Otak
(Cerebrum)

DR. HANNA CAKRAWATI

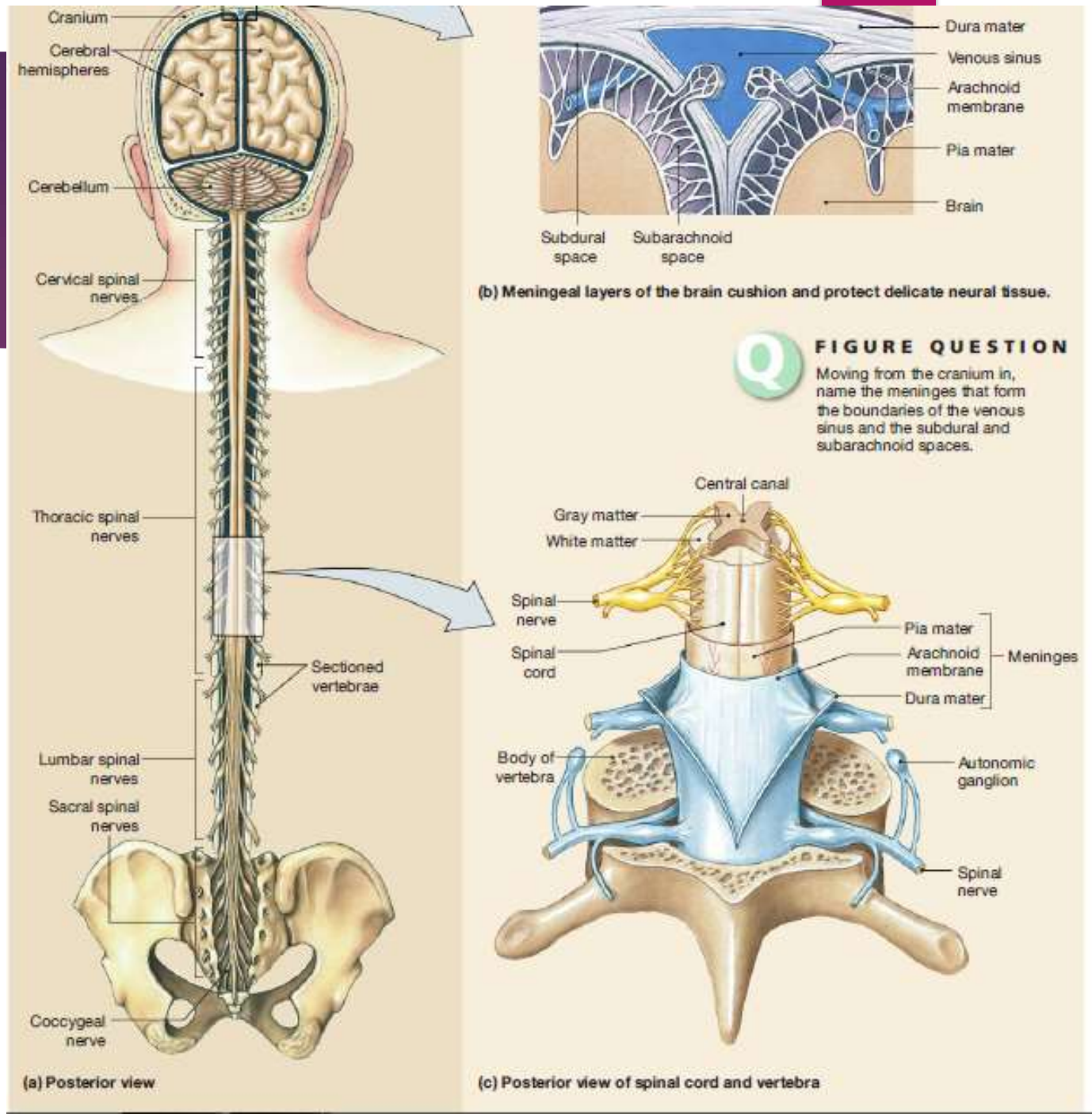
LABORATORIUM FISIOLOGI

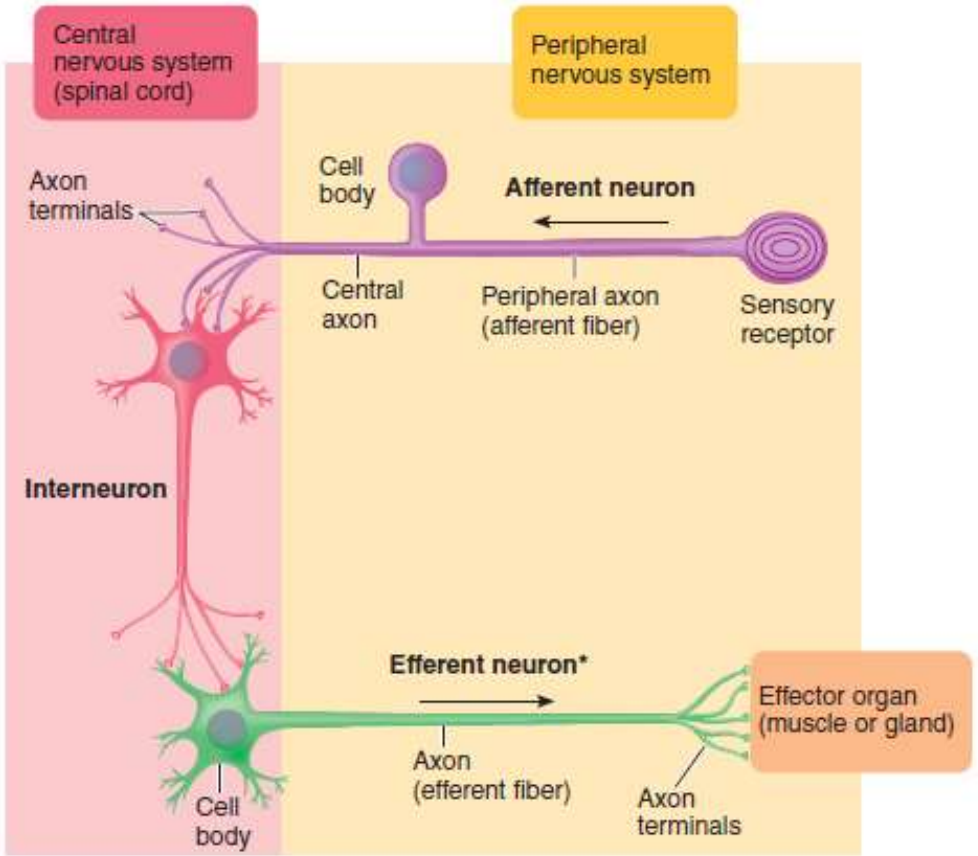
Sistem Saraf Pusat

Susunan saraf pusat terdiri dari:

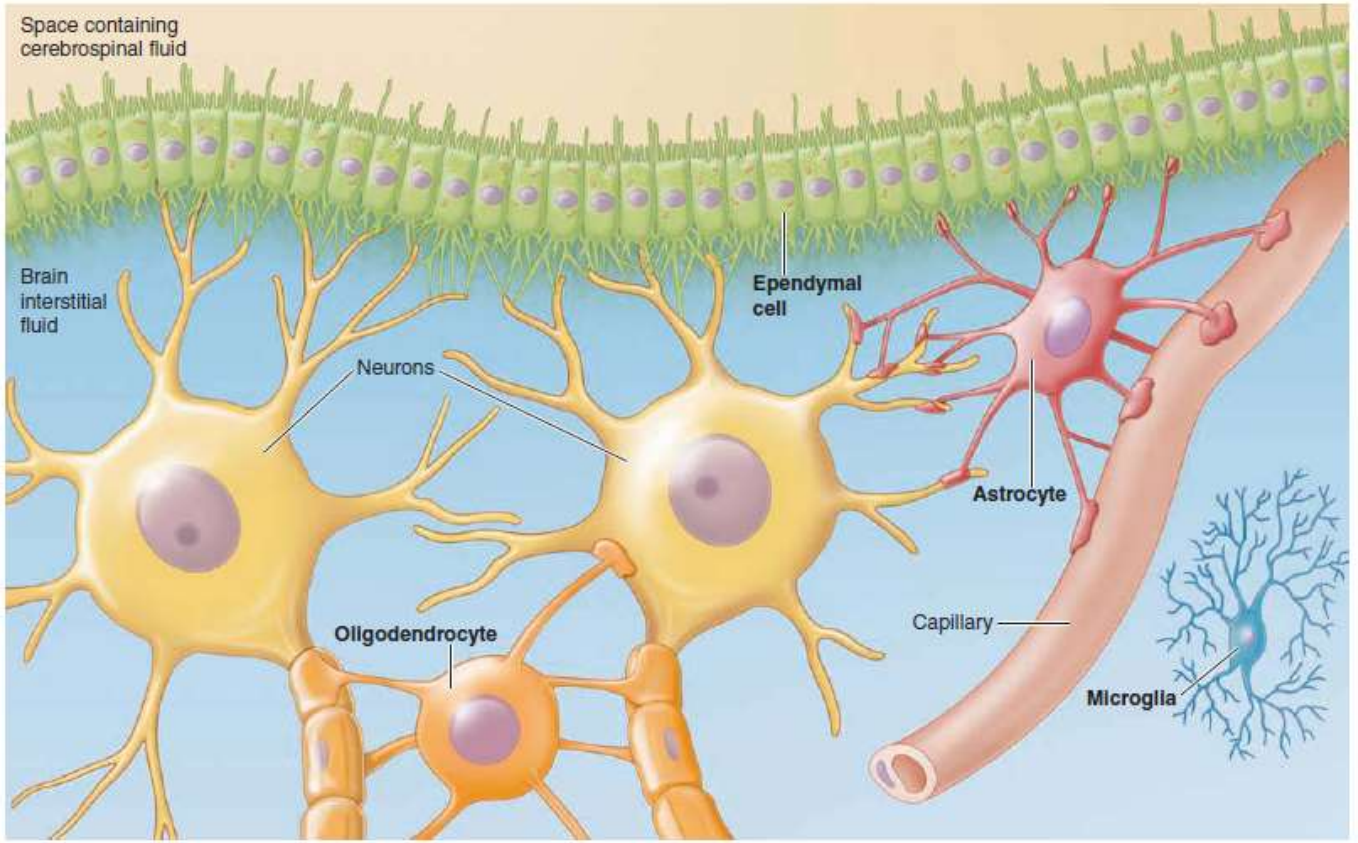
Otak dan medulla spinalis, memungkinkan untuk:

- Secara sadar mengatur lingkungan internal melalui system saraf
- Emosi
- Secara sadar mengontrol gerakan
- Menyadari keadaan tubuh dan lingkungan sekitar
- Melakukan fungsi kognitif yg lbh luhur, misalnya berfikir dan mengingat.





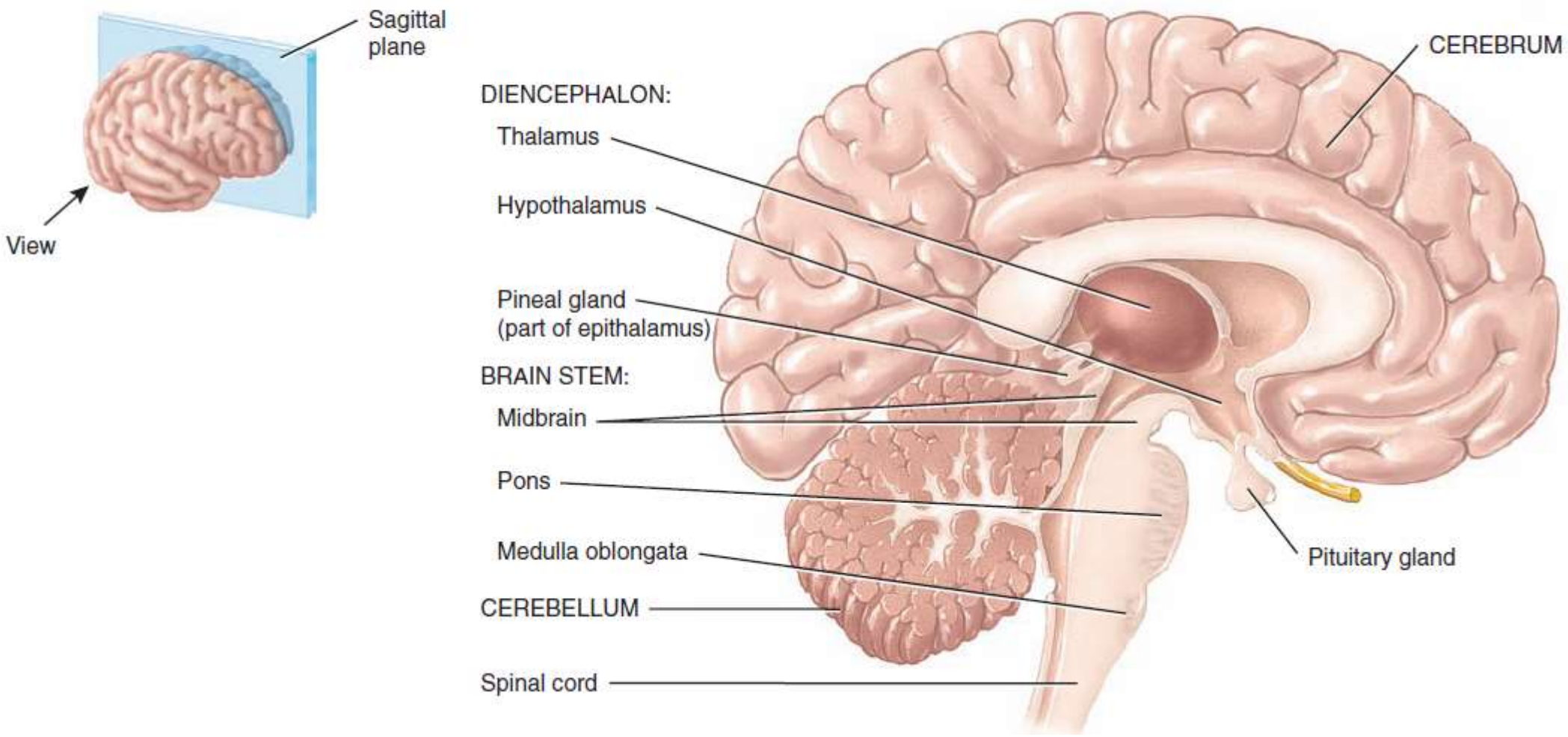
● **FIGURE 5-2 Structure and location of the three functional classes of neurons.** *Efferent autonomic nerve pathways consist of a two-neuron chain between the CNS and the effector organ.

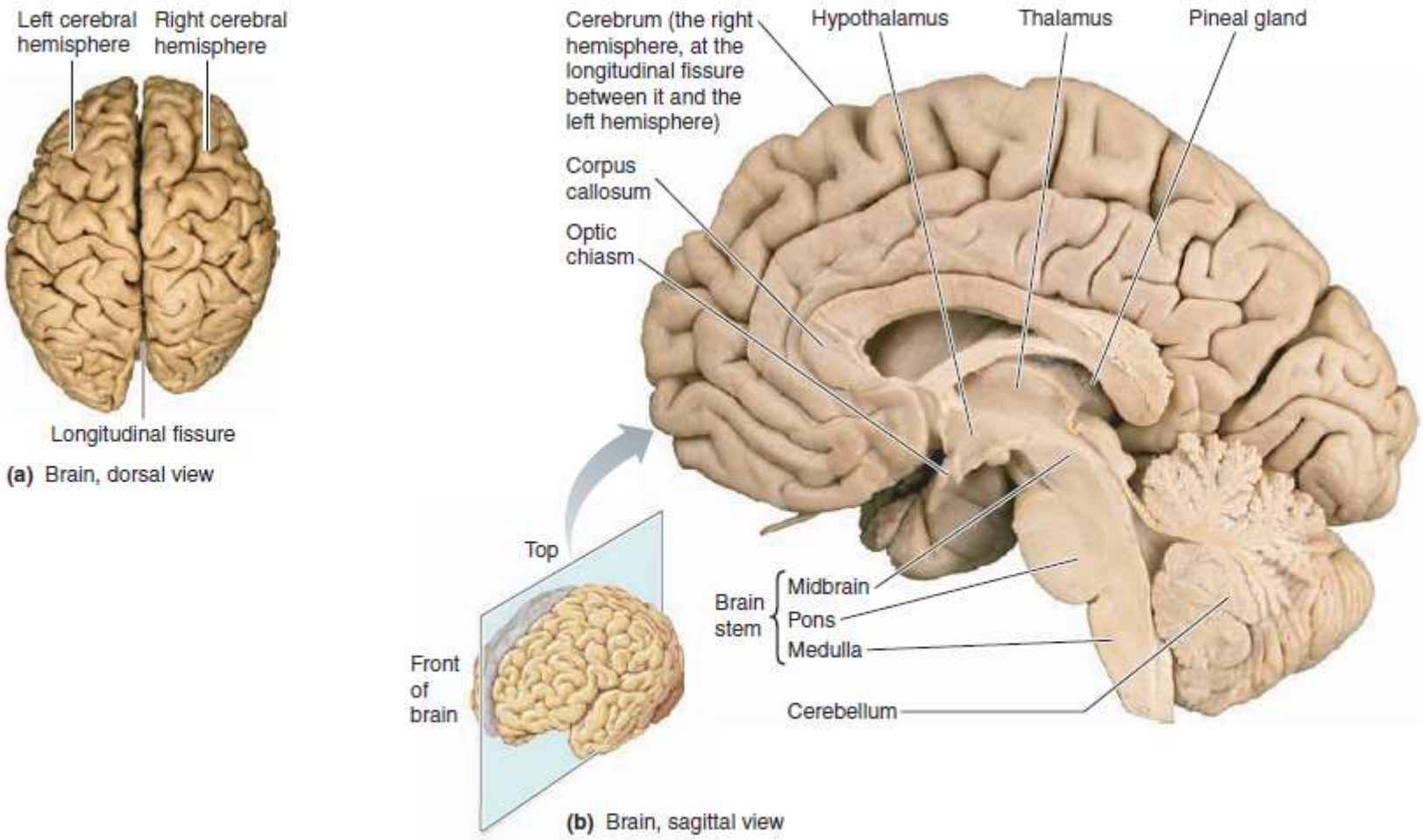


● **FIGURE 5-3 Glial cells of the central nervous system.** The glial cells include the astrocytes, oligodendrocytes, microglia, and ependymal cells.

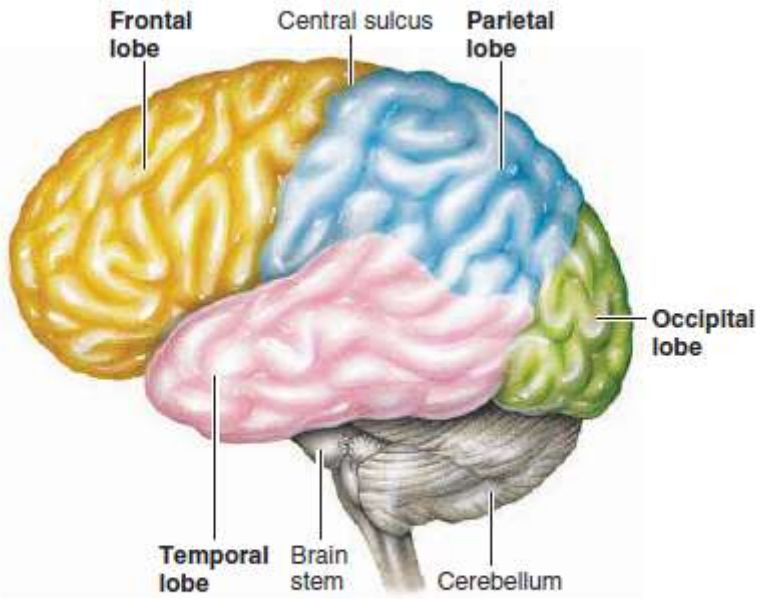
Figure 14.1 The brain. The pituitary gland is discussed with the endocrine system in Chapter 18.

The four principal parts of the brain are the brain stem, cerebellum, diencephalon, and cerebrum.

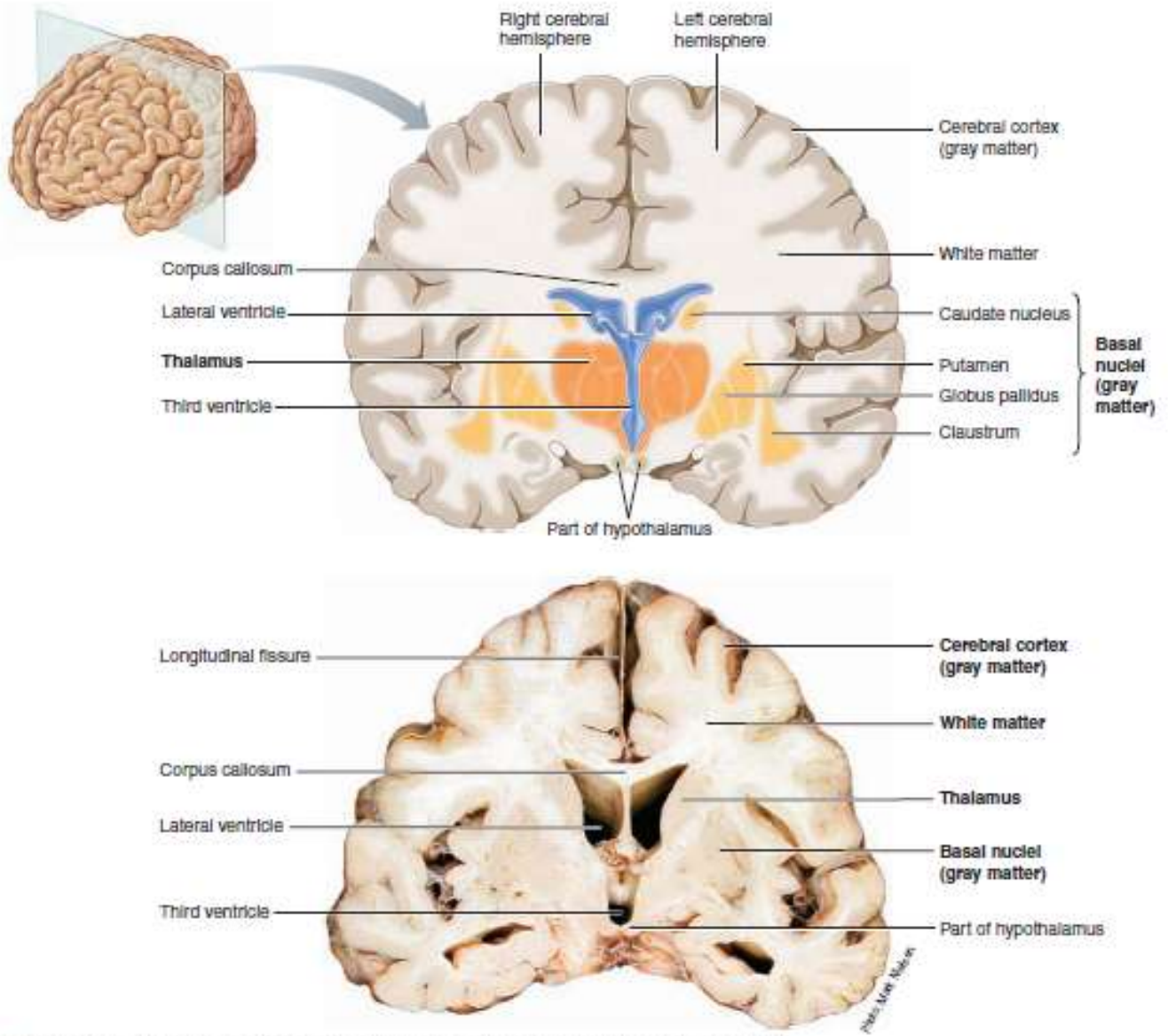




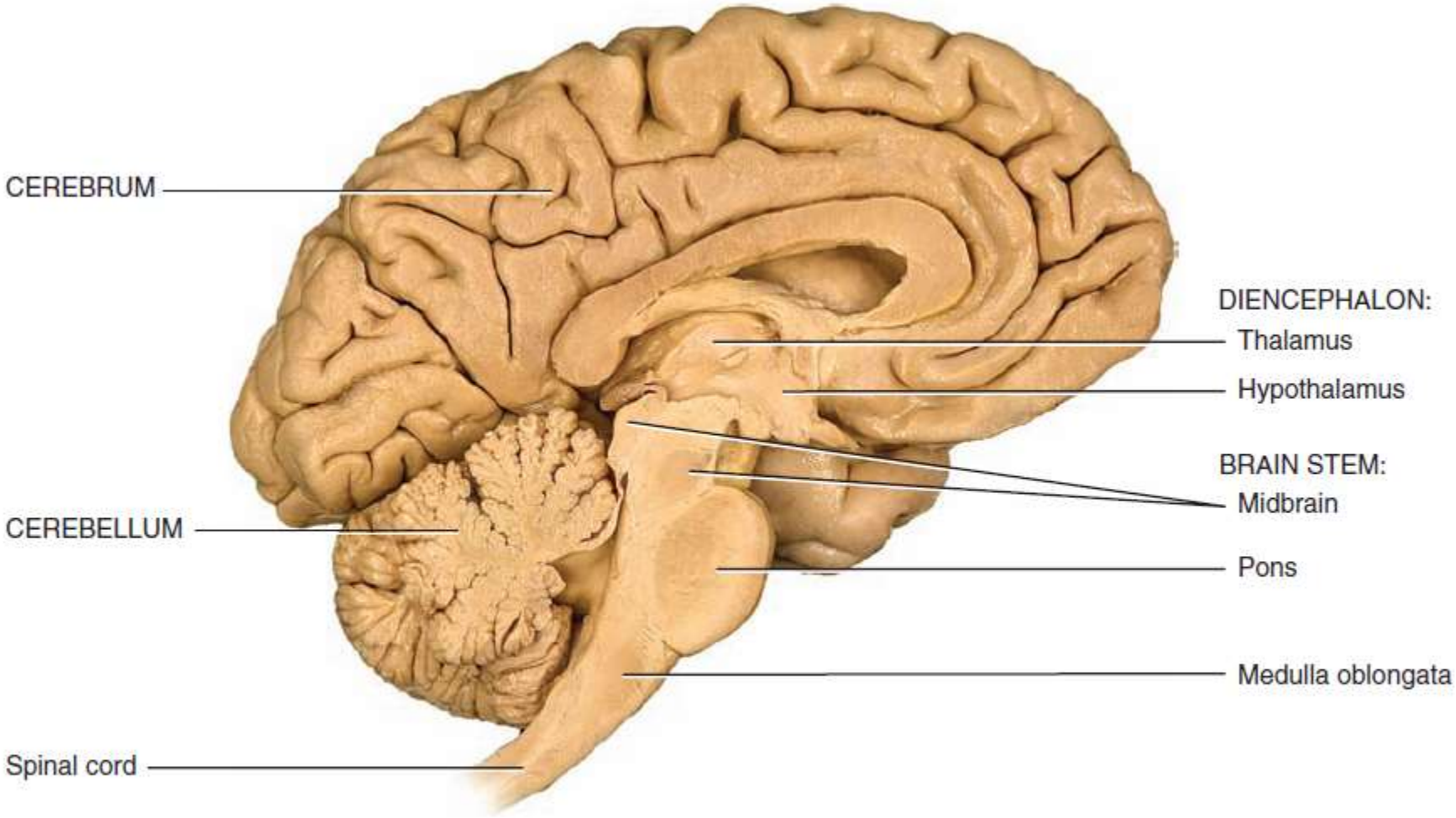
● **FIGURE 5-7 Brain of a human cadaver.** (a) Dorsal view looking down on the top of the brain. Note that the deep longitudinal fissure divides the cerebrum into the right and left cerebral hemispheres. (b) Sagittal view of the right half of the brain. All major brain regions are visible from this midline interior view. The corpus callosum serves as a neural bridge between the two cerebral hemispheres.



● **FIGURE 5-8 Cortical lobes.** Each half of the cerebral cortex is divided into the occipital, temporal, parietal, and frontal lobes, as depicted in this lateral view of the brain.



● **FIGURE 5-14 Frontal section of the brain.** The cerebral cortex, an outer shell of gray matter, surrounds an inner core of white matter. Deep within the cerebral white matter are several masses of gray matter, the basal nuclei. The ventricles are cavities in the brain through which the cerebrospinal fluid flows. The thalamus forms the walls of the third ventricle. For comparison, the colors used for these brain components are the same as those used in the lateral view depicted in Table 5-2, p. 144. Also, compare this frontal section of a cadaver brain with the sagittal section of a cadaver brain in Figure 5-7, p. 146.

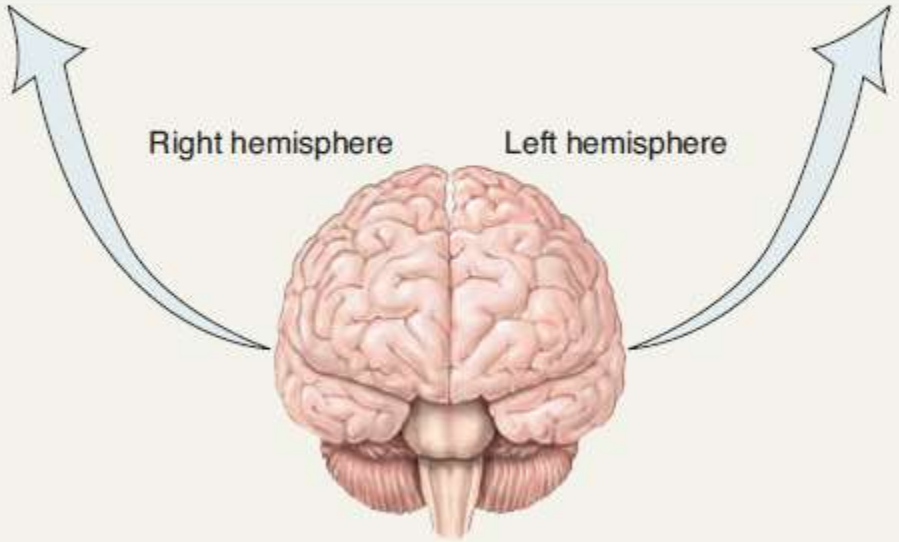


(b) Sagittal section, medial view

TABLE 14.3

Functional Differences between Right and Left Hemispheres

RIGHT HEMISPHERE FUNCTIONS	LEFT HEMISPHERE FUNCTIONS
Receives somatic sensory signals from, and controls muscles on, left side of body.	Receives somatic sensory signals from, and controls muscles on, right side of body.
Musical and artistic awareness.	Reasoning.
Space and pattern perception.	Numerical and scientific skills.
Recognition of faces and emotional content of facial expressions.	Ability to use and understand sign language.
Generating emotional content of language.	Spoken and written language.
Generating mental images to compare spatial relationships.	
Identifying and discriminating among odors.	



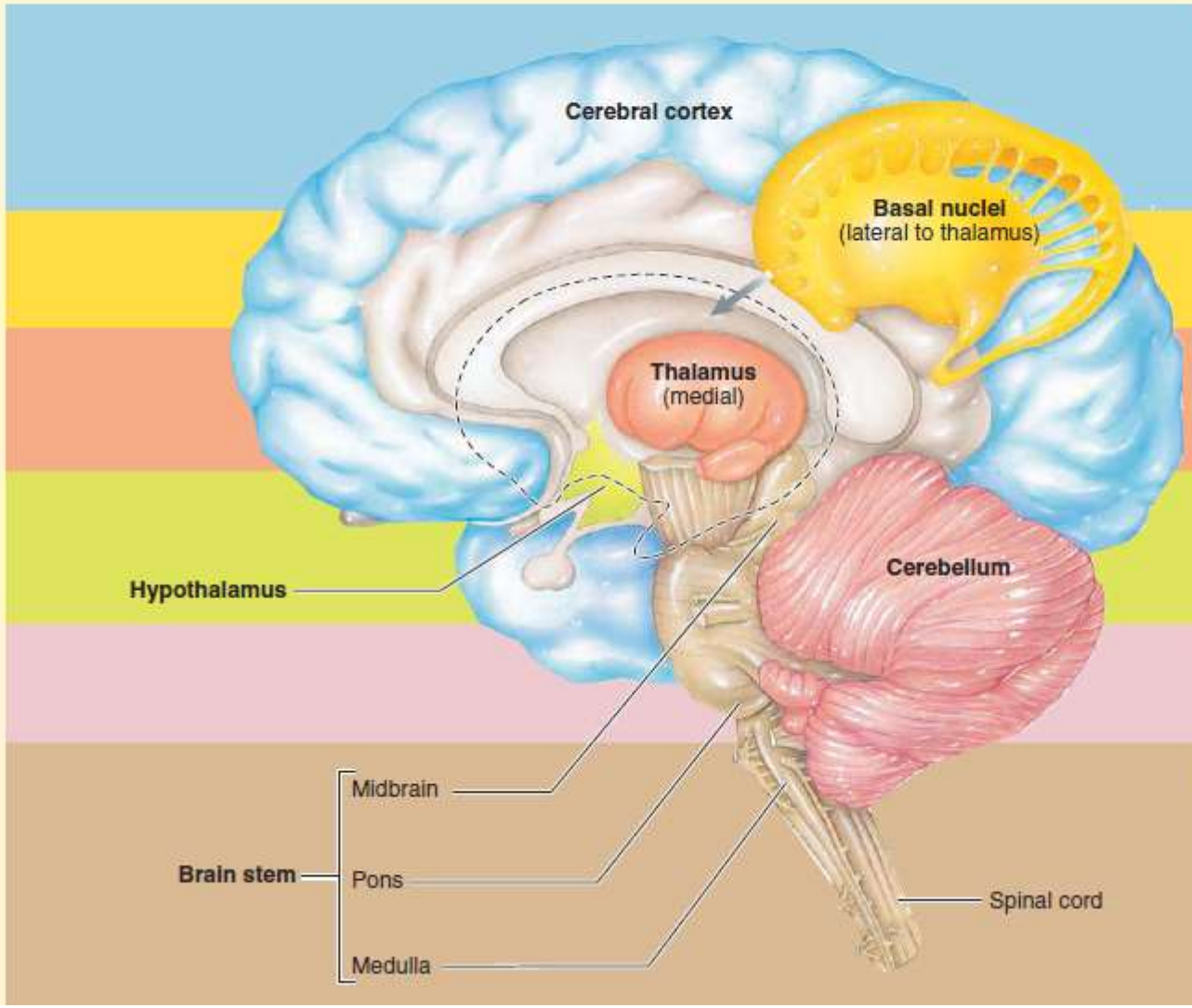
Hemisfer serebri kanan:

- Keterampilan nonbahasa→persepsi spasial dan artistic (talenta music)
- Memandang dunia dalam gambaran besar holistic
- “Pencipta”

Hemisfer serebri kiri:

- Tugas logis, analitik, sekuensial dan verbal→ matematika, bahasa dan filosofi
- Memproses informasi dalam cara yg sangat detail, terpecah
- “Pemikir”

TABLE 5-2 Overview of Structures and Functions of the Major Components of the Brain



Brain Component	Major Functions
Cerebral cortex	1. Sensory perception 2. Voluntary control of movement 3. Language 4. Personality traits 5. Sophisticated mental events, such as thinking, memory, decision making, creativity, and self-consciousness
Basal nuclei	1. Inhibition of muscle tone 2. Coordination of slow, sustained movements 3. Suppression of useless patterns of movement
Thalamus	1. Relay station for all synaptic input 2. Crude awareness of sensation 3. Some degree of consciousness 4. Role in motor control
Hypothalamus	1. Regulation of many homeostatic functions, such as temperature control, thirst, urine output, and food intake 2. Important link between nervous and endocrine systems 3. Extensive involvement with emotion and basic behavioral patterns 4. Role in sleep–wake cycle
Cerebellum	1. Maintenance of balance 2. Enhancement of muscle tone 3. Coordination and planning of skilled voluntary muscle activity
Brain stem	1. Origin of majority of peripheral cranial nerves 2. Cardiovascular, respiratory, and digestive control centers 3. Regulation of muscle reflexes involved with equilibrium and posture 4. Reception and integration of all synaptic input from spinal cord; arousal and activation of cerebral cortex 5. Role in sleep–wake cycle

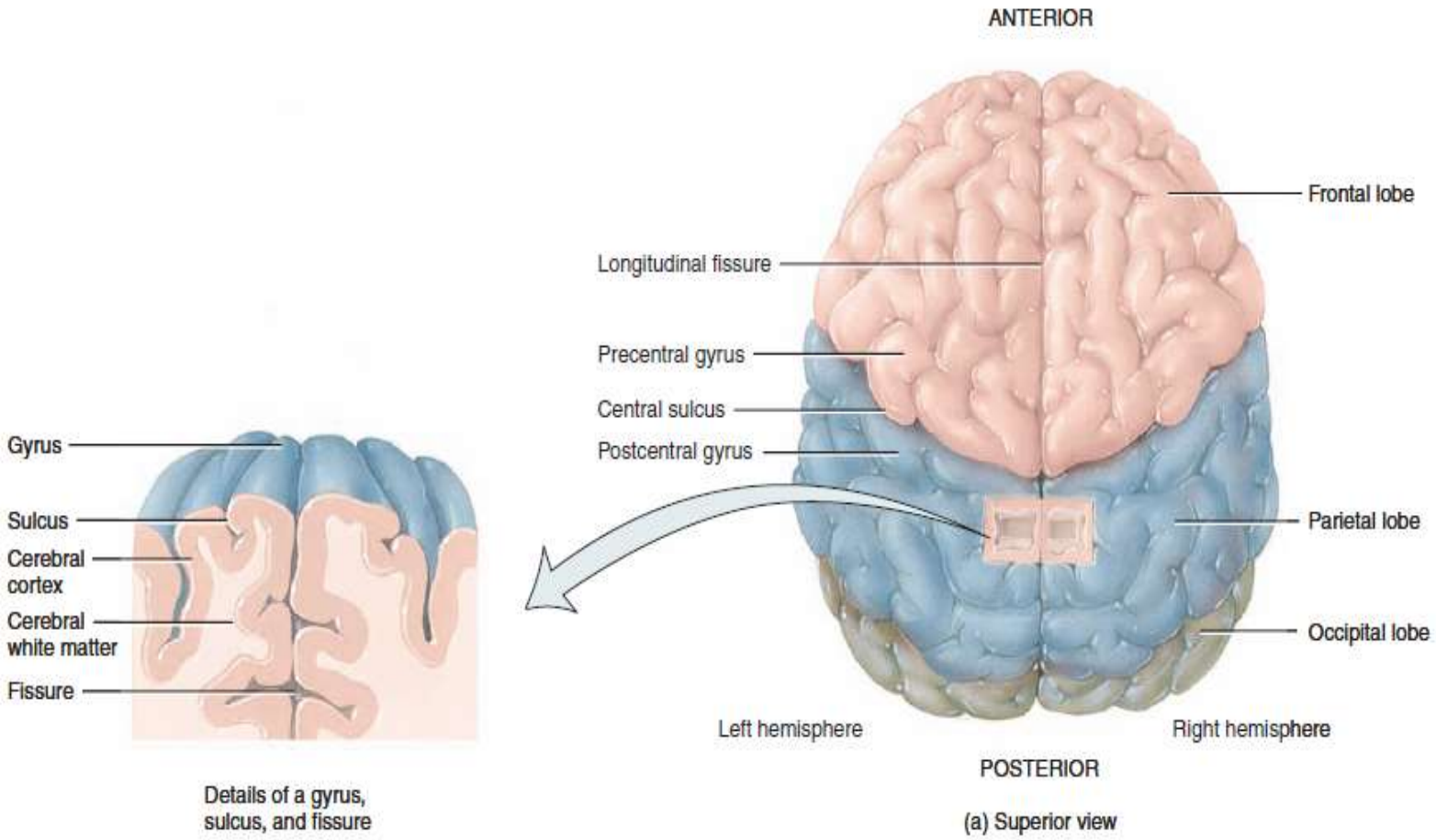
Korteks Serebri

Korteks Serebri

- Daerah integrasi otak yang paling **kompleks** dan **paling tinggi**

Figure 14.11 **Cerebrum.** Because the insula cannot be seen externally, it has been projected to the surface in (b).

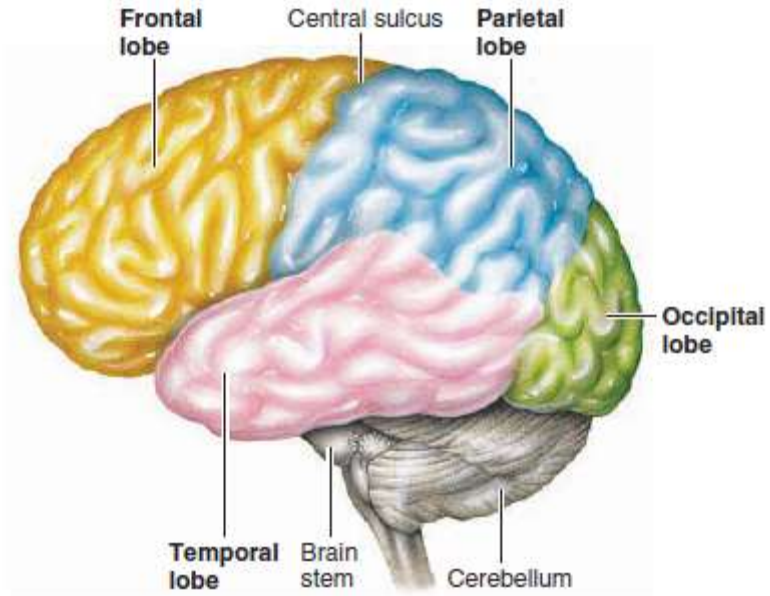
The cerebrum is the "seat of intelligence"; it provides us with the ability to read, write, and speak; to make calculations and compose music; to remember the past and plan for the future; and to create.



Substansia grisea→badan sel neuron dan ***sel glia***→(Komputer)

Substansia alba→ akson bermielin (komposisi lemak)→(kabel computer)

Lobus Frontalis

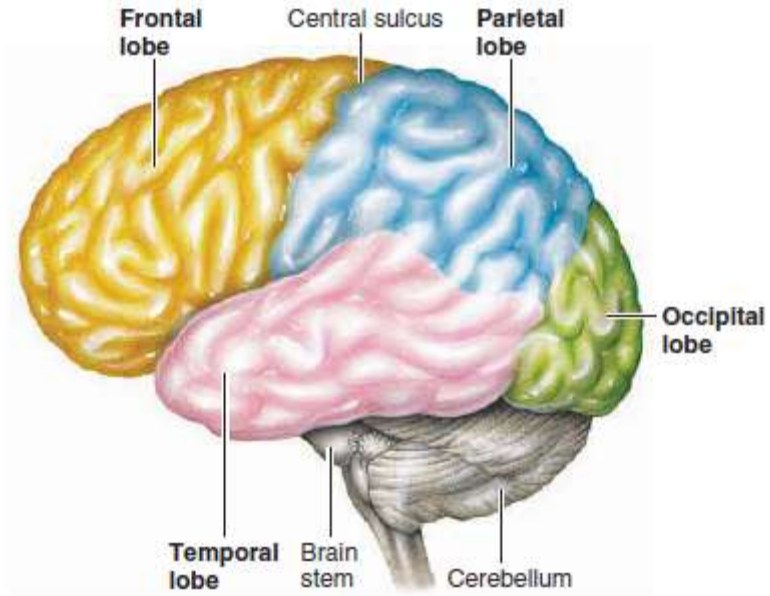


● **FIGURE 5-8 Cortical lobes.** Each half of the cerebral cortex is divided into the occipital, temporal, parietal, and frontal lobes, as depicted in this lateral view of the brain.

Berperan:

- Aktifitas motoric volunter
- Kemampuan berbicara
- Elaborasi pikiran

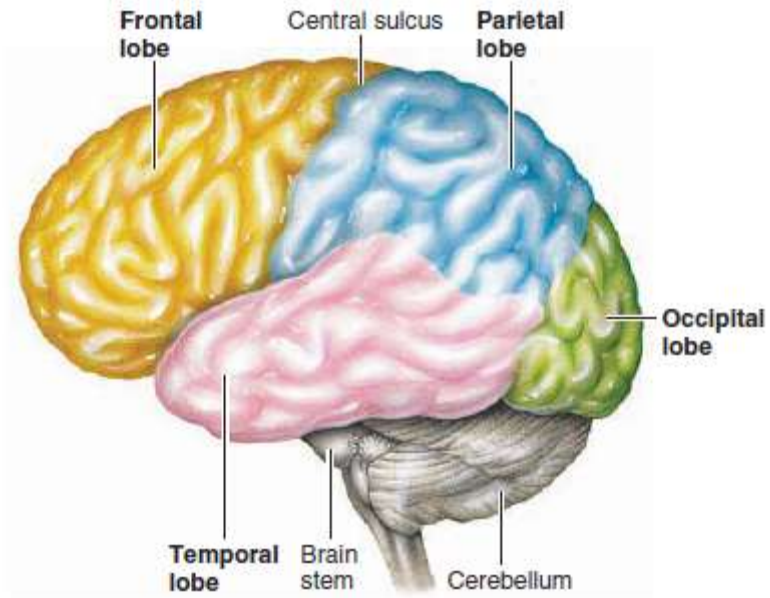
Lobus Parietalis



● **FIGURE 5-8 Cortical lobes.** Each half of the cerebral cortex is divided into the occipital, temporal, parietal, and frontal lobes, as depicted in this lateral view of the brain.

- Berperan menerima dan memproses masukkan sensoris.

Lobus Oksipitalis

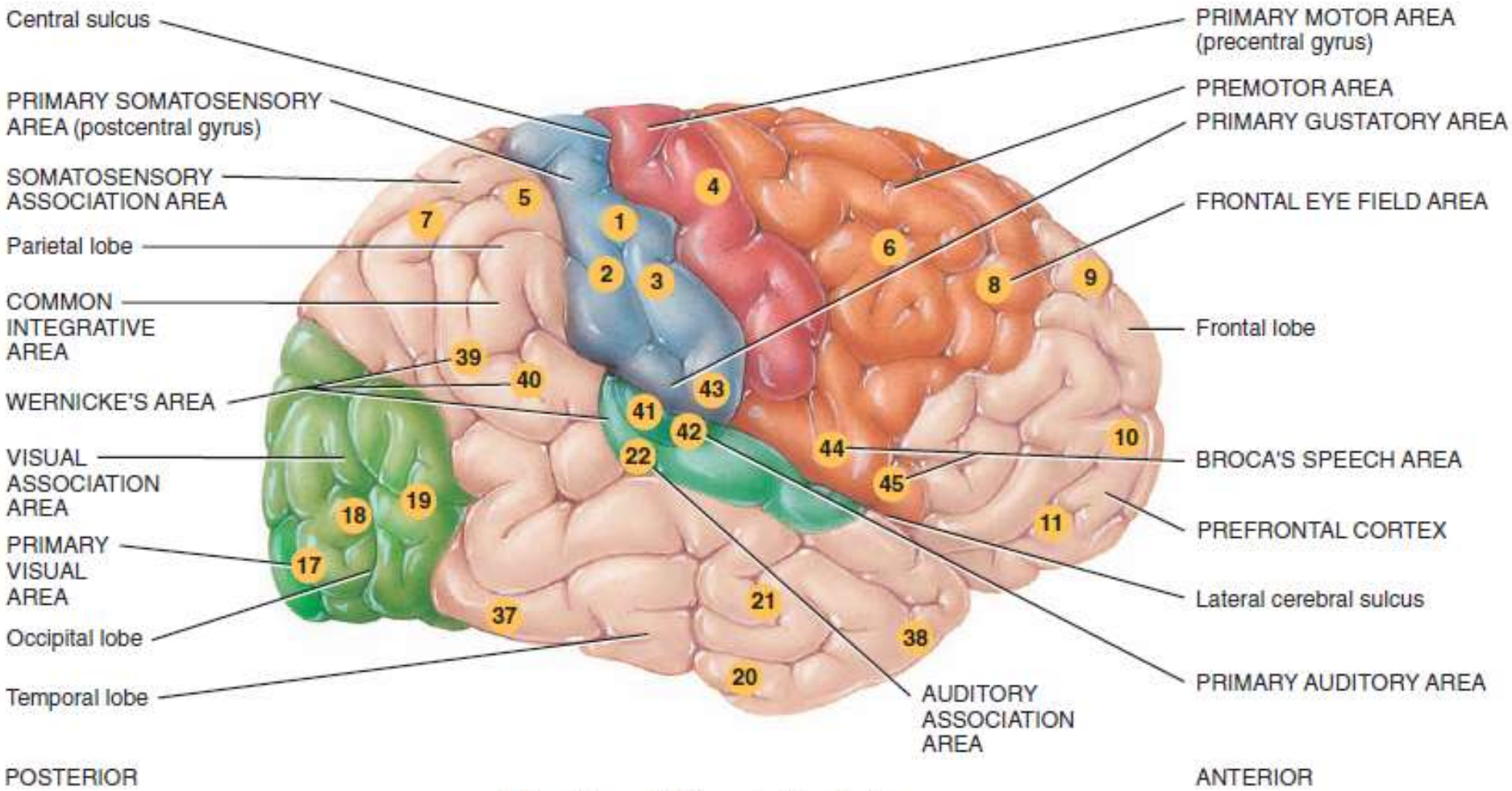


● **FIGURE 5-8 Cortical lobes.** Each half of the cerebral cortex is divided into the occipital, temporal, parietal, and frontal lobes, as depicted in this lateral view of the brain.

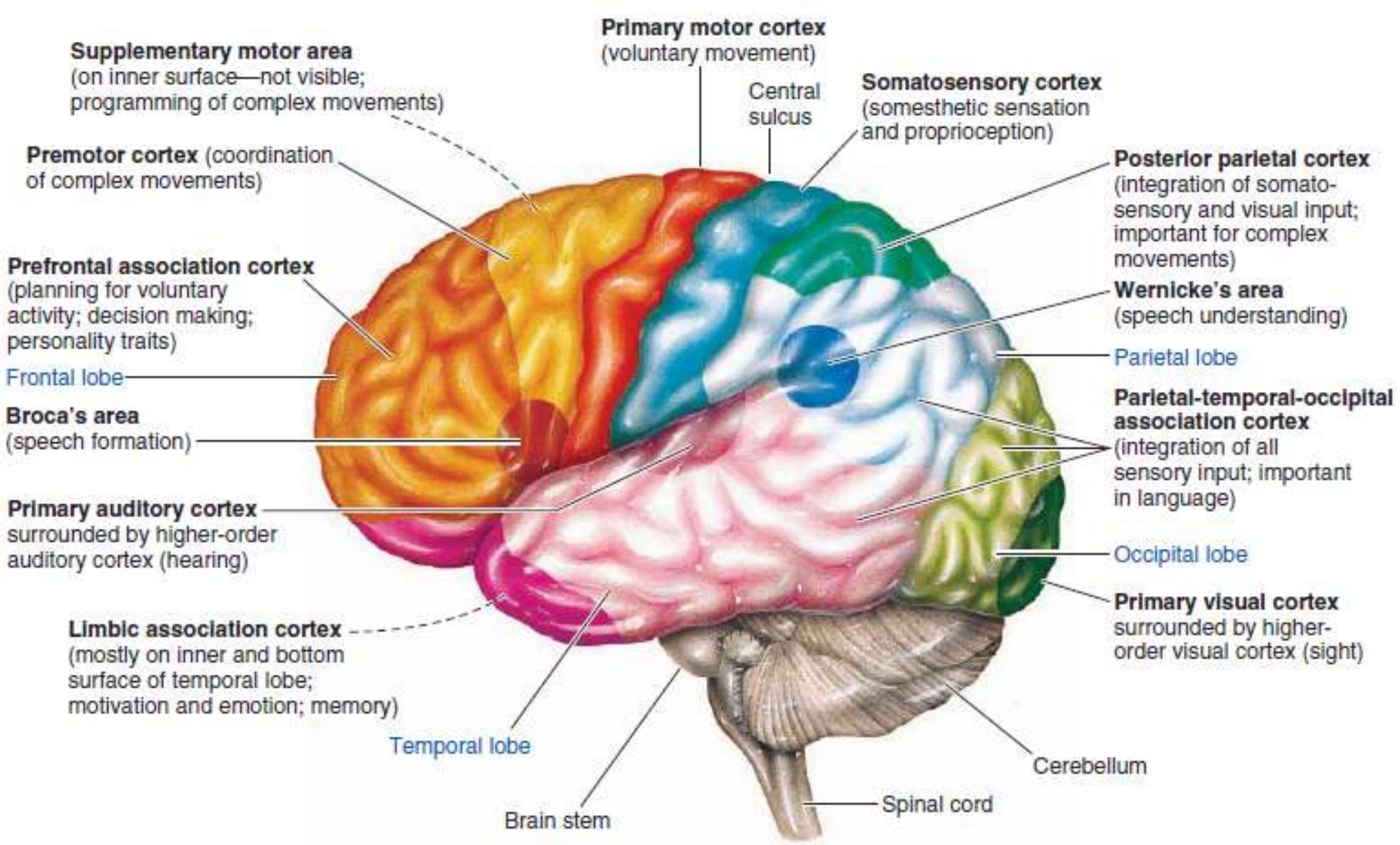
- Melaksanakan pemprosesan awal masukkan penglihatan.

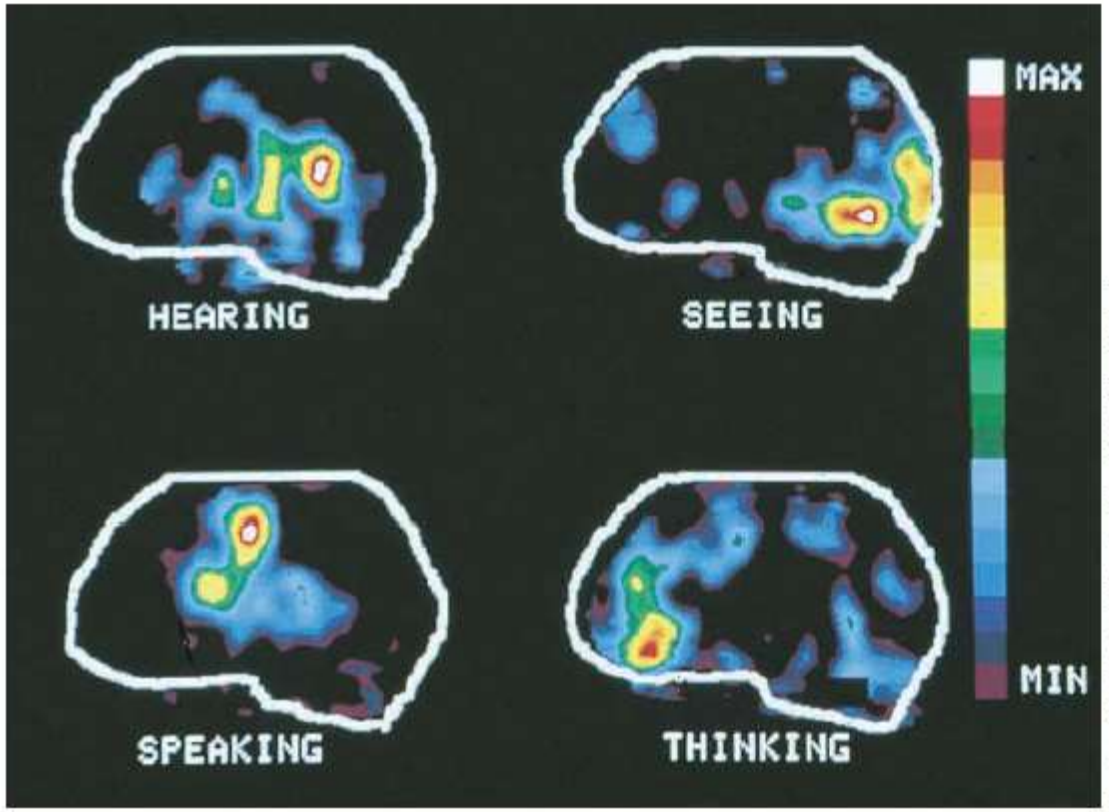
Figure 14.15 **Functional areas of the cerebrum.** Broca's speech area and Wernicke's area are in the left cerebral hemisphere of most people; they are shown here to indicate their relative locations. The numbers, still used today, are from K. Brodmann's map of the cerebral cortex, first published in 1909.

⑥ Particular areas of the cerebral cortex process sensory, motor, and integrative signals.



Lateral view of right cerebral hemisphere


Supplementary motor area
(on inner surface—not visible; programming of complex movements)
Primary motor cortex
(voluntary movement)
Central sulcus
Somatosensory cortex
(somesthetic sensation and proprioception)
Premotor cortex (coordination of complex movements)
Posterior parietal cortex
(integration of somato-sensory and visual input; important for complex movements)
Prefrontal association cortex
(planning for voluntary activity; decision making; personality traits)
Wernicke's area
(speech understanding)
Frontal lobe
Parietal lobe
Broca's area
(speech formation)
Parietal-temporal-occipital association cortex
(integration of all sensory input; important in language)
Primary auditory cortex
surrounded by higher-order auditory cortex (hearing)
Occipital lobe
Primary visual cortex
surrounded by higher-order visual cortex (sight)
Limbic association cortex
(mostly on inner and bottom surface of temporal lobe; motivation and emotion; memory)
Temporal lobe
Cerebellum
Brain stem
Spinal cord



(b) Regions of increased blood flow during different tasks

● **FIGURE 5-9 Functional areas of the cerebral cortex.** (a) Various regions of the cerebral cortex are primarily responsible for various aspects of neural processing, as indicated in this lateral view of the brain. (b) Different areas of the brain "light up" on positron-emission tomography (PET) scans as a person performs different tasks. PET scans detect the magnitude of blood flow in various regions of the brain. Because more blood flows into a particular region of the brain when it is more active, neuroscientists can use PET scans to "take pictures" of the brain at work on various tasks.

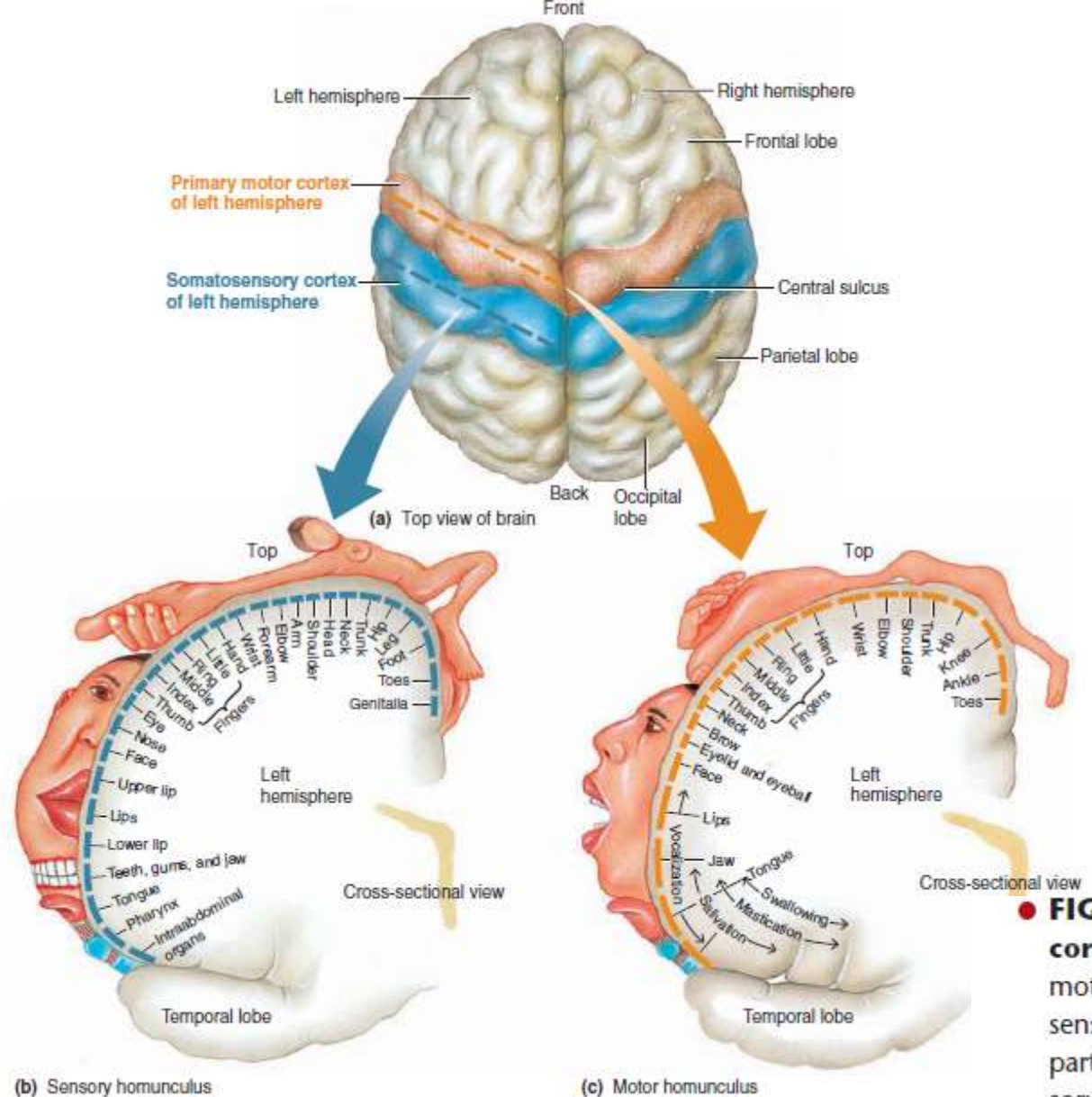
Korteks Motorik Primer Terletak di Lobus Frontalis

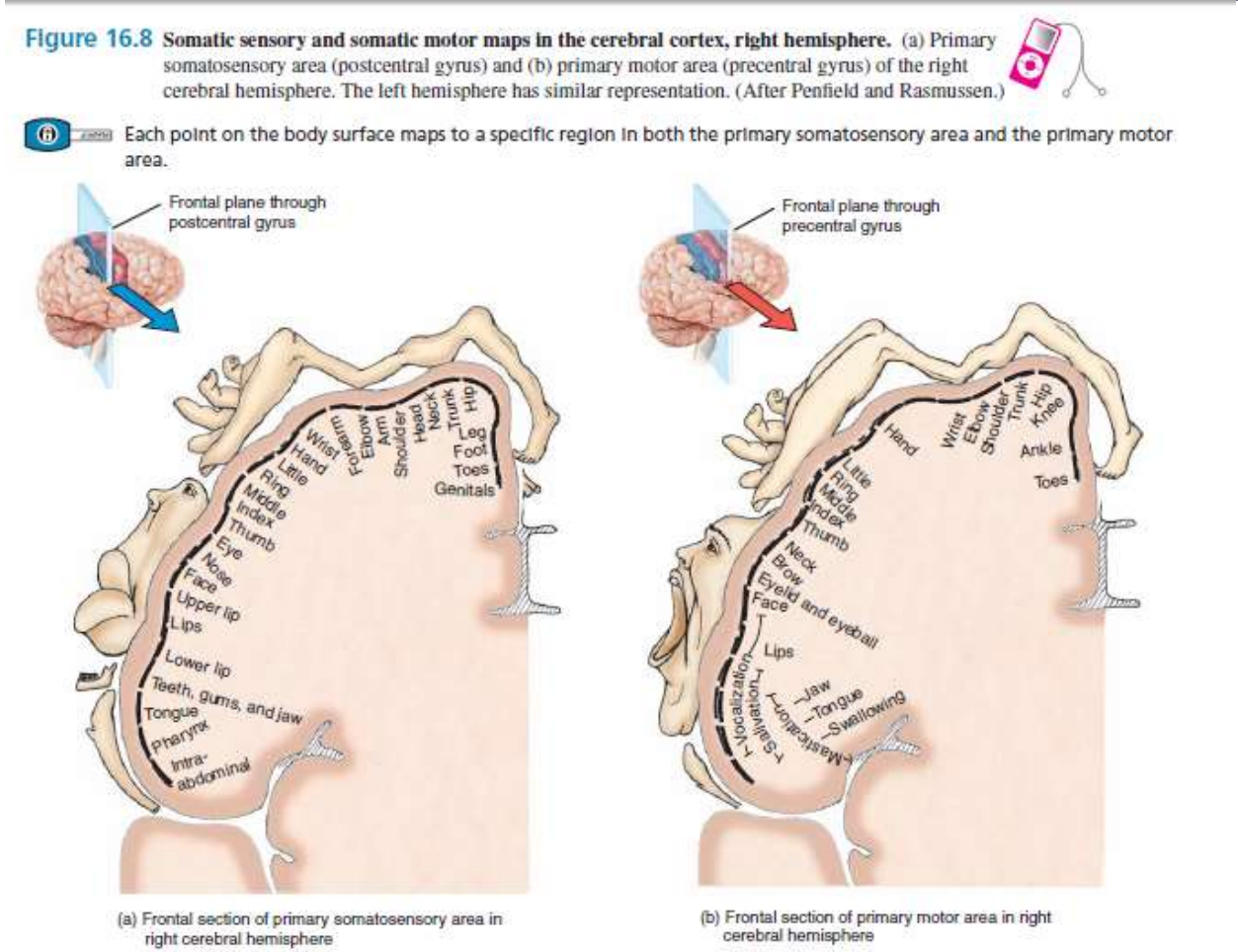
- Melaksanakan control volunteer atas gerakan yg dihasilkan oleh otot rangka→ kontralateral.
- Homunkulus motoric

Bagian-bagian otak lain selain korteks motoric primer yg penting dlm control motoric:

- Daerah motoric suplementer→ membentuk pola gerakan (buka-tutup tangan)
- Korteks pramotorik→ mengarahkan tubuh dan lengan ke sasaran tertentu (mengkoordinasi gerakkan)
- Korteks parietalis posterior→kiriman input sensoris untuk diteruskan ke korteks pramotorik

Kesulitan dalam menggunakan peralatan makanan





● **FIGURE 5-10 Somatotopic maps of the somatosensory cortex and primary motor cortex.** (a) Top view of cerebral hemispheres showing somatosensory cortex and primary motor cortex. (b) Sensory homunculus showing the distribution of sensory input to the somatosensory cortex from different parts of the body. The distorted graphic representation of the body parts indicates the relative proportion of the somatosensory cortex devoted to reception of sensory input from each area. (c) Motor homunculus showing the distribution of motor output from the primary motor cortex to different parts of the body. The distorted graphic representation of the body parts indicates the relative proportion of the primary motor cortex devoted to controlling skeletal muscles in each area.

Korteks Somatosensory

- Peta somatotropik sedikit bervariasi antara individu dan bersifat dinamik, tidak static.
- Plastisitas→ pembentukan jalur saraf baru (perubahan bentuk dendrit)
- Karena sifat plastisnya, maka otak dapat mengalami perubahan (remodeling) sebagai respon terhadap beragam kebutuhan.

- Homunkulus sensoris

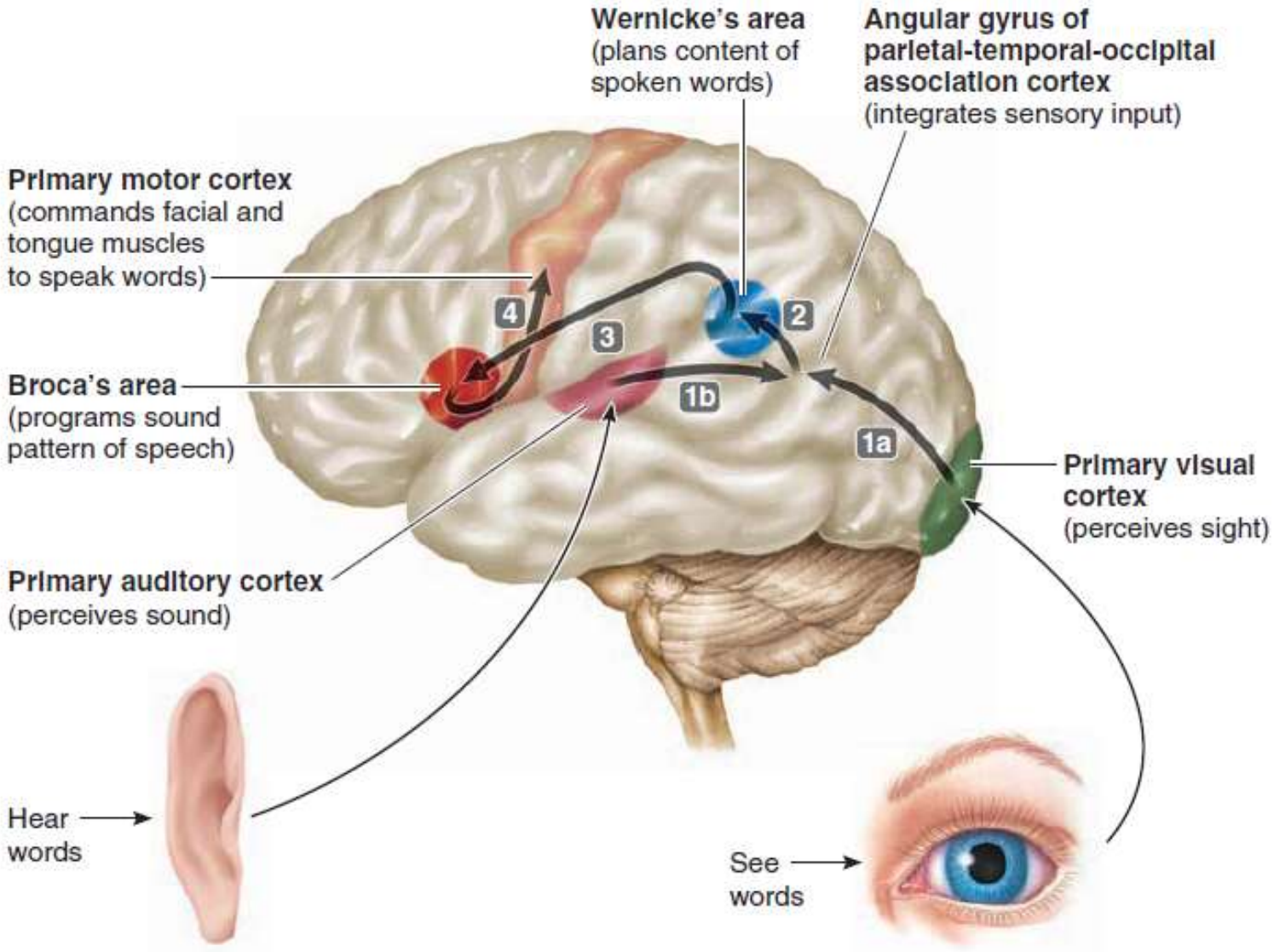
Peran daerah Broca dan daerah Wernicke

- Kemampuan bahasa adalah contoh yang sangat baik tentang plastisitas dini korteks yang kemudian diikuti oleh keadaan permanen.
- Sebagian besar daerah otak yg bertanggung jawab untuk kemampuan bahasa hanya ditentukan di salah satu hemisfer (hemisfer kiri)
- Bagian korteks yang berbeda mengontrol aspek bahasa yang berbeda

Broca→mengendalikan kemampuan berbicara→ mengontrol otot-otot untuk artikulasi

Wenick→pemahaman bahasa

Afasia? Disleksia?



● **FIGURE 5-11 Cortical pathway for speaking a word seen or heard.** The arrows and numbered steps describe the pathway used to speak about something seen or heard. Similarly, appropriate muscles of the hand can be commanded to write the desired words.

1a To speak about something seen, the brain transfers the visual information from the primary visual cortex to the angular gyrus of the parietal-temporal-occipital association cortex, which integrates inputs such as sight, sound, and touch.

1b To speak about something heard, the brain transfers the auditory information from the primary auditory cortex to the angular gyrus.

2 The information is transferred to Wernicke's area, where the choice and sequence of words to be spoken are formulated.

3 This language command is then transmitted to Broca's area, which translates the message into a programmed sound pattern.

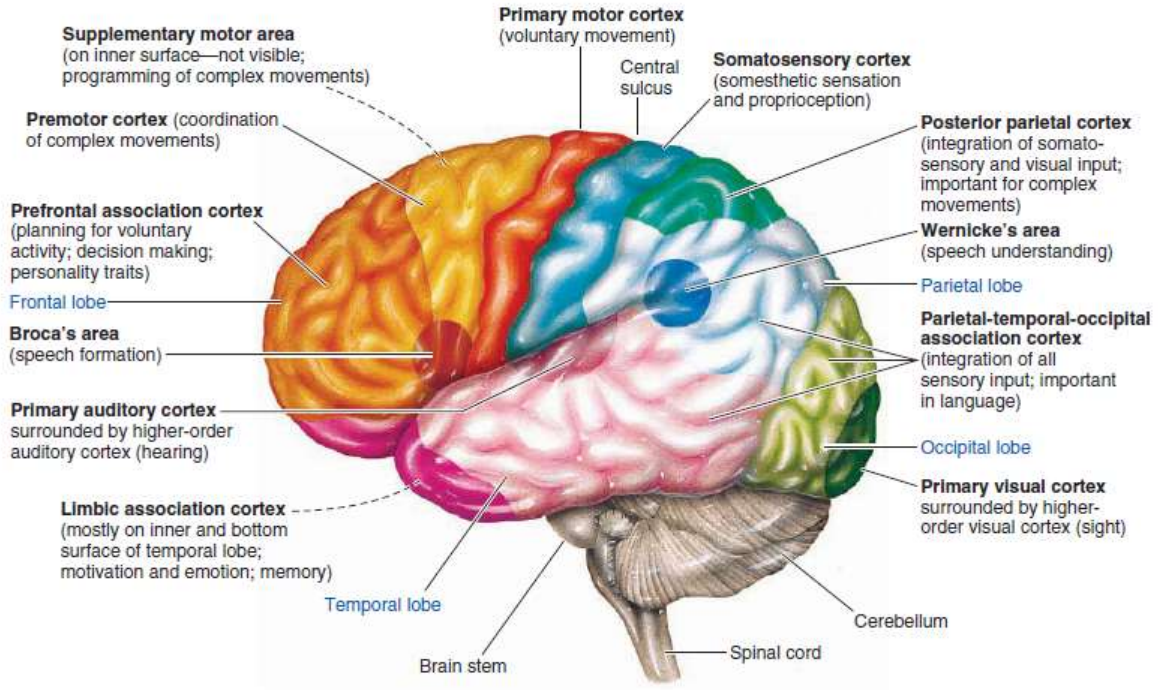
4 This sound program is conveyed to the precise areas of the primary motor cortex that activate the appropriate facial and tongue muscles for causing the desired words to be spoken.

Daerah Asosiasi Korteks

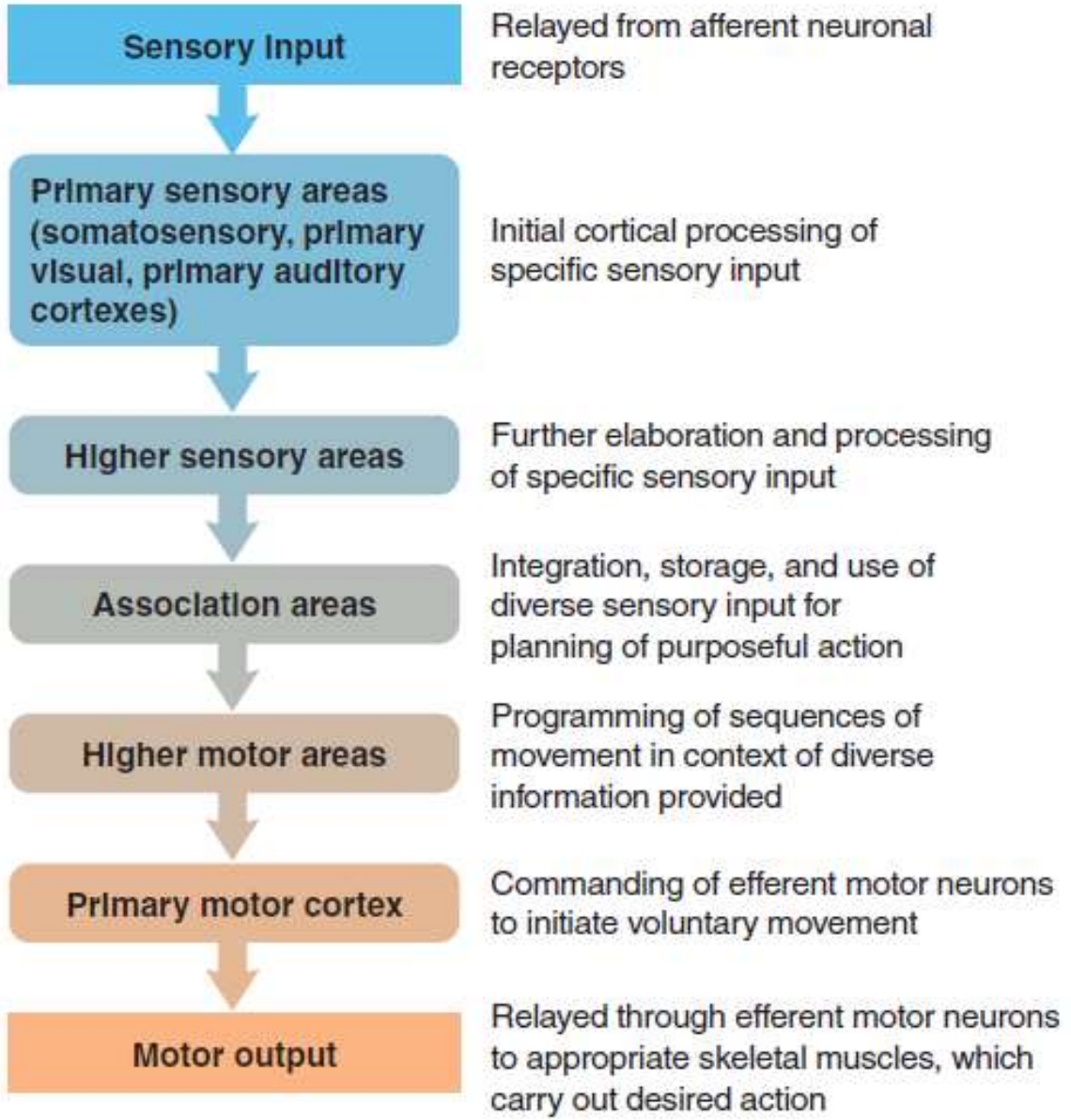
- Berperan dalam banyak fungsi luhur

Daerah asosiasi korteks

- Korteks asosiasi prefrontal
  - Perencanaan aktivitas volunteer, pengambilan keputusan
  - Kreativitas
  - Sifat kepribadian→ lobotomy
- Korteks asosiasi parietal-temporal-oksipital
- Korteks asosiasi limbik



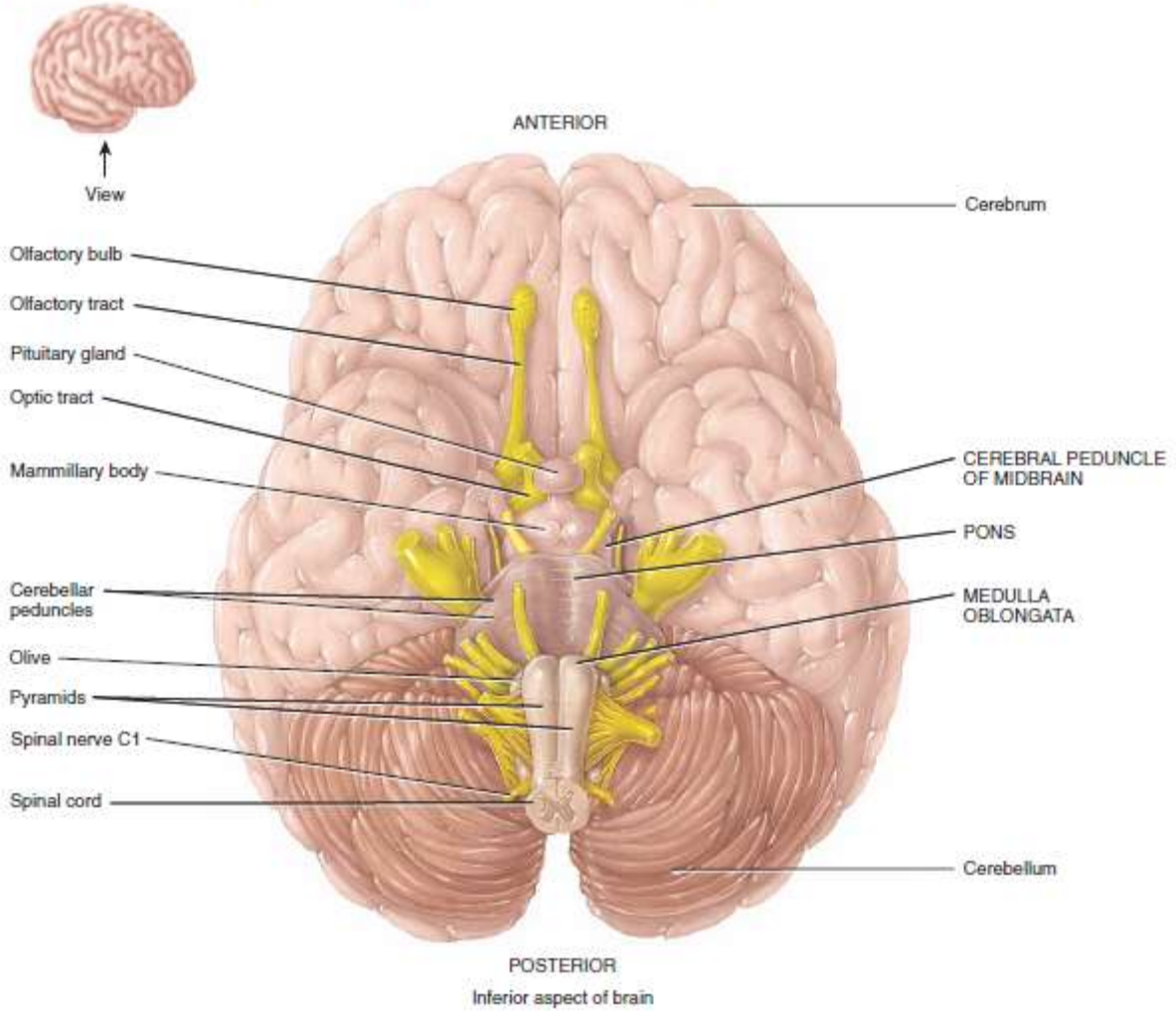
Skema Hubungan Berbagai Bagian di Korteks



● **FIGURE 5-12 Linking of various regions of the cortex.** For simplicity, a number of interconnections have been omitted.

Figure 14.5 **Medulla oblongata in relation to the rest of the brain stem.**

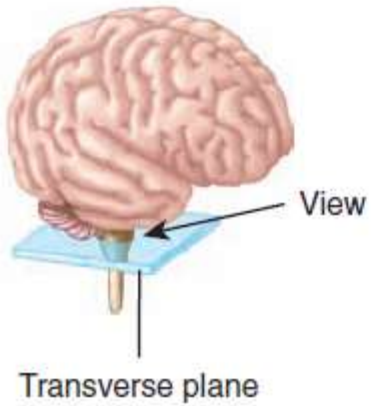
The brain stem consists of the medulla oblongata, pons, and midbrain.

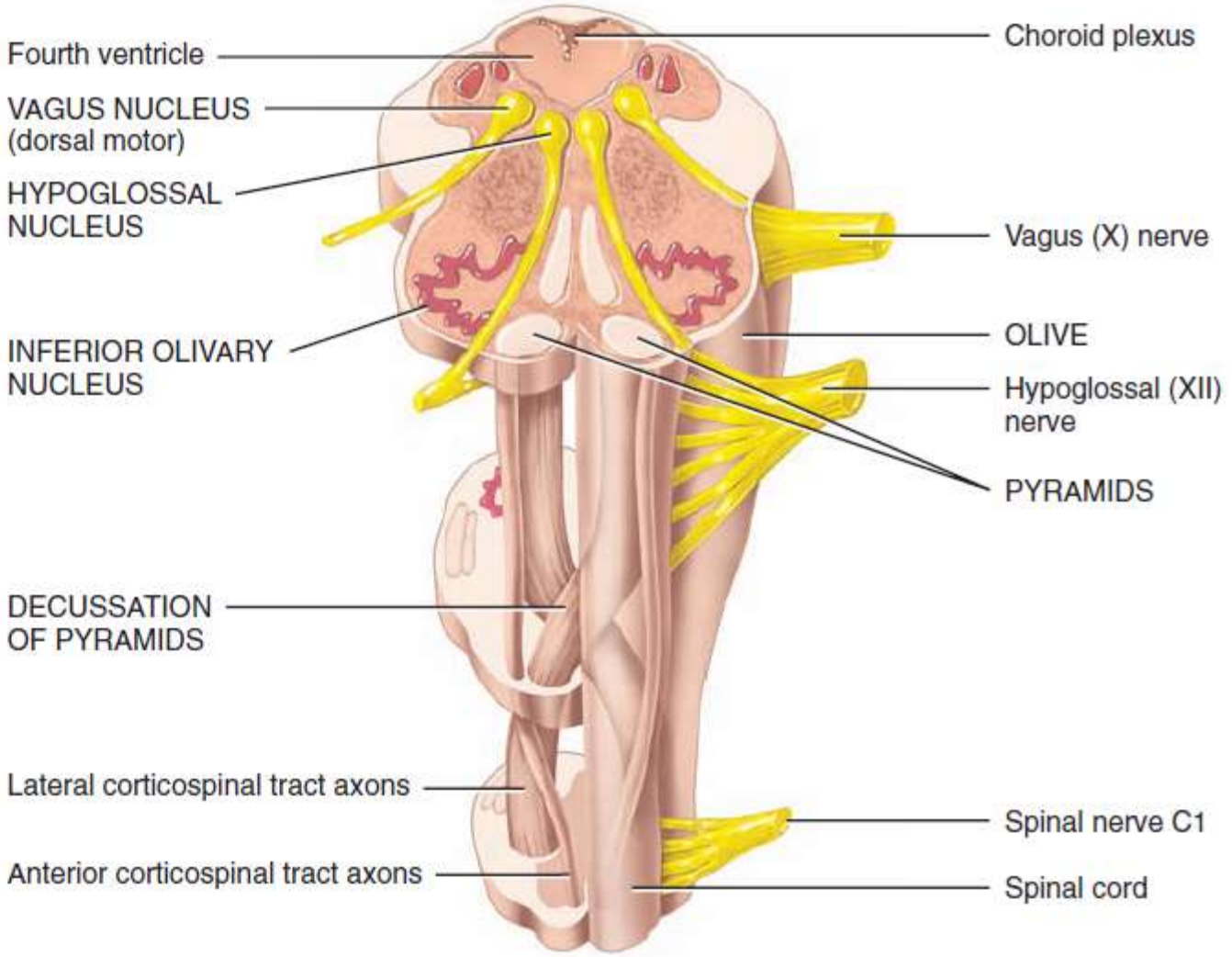


Inferior aspect of brain

Figure 14.6 Internal anatomy of the medulla oblongata.

6 The pyramids of the medulla contain the large motor tracts that run from the cerebrum to the spinal cord.

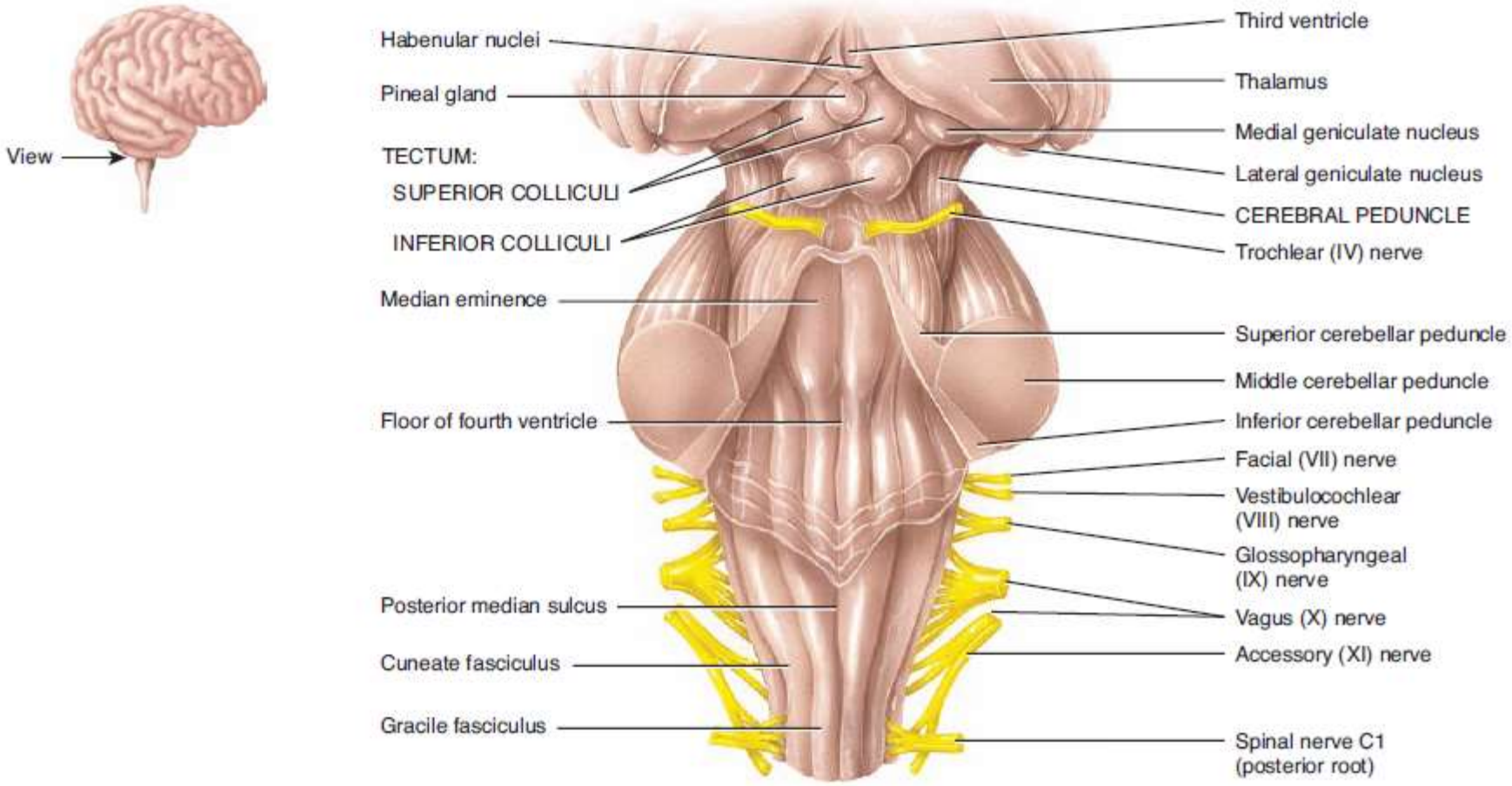




Transverse section and anterior surface of medulla oblongata

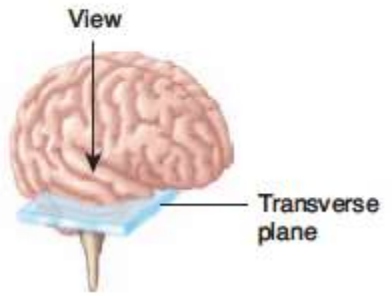
Figure 14.7 Midbrain.

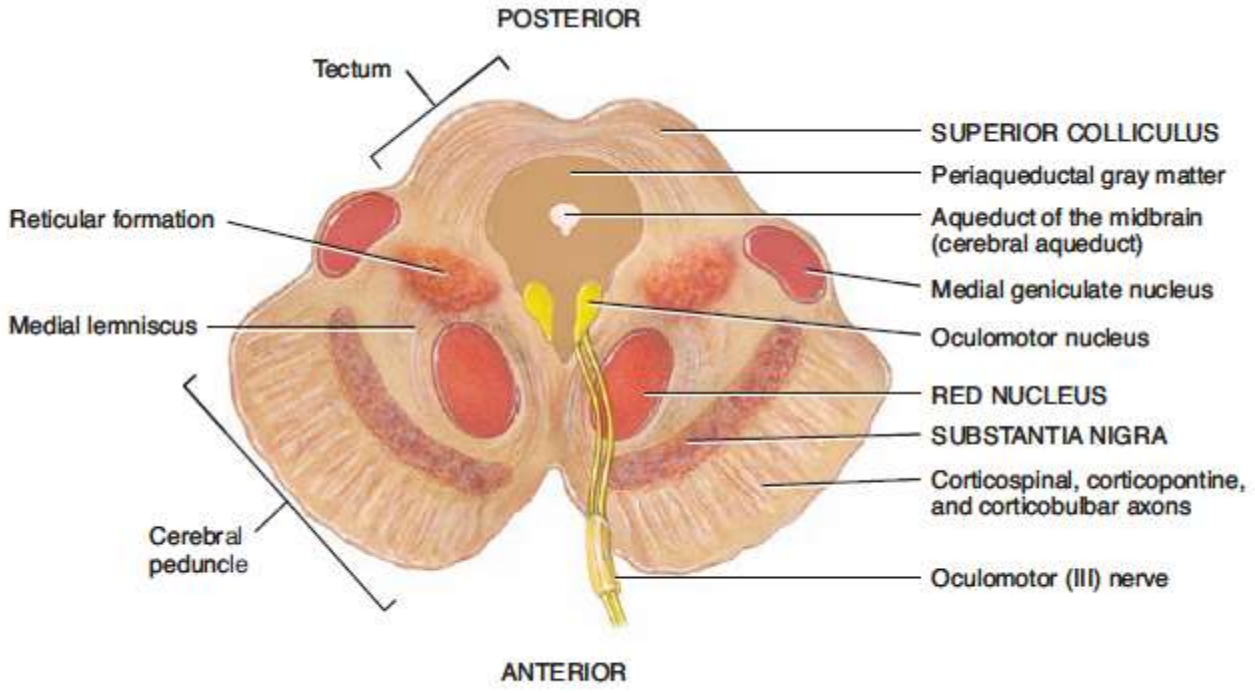
The midbrain connects the pons to the diencephalon.



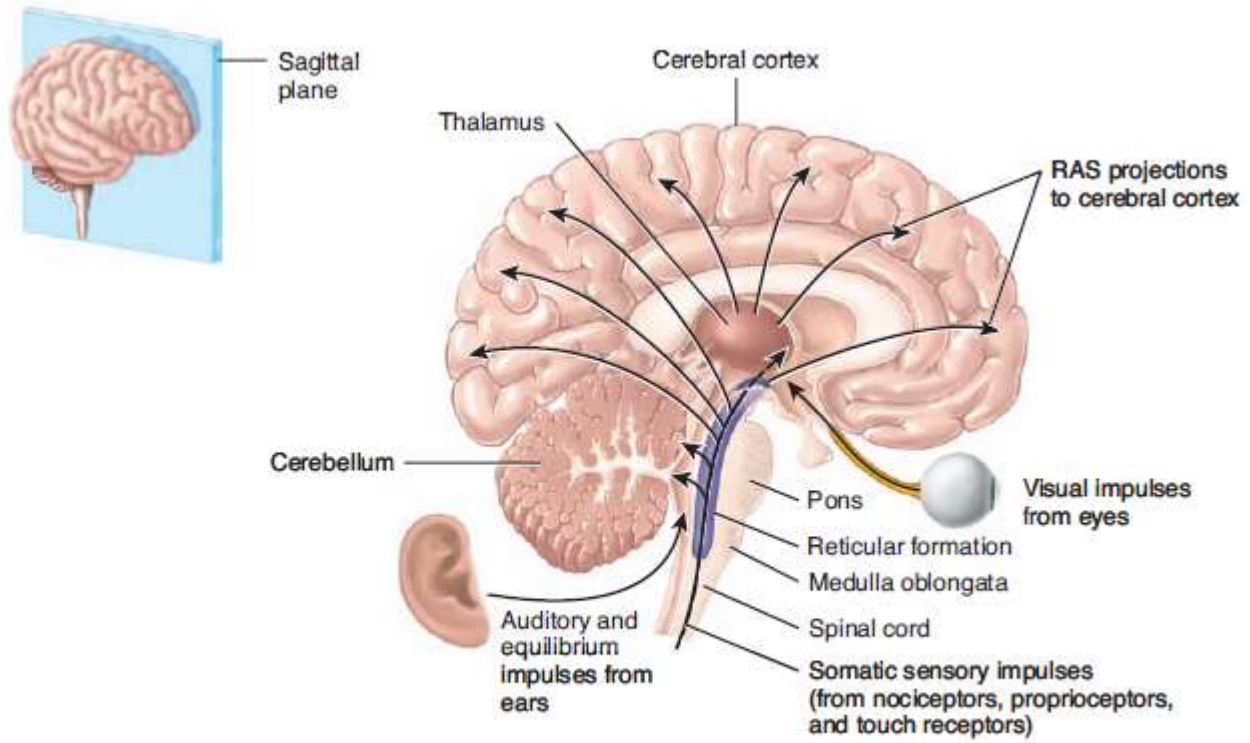
(a) Posterior view of midbrain in relation to brain stem

FIGURE 14.7 CONTINUED





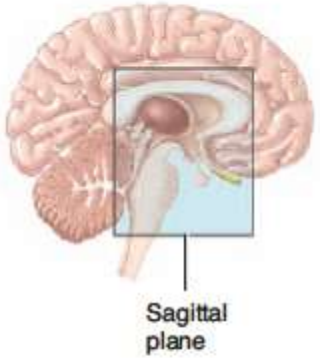
(b) Transverse section of midbrain



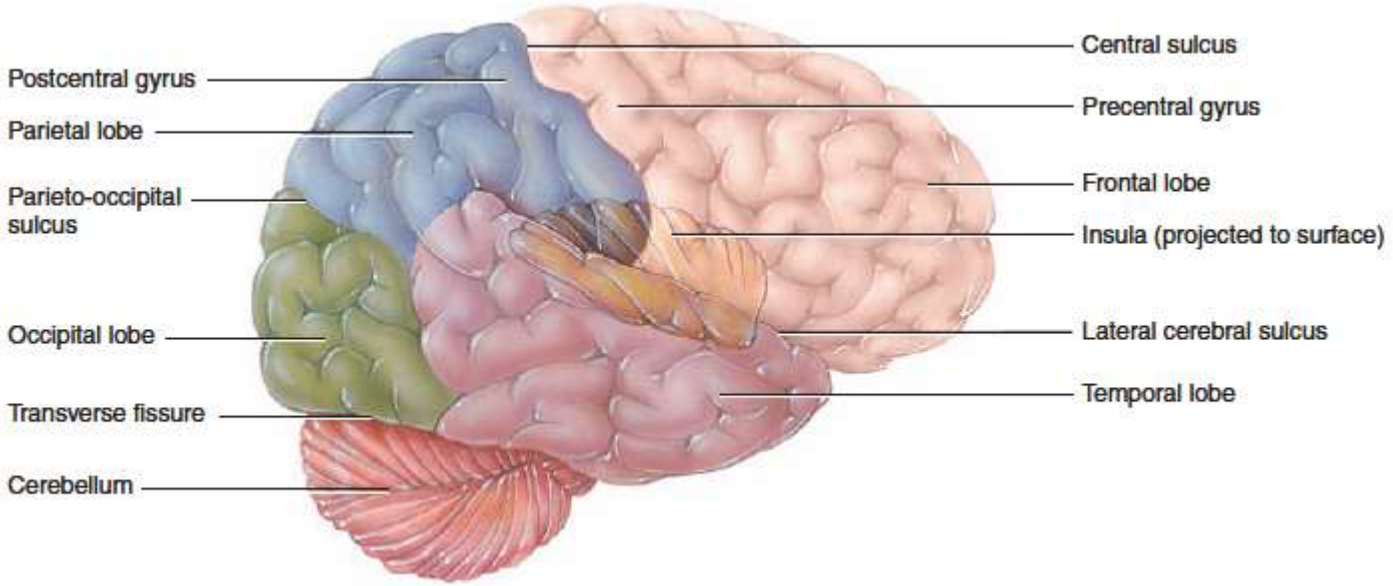
(c) Sagittal section through brain and spinal cord showing the reticular formation

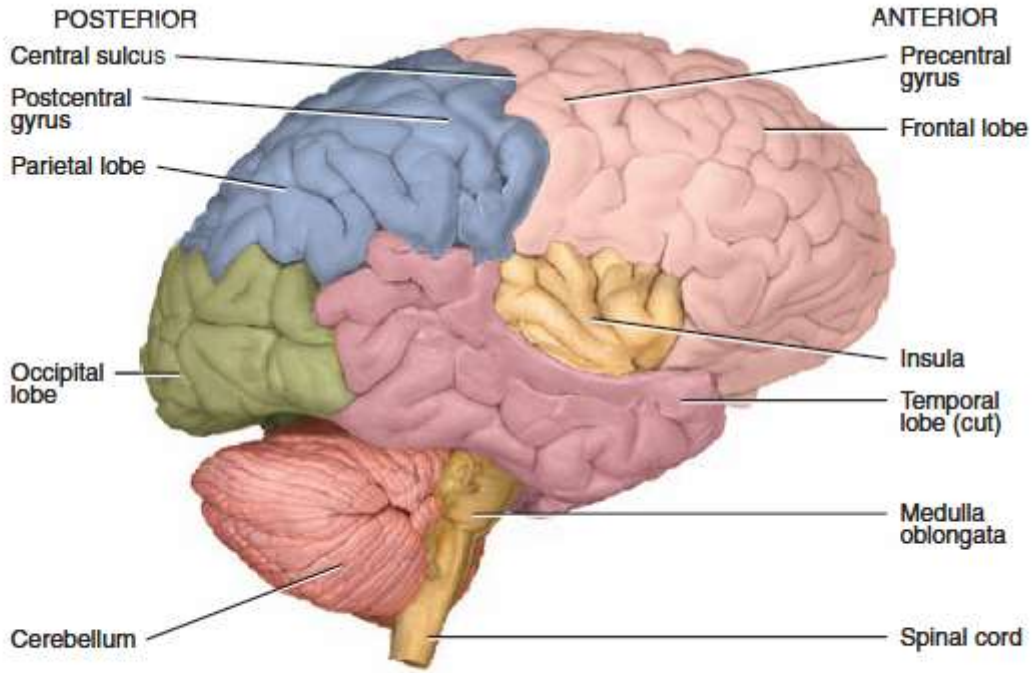
Figure 14.10 **Hypothalamus.** Selected portions of the hypothalamus and a three-dimensional representation of hypothalamic nuclei are shown (after Netter).

The hypothalamus controls many body activities and is an important regulator of homeostasis.



Sagittal section of brain showing hypothalamic nuclei

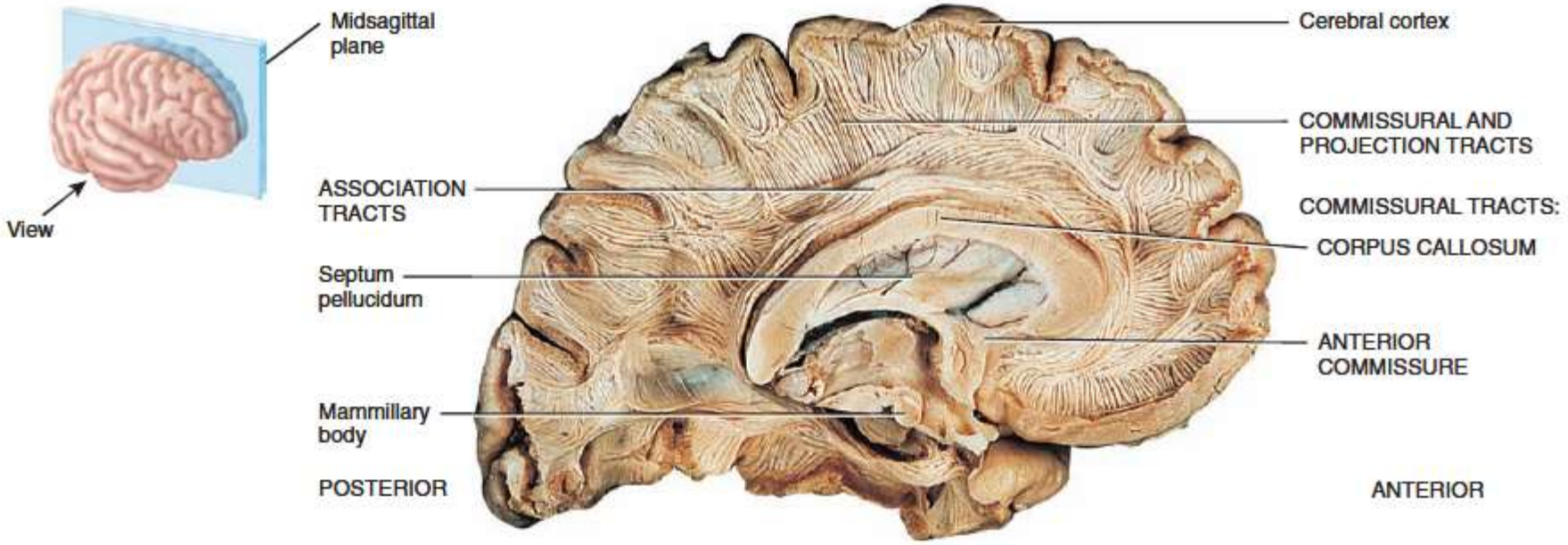

Central sulcus
Postcentral gyrus
Precentral gyrus
Parietal lobe
Frontal lobe
Parieto-occipital sulcus
Insula (projected to surface)
Occipital lobe
Lateral cerebral sulcus
Temporal lobe
Transverse fissure
Cerebellum



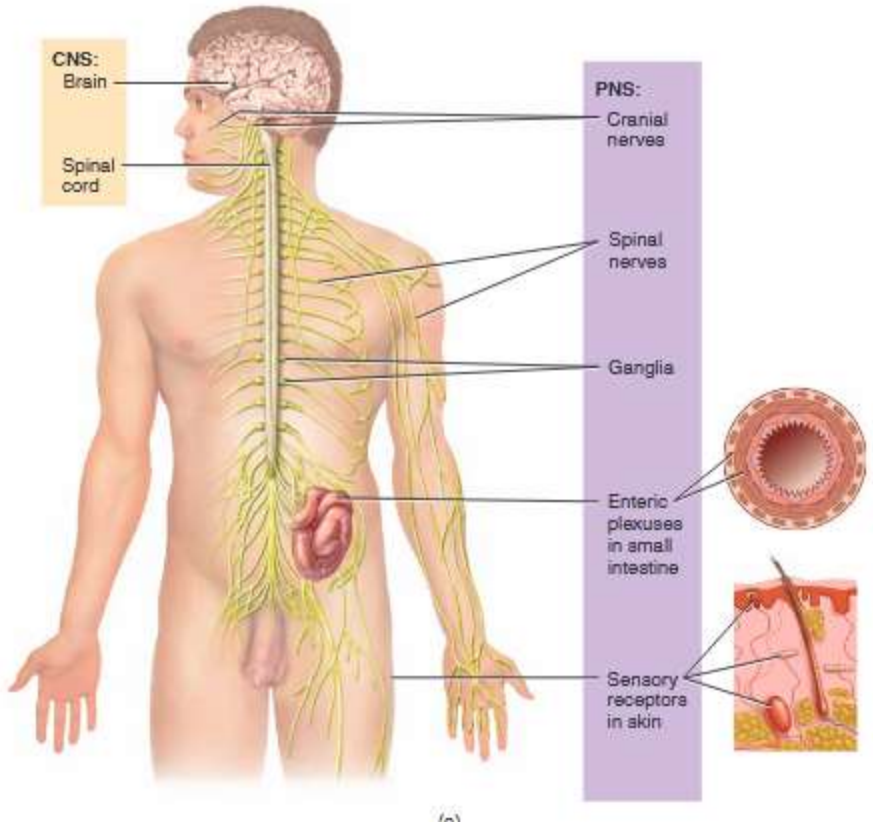
(c) Right lateral view with temporal lobe cut away

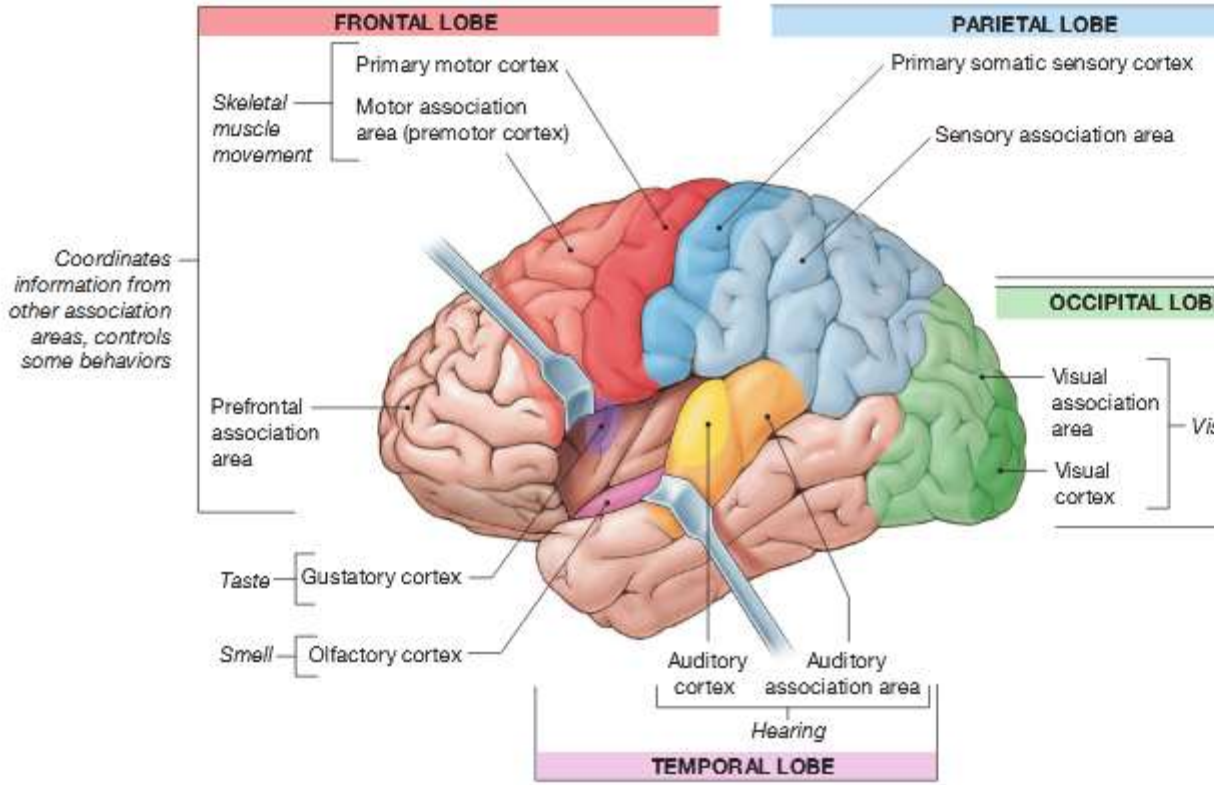
Figure 14.12 **Organization of white matter tracts of the left cerebral hemisphere.**

6 Association tracts, commissural tracts, and projection tracts form white matter tracts in the cerebral hemispheres.

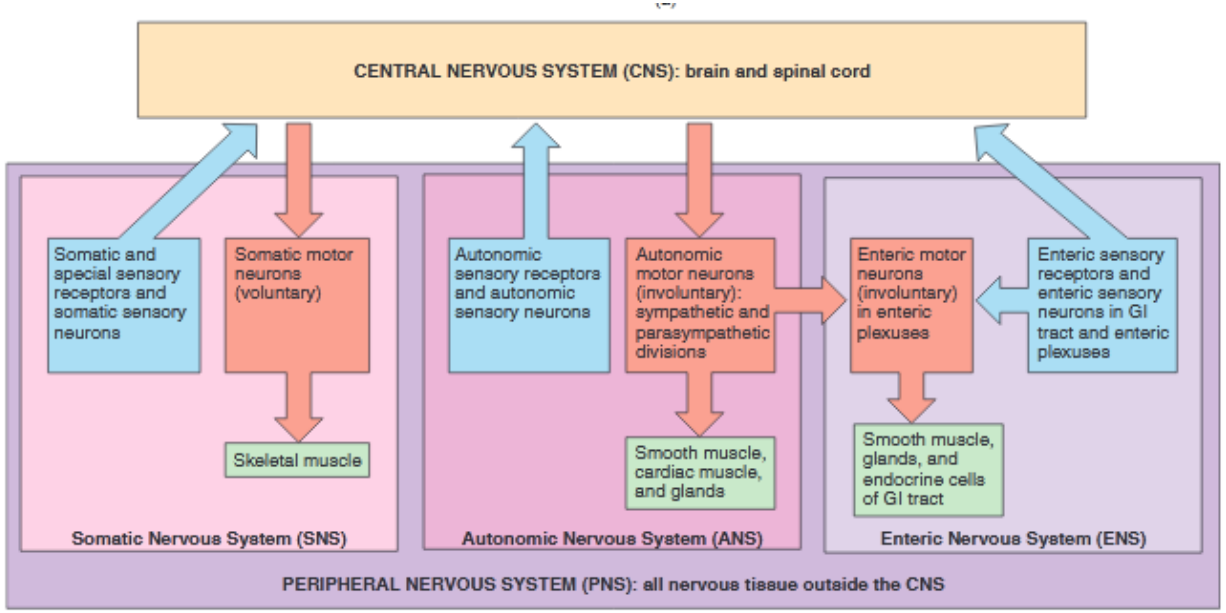


Medial view of tracts revealed by removing gray matter from a midsagittal section





● **FIGURE 9-15** ***The cerebral cortex is specialized into functional areas.*** The cerebral cortex contains sensory areas for perception, motor areas that direct movement, and association areas that integrate information.



(b)

? What are some of the functions of the CNS?