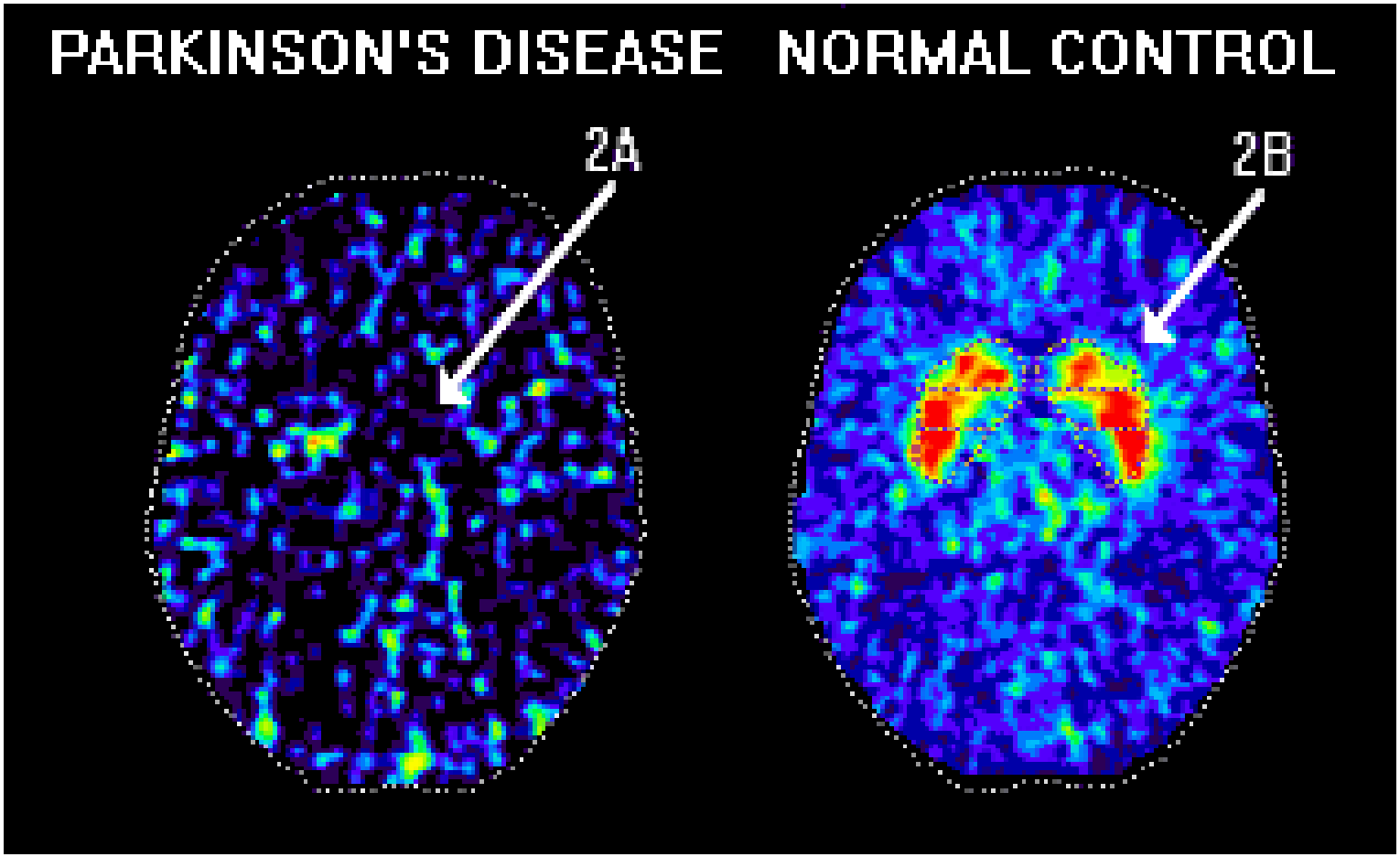
- resting tremor on one side of the body
- generalized slowness of movement (bradykinesia)
- stiffness of limbs (rigidity)
- gait or balance problems (postural dysfunction).

Parkinson’s disease

Treatments:

- L-dopa
- Deprenyl
- Deep brain stimulation w/electrodes
- Fetal tissue

Parkinson’s disease



F-Dopa deficiency

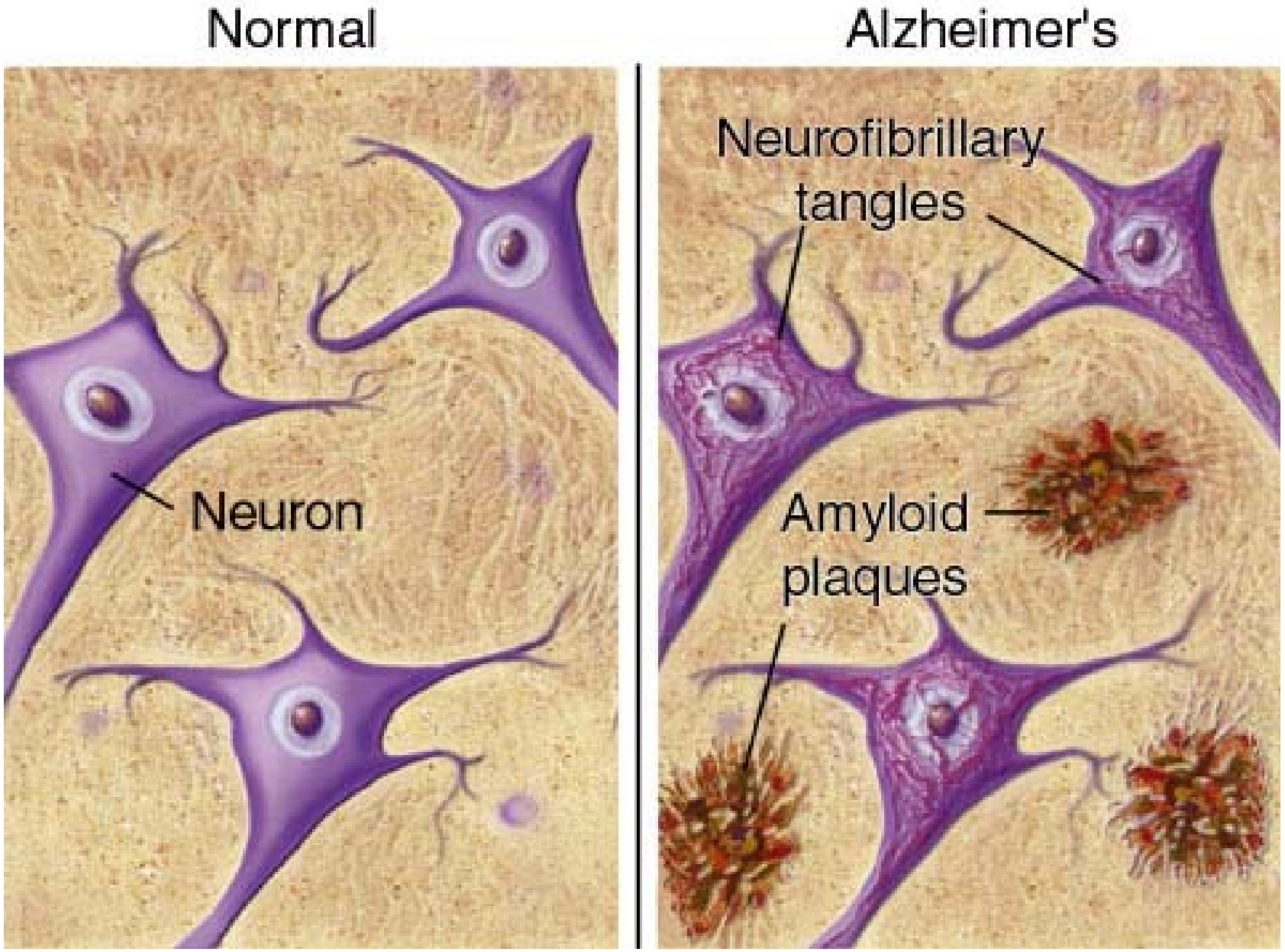
Alzheimer's Disease

Results in dementia

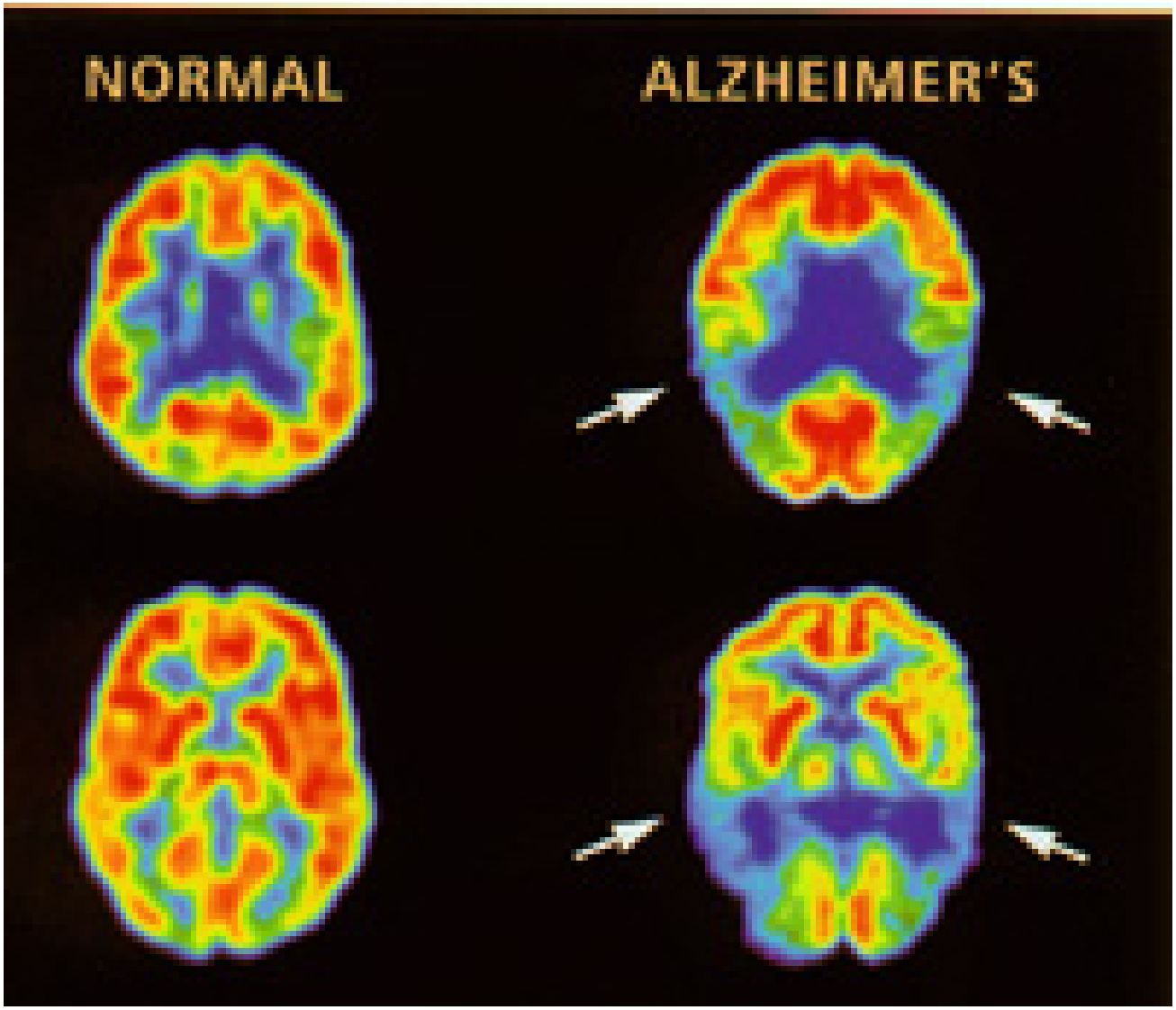
- 5-15% over age 65
- 50% over age 85

Associated with :

- Acetylcholine shortage
- Amyloid plaques
- Neurofibullary tangles


Normal
Alzheimer's
Neuron
Neurofibrillary tangles
Amyloid plaques

PET Scans



Huntington's Disease

Fatal hereditary disorder

- Onset at ~40 years
- Fatal w/in 15 years
- Dance-like movement

Associated with :

- Huntingtin protein

INQUIRY

1. What layer of tissue adheres most tightly to the brain?
2. CSF stands for-------.
3. What does it do?
4. What does the thalamus do?
5. What does the vestibulocochlear nerve control?
6. Where is dark matter located in the spinal cord?
7. A thrombus that moves to a new site is called ----.