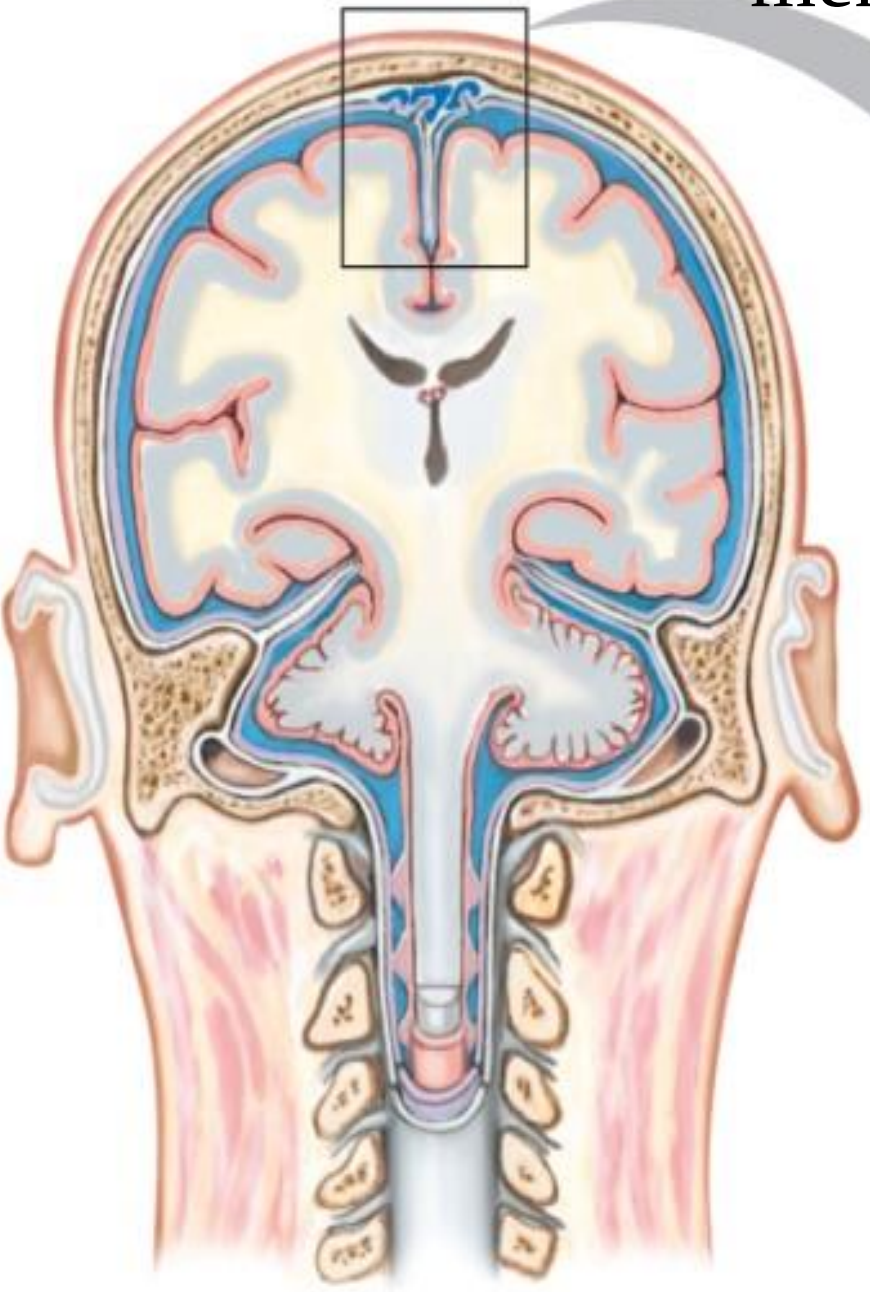
11.1: Introduction

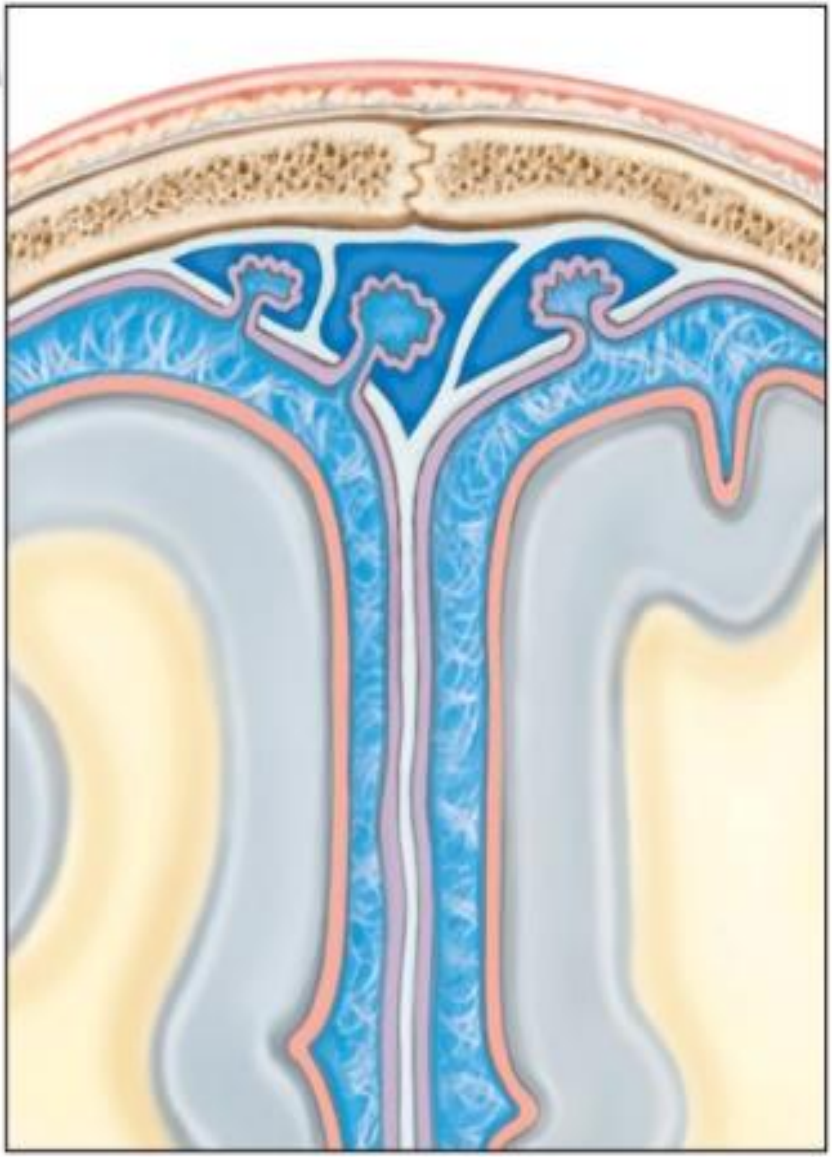
- The central nervous system (CNS) consists of the brain and spinal cord.
- The brainstem connects the brain to the spinal cord.
- Communication to the peripheral nervous system (PNS) is by way of the spinal cord.

Page 391

Bones, membranes, and fluid surround the organs of the CNS. Beneath the bony coverings, membranes called **meninges** are located between the bone and the soft tissue. There are three layers of meninges, the **dura** mater, the **arachnoid** mater, and the **pia mater**

meninges





Dura mater is the outermost layer next to the inside of the cranial cavity and forms the internal periosteum. In some regions, it extends inward between lobes of the brain and forms supportive and protective partitions. In other areas it splits into two layers forming channels called dural sinuses where venous blood flows through the channels as it returns from the heart.

(continued on next slide)

The dura mater continues into the vertebral canal (canal containing spinal cord) as a strong, tubular sheath that surrounds the spinal cord. It is attached to the cord at regular intervals by a band of pia mater. The dural sheath terminates as a blind sac at the level of the second sacral vertebra below the end of the spinal cord. (cont.)

The sheath around the spinal cord is not attached directly to the vertebrae but is separated by an epidural space, which lies between the dural sheath and the bony walls (pg. 391). This space contains blood vessels, loose connective tissue, and adipose tissue that pad the spinal cord.

The arachnoid mater is a thin, weblike membrane that does not have blood vessels and is located between the dura and pia maters. It spreads over the brain and spinal cord but generally does not dip into the grooves and depressions on their surfaces (continued on next slide)

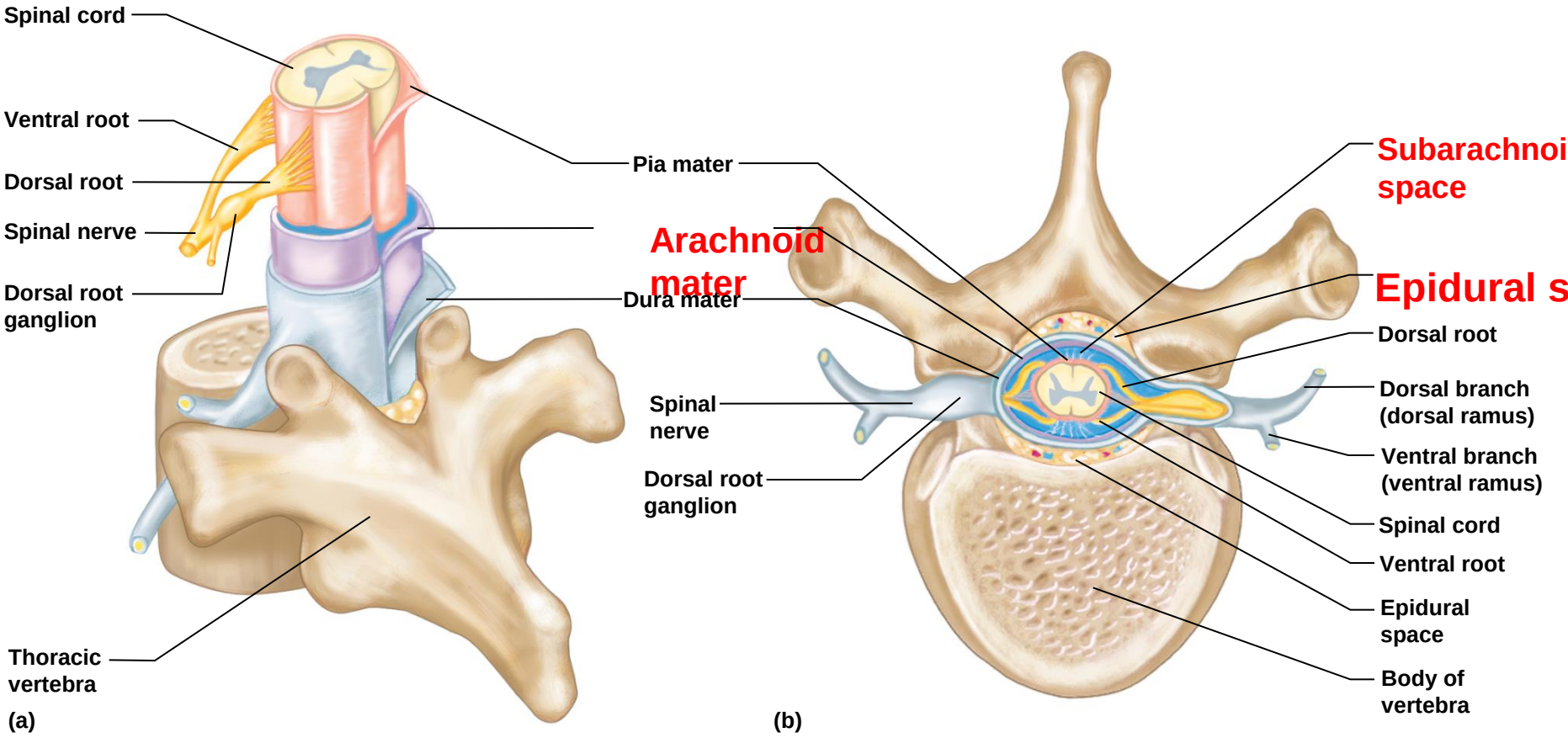
A subarachnoid space between the arachnoid and and pia maters contains the clear watery cerebrospinal fluid or CSF.

Page 392

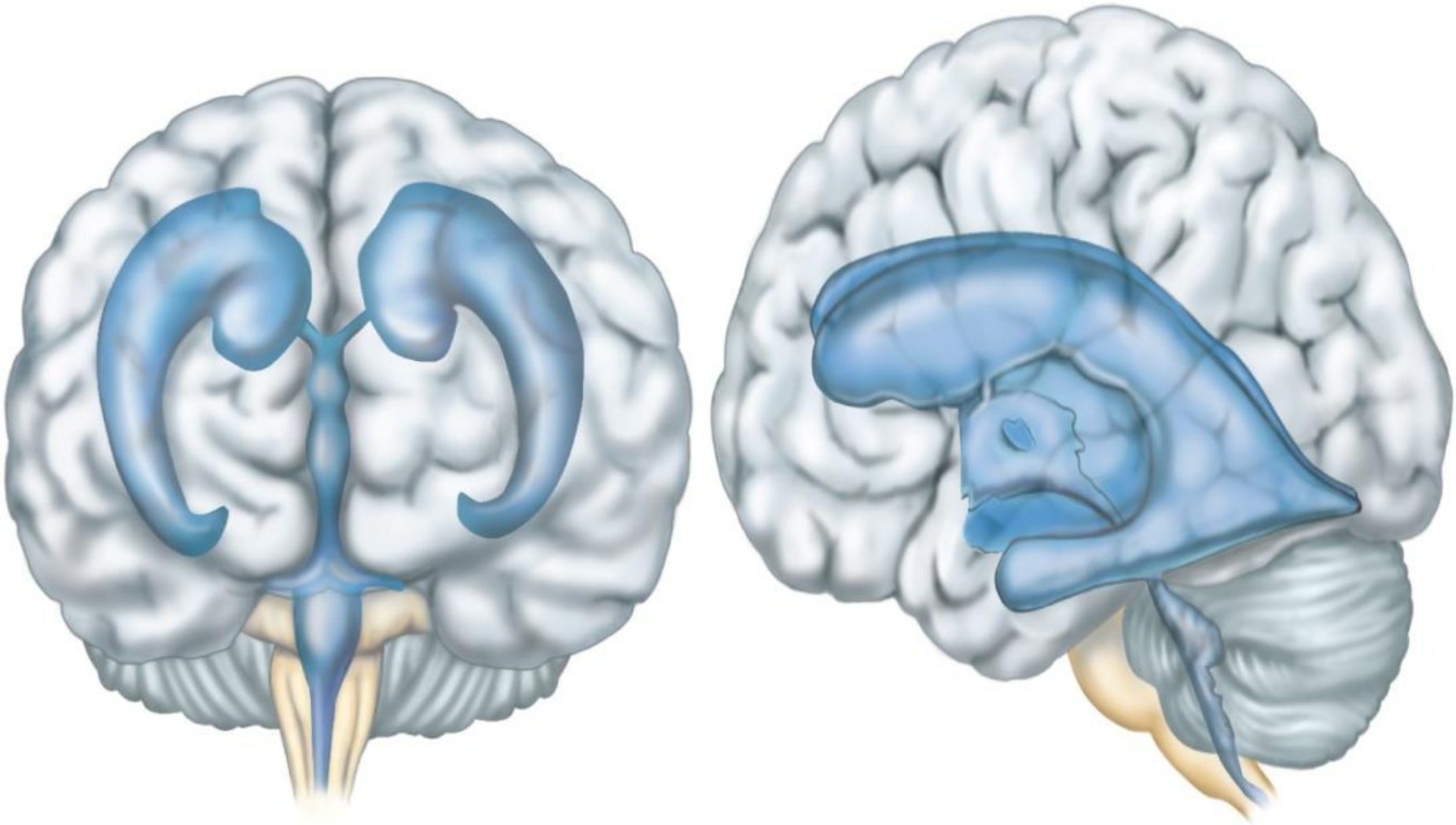
The **pia mater** is thin and contains many nerves, as well as blood vessels that nourish the underlying cells of the brain and spinal cord. (cont.)

The pia mater is attached to the surfaces of the brain and spinal cord and follows their irregular contours, passing over the high areas and dipping into the depressions.

Meninges of the Spinal Cord p392



11.3: Ventricles page 393 and Cerebrospinal Fluid

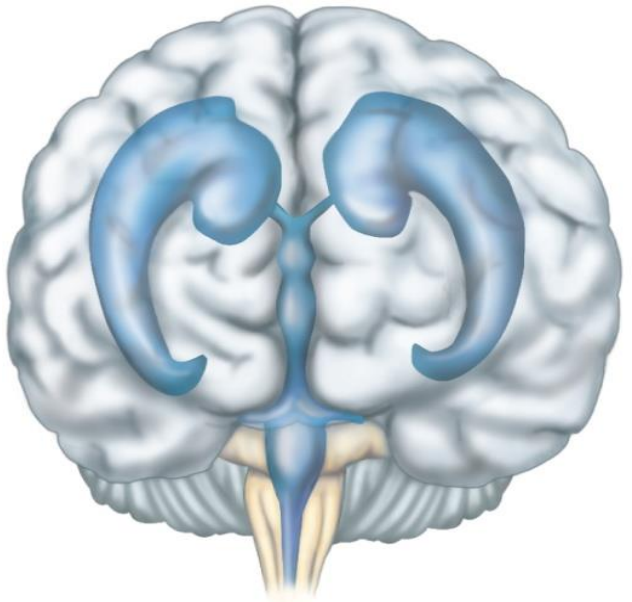


There are four (4) ventricles

The ventricles are interconnected cavities within cerebral hemispheres and brain stem

The ventricles are continuous with the central canal of the spinal cord

They are filled with cerebrospinal fluid (CSF)

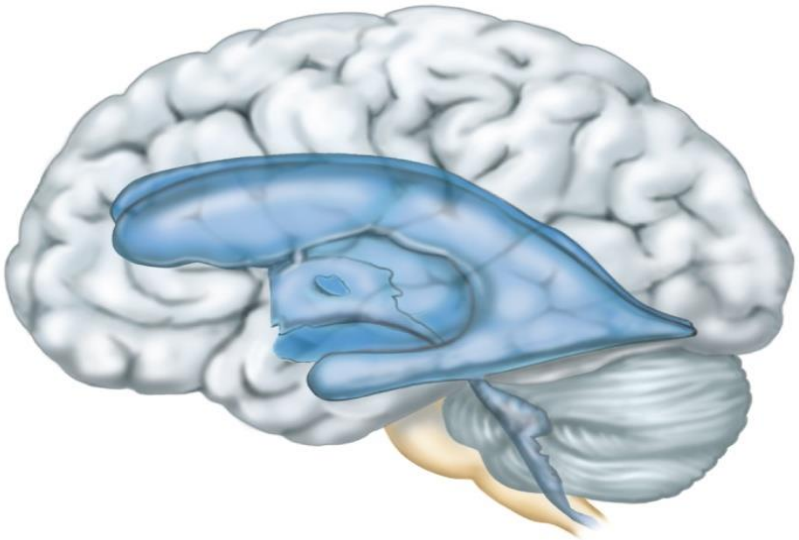


Page 393

The four (4) ventricles are:

- Lateral ventricles (2)

  Known as the first and second ventricles
- Third ventricle
- Fourth ventricle



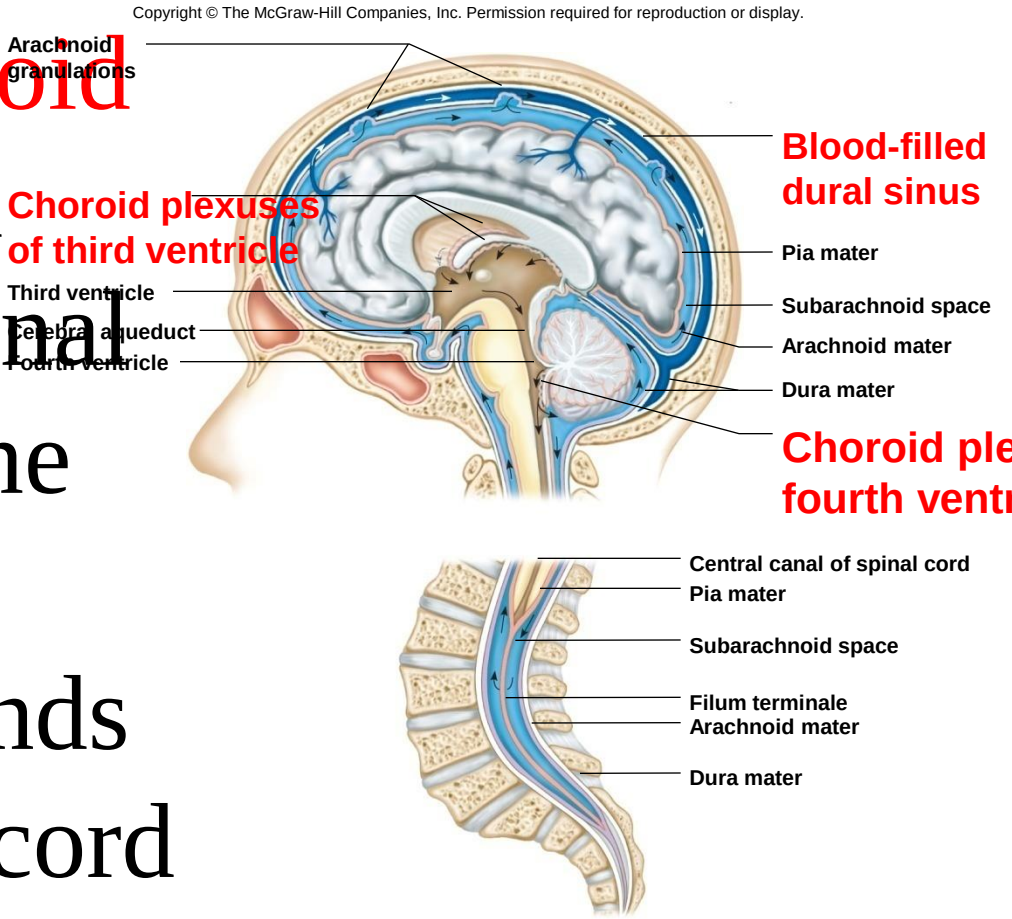
Interventricular foramen

Cerebral aqueduct

Cerebrospinal Fluid p 394/95

Secreted by the choroid plexus (Circulates in ventricles, central canal of spinal cord, and the subarachnoid space

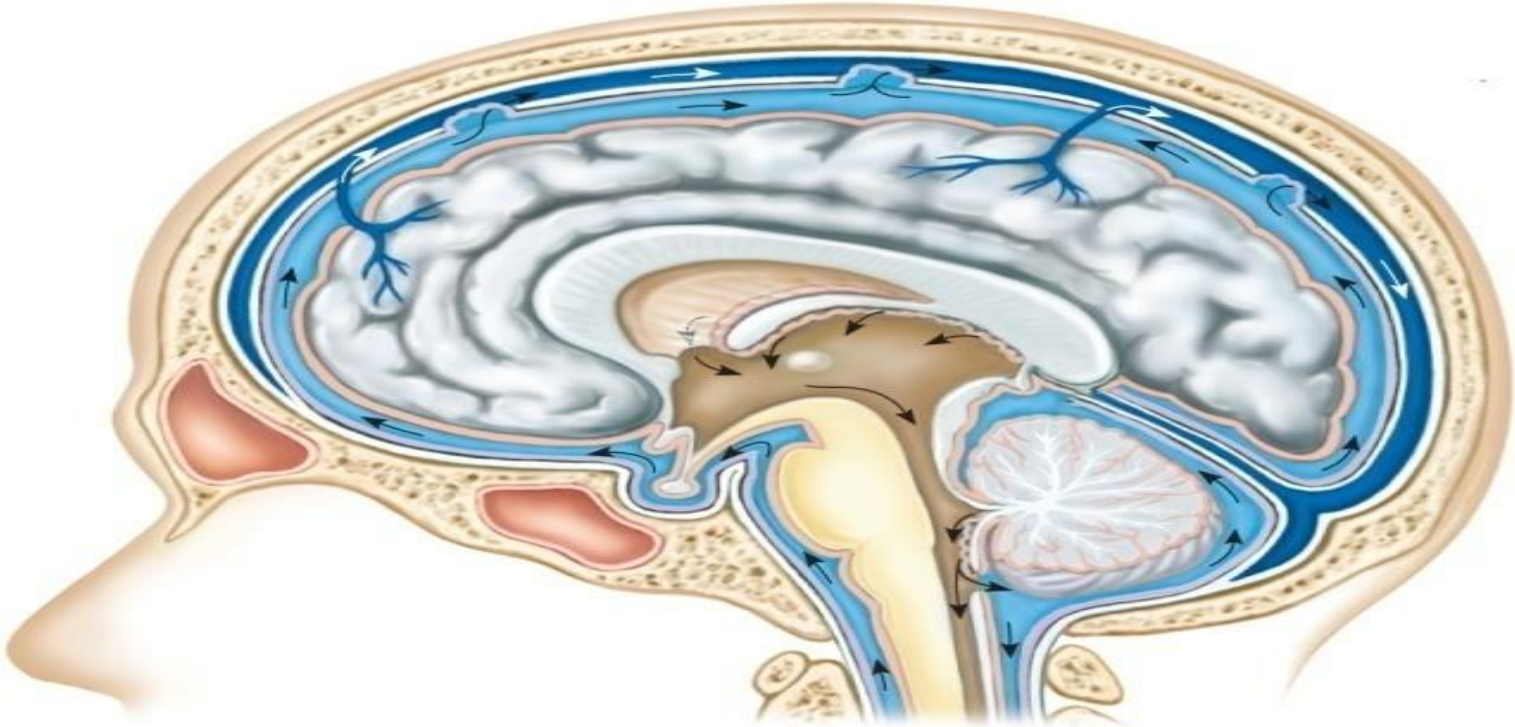
- Completely surrounds the brain and spinal cord

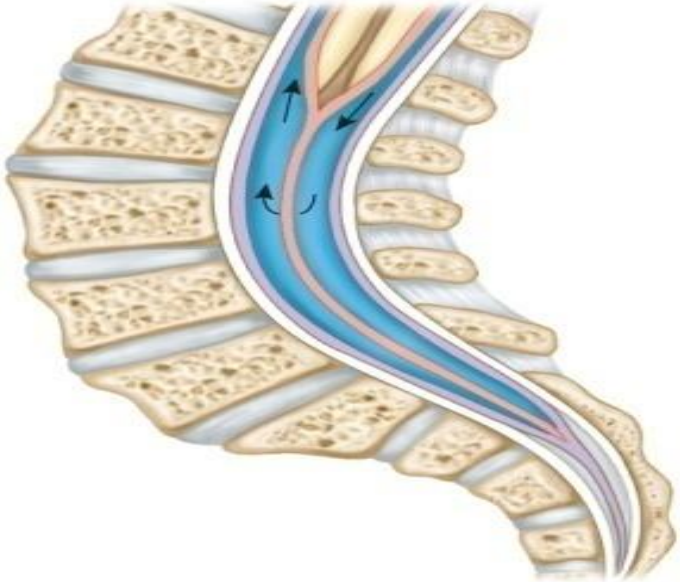


Excess or wasted CSF is absorbed by the arachnoid villi. Fluid pressure in the ventricles remains relatively constant. CSF is clear fluid similar to blood plasma. The volume is only about 140ml in the nervous system at any time.

It is nutritive and protective, and helps maintain stable ion concentrations in the CNS.

Page 392

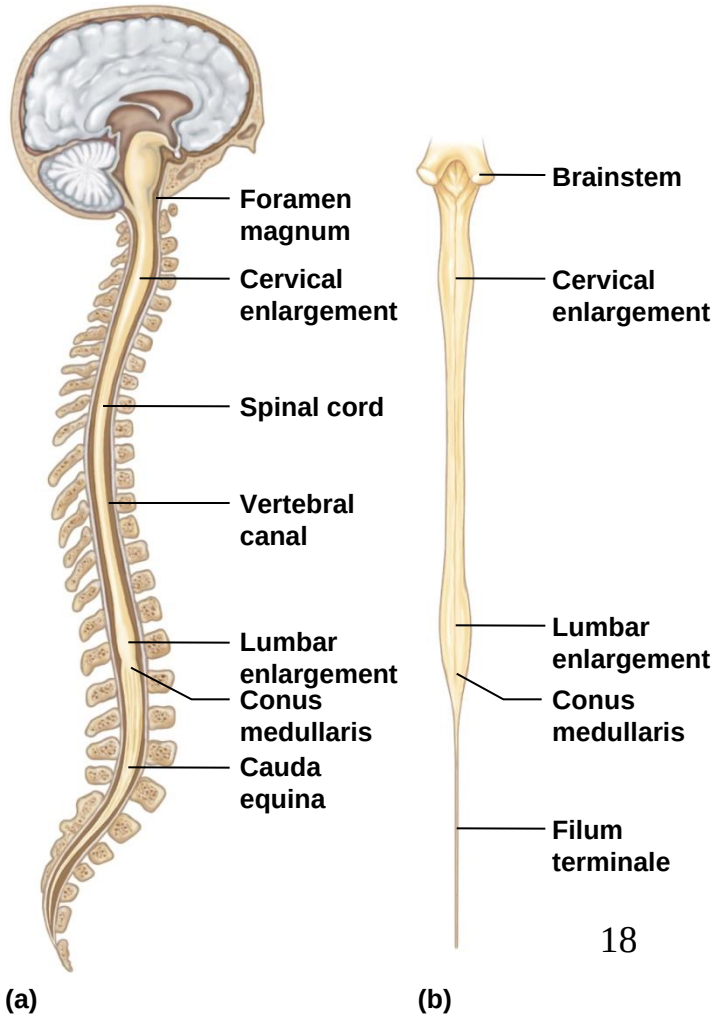




11.4: Spinal Cord p396

- Slender column of nervous tissue continuous with brain and brainstem
- Extends downward through vertebral canal

(cont.)



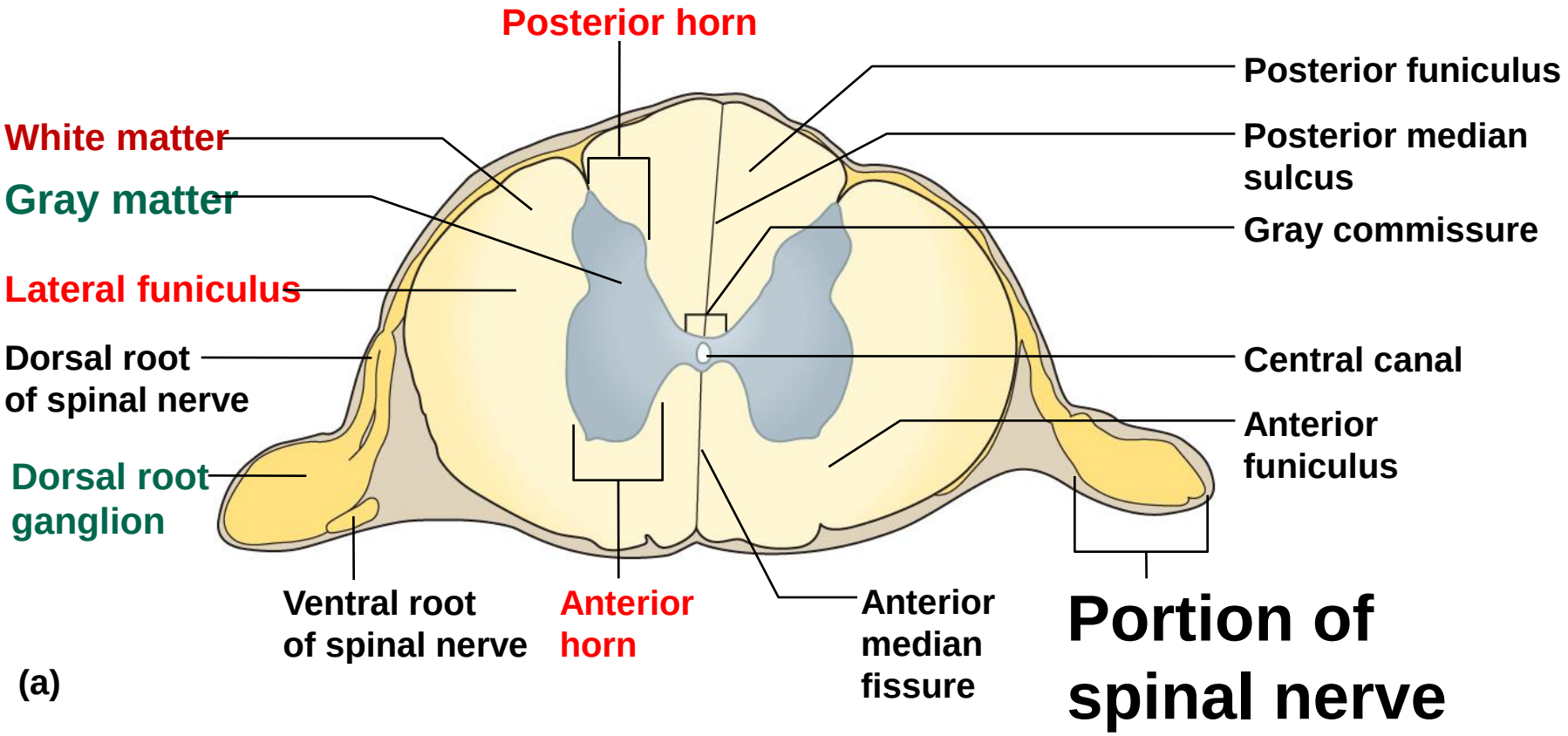
The Spinal Cord consists of thirty-one segments, each of which gives rise to a pair of spinal nerves. These nerves branch to various body parts and connect with the CNS. In the neck region, a thickening in the spinal cord, called the cervical enlargement supplies nerves to the upper limbs.

The spinal cord begins at the foramen magnum and ends at L1/L2 interspace.

Conduit for nerve impulses to and from brain and brainstem

Center for spinal reflexes

Structure of the Spinal Cord page 397



The cross section reveals that it (the spinal cord) consists of white matter surrounding a core of gray matter. The wings consist of gray matter, you have posterior horns anterior horns, and between them on either side is a protrusion of gray matter called the lateral horn. (cont.)

Motor neurons with relatively large cell bodies in the anterior horns give rise to axons that pass out through spinal nerves to various skeletal muscles. The majority of neurons in the gray matter are interneurons.

The gray matter divides the white matter of the spinal cord into three regions on each side—the **anterior**, **lateral**, and **posterior funiculi**. Each funiculus, or column consists of longitudinal bundles of **myelinate**d nerve fibers that compose major nerve pathways called **tracts.**

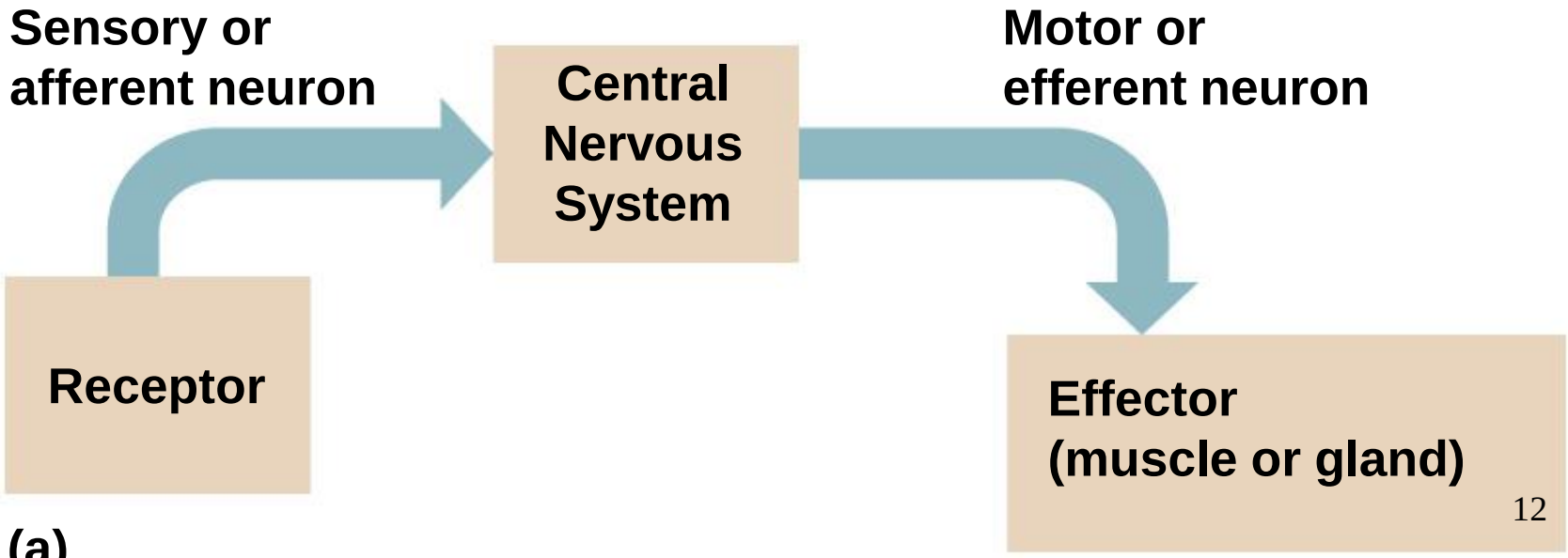
The spinal cord has two main functions. It is a center for spinal reflexes and it is a conduit for impulses to and from the brain.

All reflexes share the same basic components which together are known as a reflex arc. A reflex arc **begins with a sensory receptor at the dendritic** end of a sensory neuron. **Impulse enters the CNS** (afferent), **connects with motor neurons**, **whose fibers pass outward from CNS to effectors.** (effector neurons control effector organs)

Reflexes occur through-out the CNS. Those that involve the spinal cord are called spinal reflexes and reflect the simplest level of CNS function

Reflex Arcs p396-400

- Reflexes are automatic, subconscious responses to stimuli within or outside the body
  - Simple reflex arc (sensory – motor)
  - Most common reflex arc (sensory – association – motor)



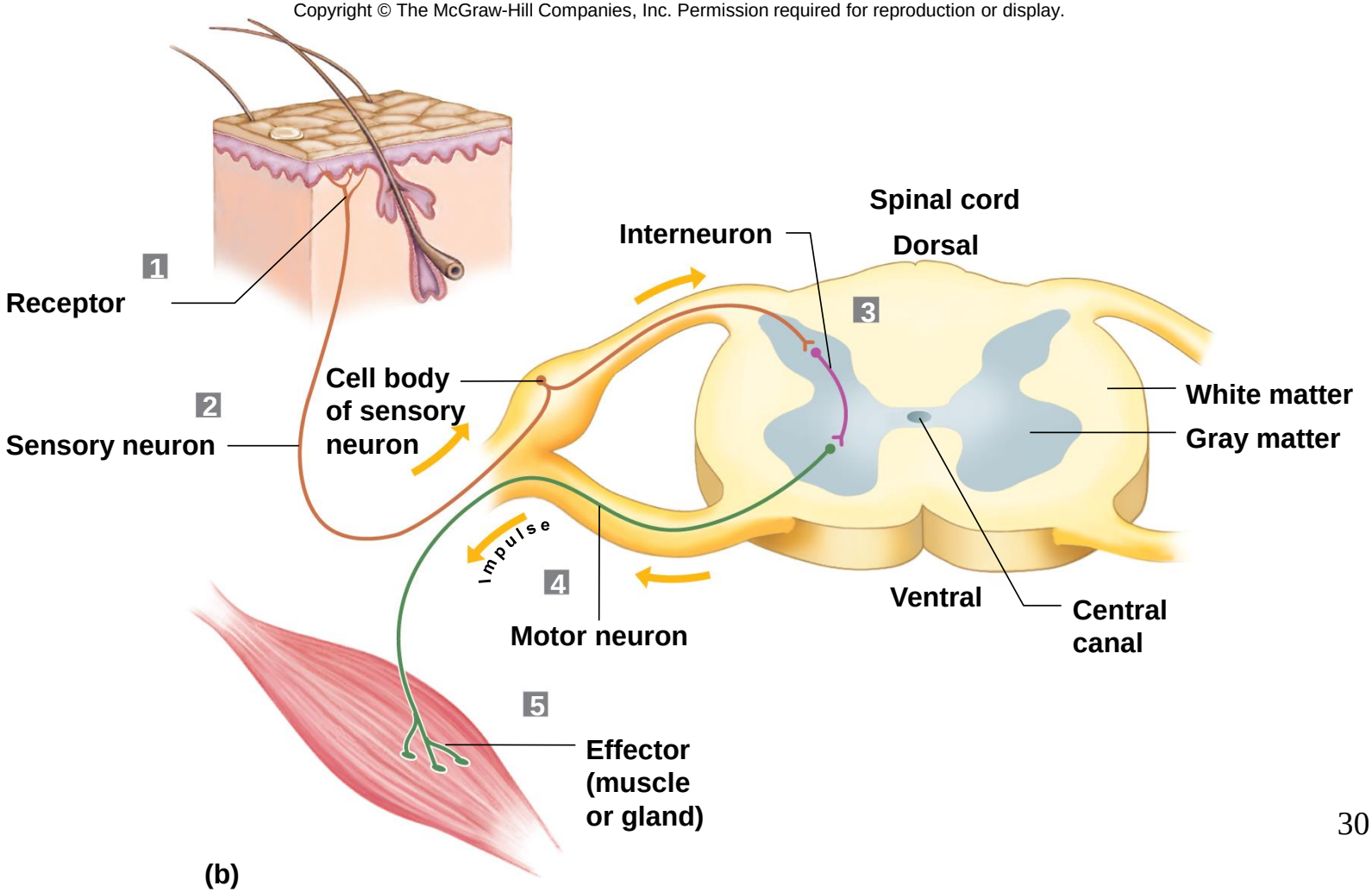
(a)

Reflex Arcs p 398/99

TABLE 11.2 | Parts of a Reflex Arc

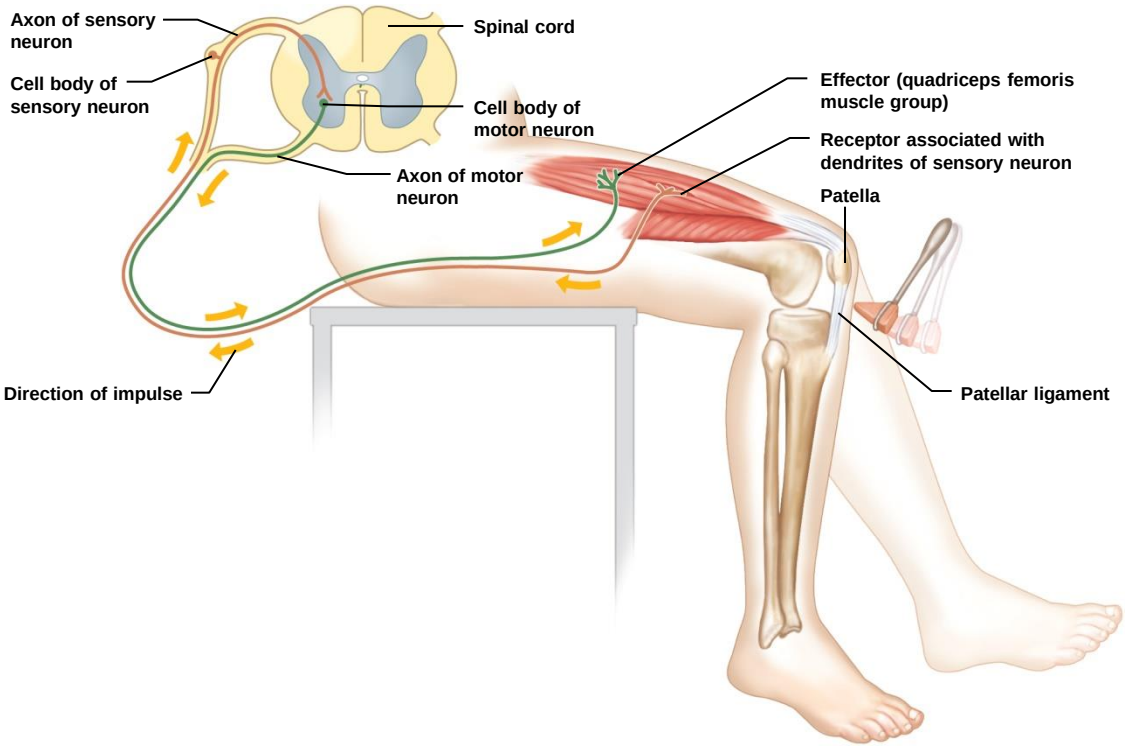
Part	Description	Function
Receptor	The receptor end of a dendrite or a specialized receptor cell in a sensory organ	Sensitive to a specific type of internal or external change
Sensory neuron	Dendrite, cell body, and axon of a sensory neuron	Transmits nerve impulse from the receptor into the brain or spinal cord
Interneuron	Dendrite, cell body, and axon of a neuron within the brain or spinal cord	Serves as processing center; conducts nerve impulse from the sensory neuron to a motor neuron
Motor neuron	Dendrite, cell body, and axon of a motor neuron	Transmits nerve impulse from the brain or spinal cord out to an effector
Effector	A muscle or gland	Responds to stimulation by the motor neuron and produces the reflex or behavioral action

General Components of a Spinal Reflex p398



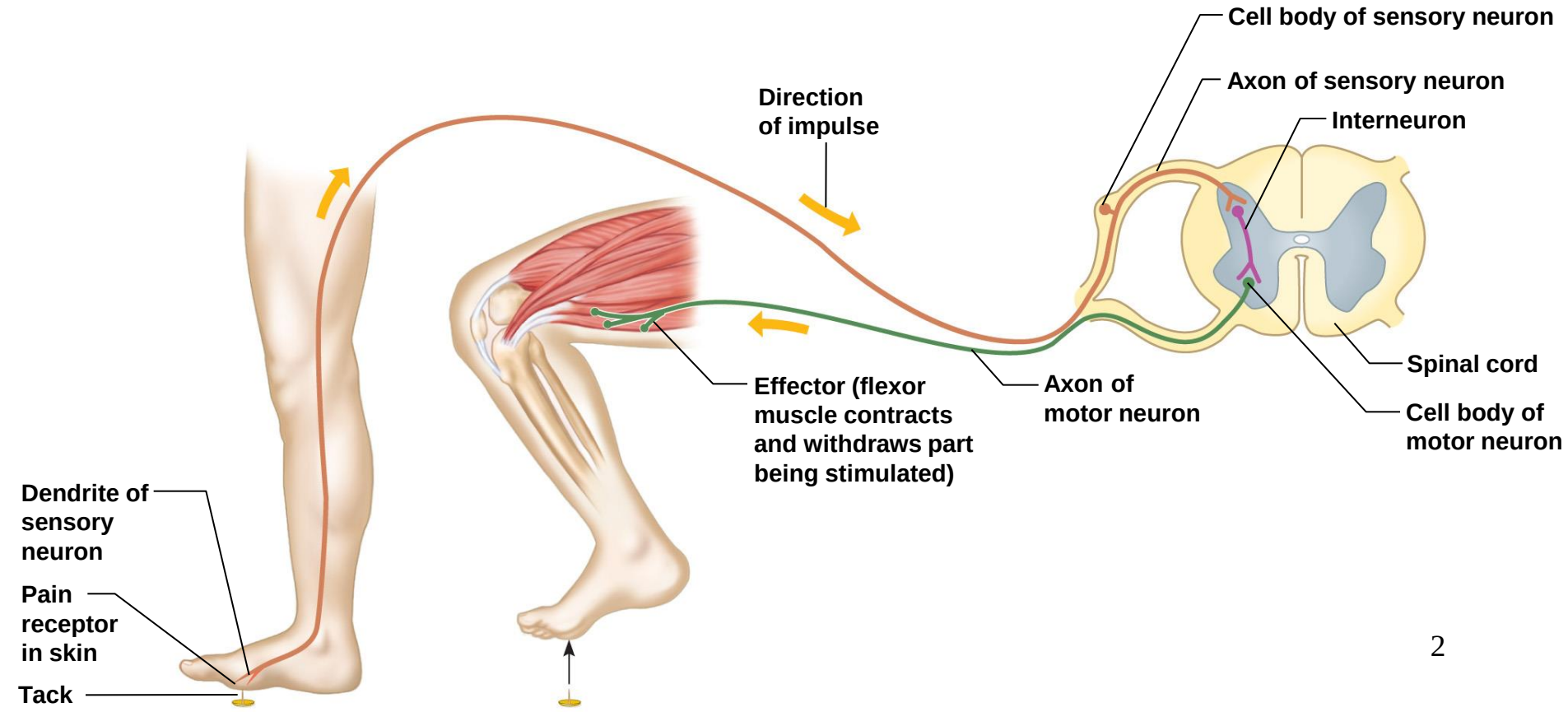
Reflex Behavior p399

- Example is the *knee-jerk reflex*
- Simple monosynaptic reflex
- Helps maintain an upright posture



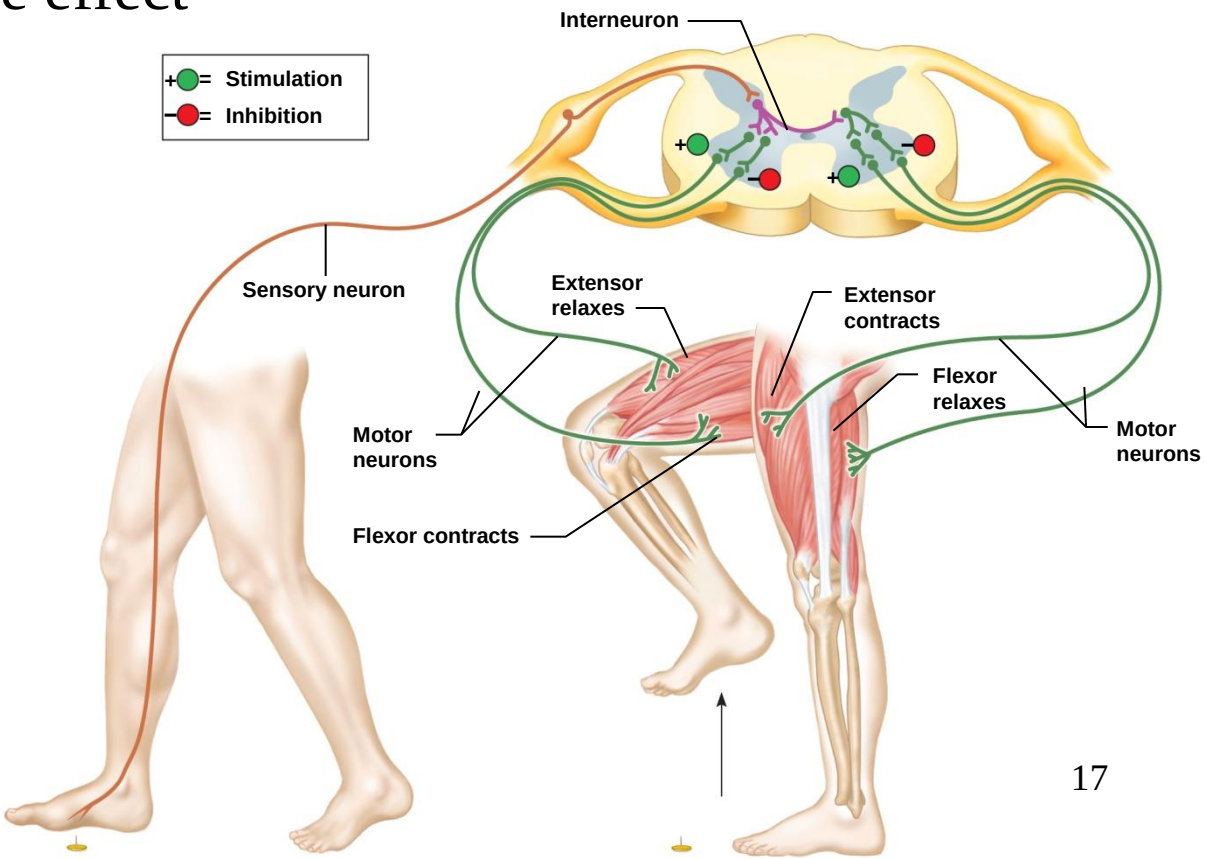
Reflex Behavior p399

- Example is a *withdrawal reflex*
- Prevents or limits tissue damage



Reflex Arc p400

- Example *crossed extensor reflex*
- Crossing of sensory impulses within the reflex center to produce an opposite effect



The crossed extensor reflex

ex: painful stimulation of one foot causes flexion (withdrawal) of the ipsilateral leg as well as the extension of the contralateral leg to stabilize the posture. Thus, the ipsilateral leg flexors are activated and the extensors are inhibited and vice versa in the contralateral leg.

Babinski reflex

www.youtube.com/watch?v=kOq5Np0eZ6A

Abdominal reflex

https://www.youtube.com/watch?v=4oo1oDQSfPs

Biceps-jerk reflex

https://www.youtube.com/watch?v=KUtD5TVjc6A

Triceps-jerk reflex

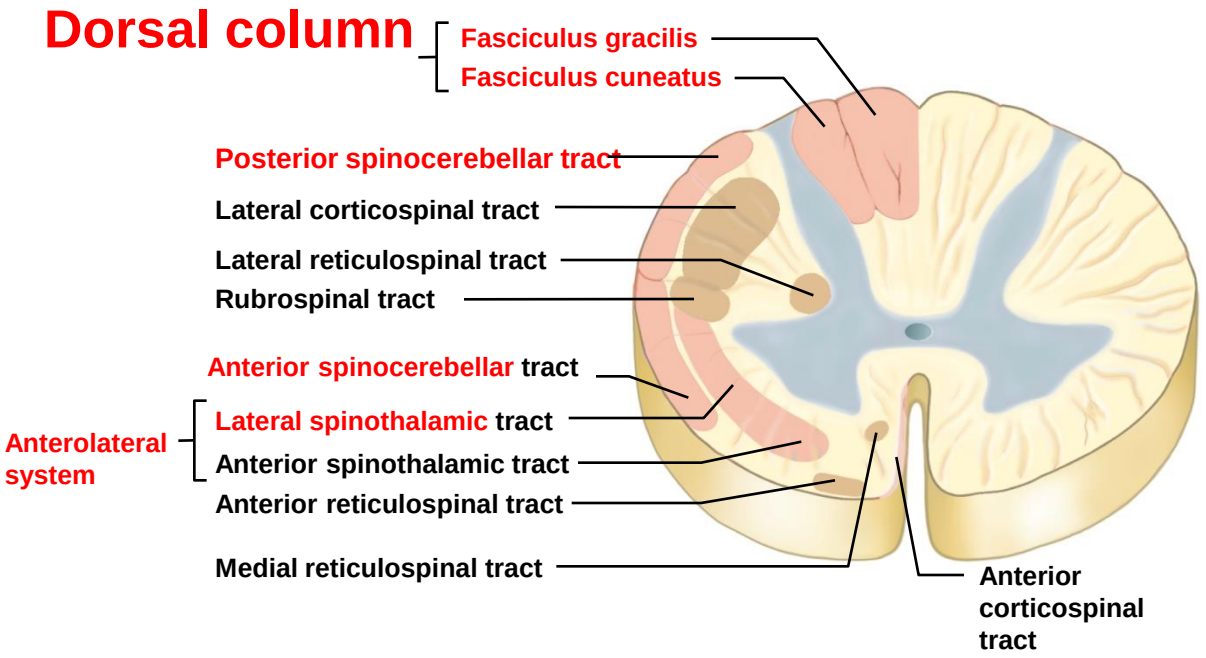
https://www.youtube.com/watch?v=2sm4ynlzEi8

Ankle jerk reflex

https://www.youtube.com/watch?v=BEQ6BbLLucA

Tracts of the Spinal Cord p401

- Ascending tracts (dorsal) conduct sensory impulses to the brain
- Descending tracts (ventral) conduct motor impulses from the brain to motor neurons reaching muscles and glands

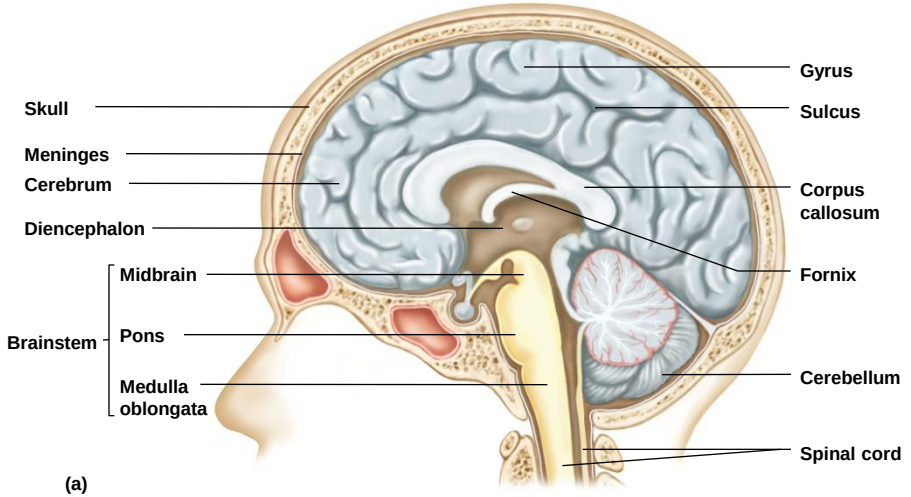


Nerve Tracts of the Spinal Cord p403

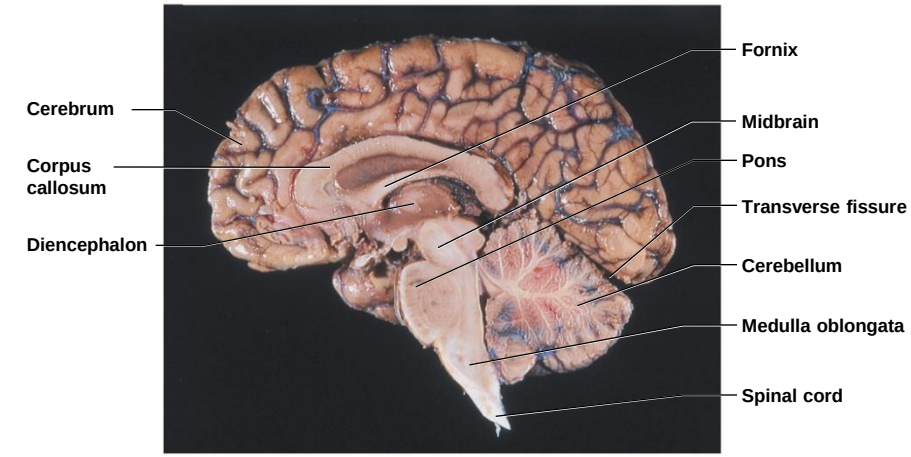
TABLE 11.3 | Nerve Tracts of the Spinal Cord

Tract	Location	Function
Ascending Tracts		
1. Fasciculus gracilis and fasciculus cuneatus	Posterior funiculi	Conduct sensory impulses associated with the senses of touch, pressure, and body movement from skin, muscles, tendons, and joints to the brain
2. Spinothalamic tracts (lateral and anterior)	Lateral and anterior funiculi	Conduct sensory impulses associated with the senses of pain, temperature, touch, and pressure from various body regions to the brain
3. Spinocerebellar tracts (posterior and anterior)	Lateral funiculi	Conduct sensory impulses required for the coordination of muscle movements from muscles of the lower limbs and trunk to the cerebellum
Descending Tracts		
1. Corticospinal tracts (lateral and anterior)	Lateral and anterior funiculi	Conduct motor impulses associated with voluntary movements from the brain to skeletal muscles
2. Reticulospinal tracts (lateral, anterior, and medial)	Lateral and anterior funiculi	Conduct motor impulses associated with the maintenance of muscle tone and the activity of sweat glands from the brain
3. Rubrospinal tracts	Lateral funiculi	Conduct motor impulses associated with muscular coordination and the maintenance of posture from the brain

The Brain p406



(a)

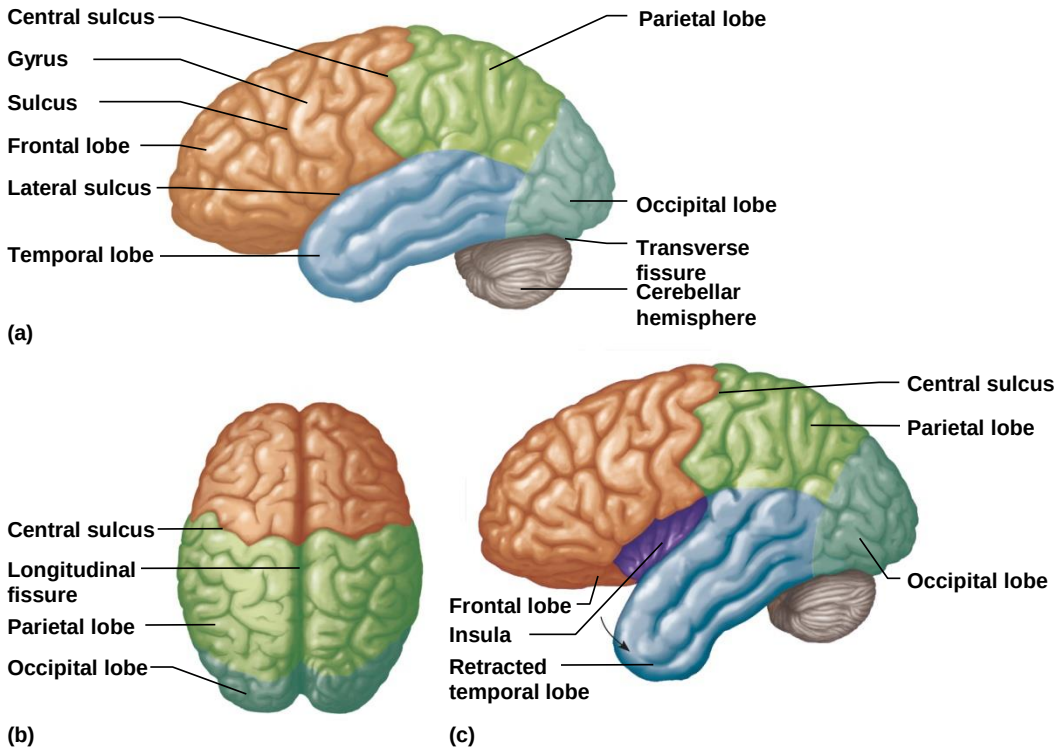


(b)

b: © Martin M. Rotker/Photo Researchers, Inc.

Structure of the Cerebrum p 407

- Corpus callosum
  - Connects cerebral hemispheres (a commissure)
- Gyri
  - Bumps or convolutions
- Sulci
  - Grooves in gray matter
    - Central sulcus of Rolando
- Fissures
  - Longitudinal: separates the cerebral hemispheres
  - Transverse: separates cerebrum from cerebellum
  - Lateral fissure of Sylvius



Split Brain Research

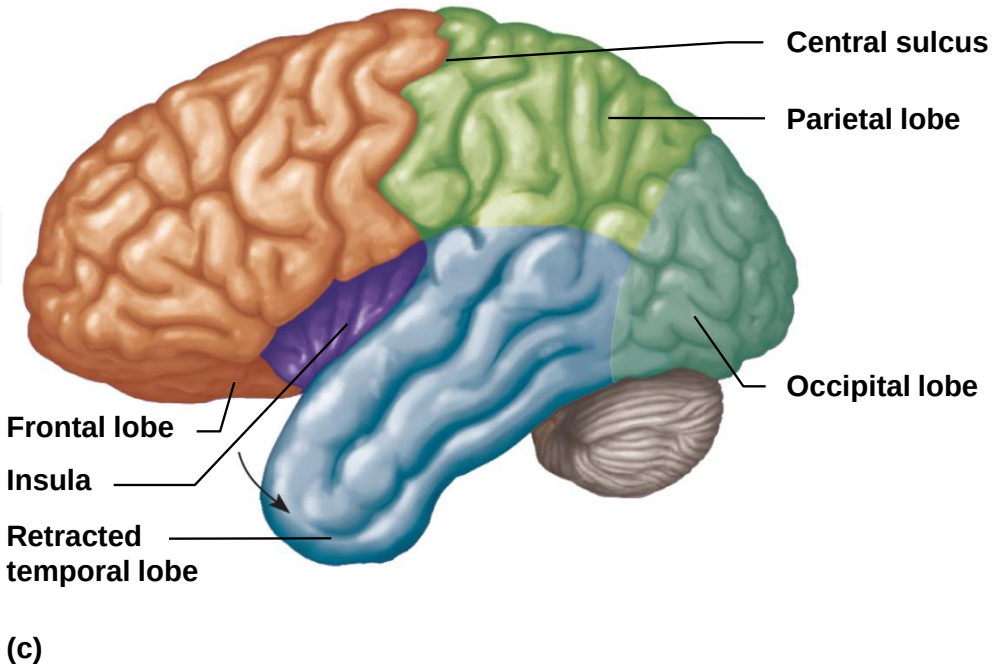
The following videos give some idea as to what occurs
on each side of the brain and what happens when the
corpus callosum is severed (video 1) or missing altogether
(video 2).

http://www.youtube.com/watch?v=VHgClWAPbBY&feature=related

http://www.youtube.com/watch?v=lfGwsAdS9Dc&feature=related

Lobes of the Cerebrum

- Five (5) lobes bilaterally:
  - Frontal lobe
  - Parietal lobe
  - Temporal lobe
  - Occipital lobe
  - Insula aka 'Island of Reil' (functions in interoceptive awareness & judging intensity of pain, among other things)

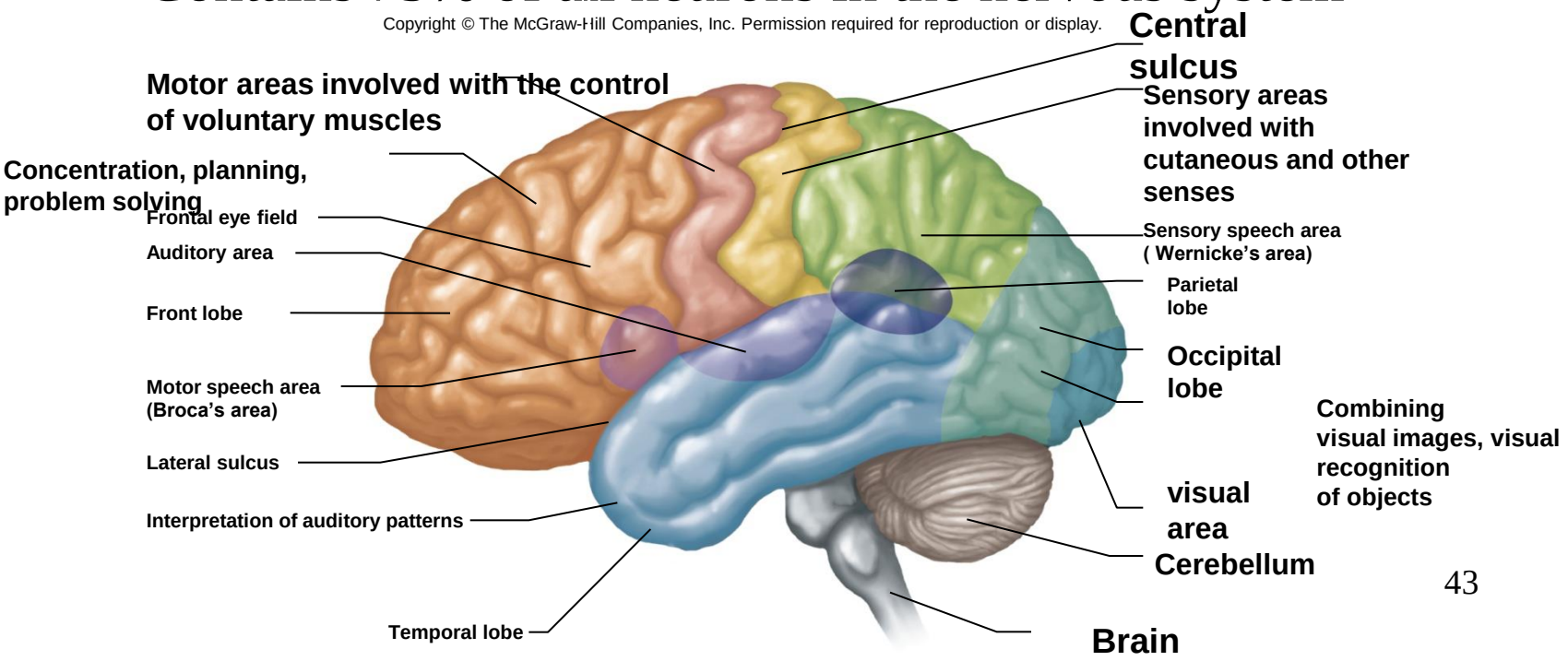


Functions of the Cerebrum

- Interpreting impulses
- Initiating voluntary movements
- Storing information as memory
- Retrieving stored information
- Reasoning
- Seat of intelligence and personality

Functional Regions of the Cerebral Cortex p408

- Cerebral cortex
  - Thin layer of gray matter that constitutes the outermost portion of cerebrum
  - Contains 75% of all neurons in the nervous system



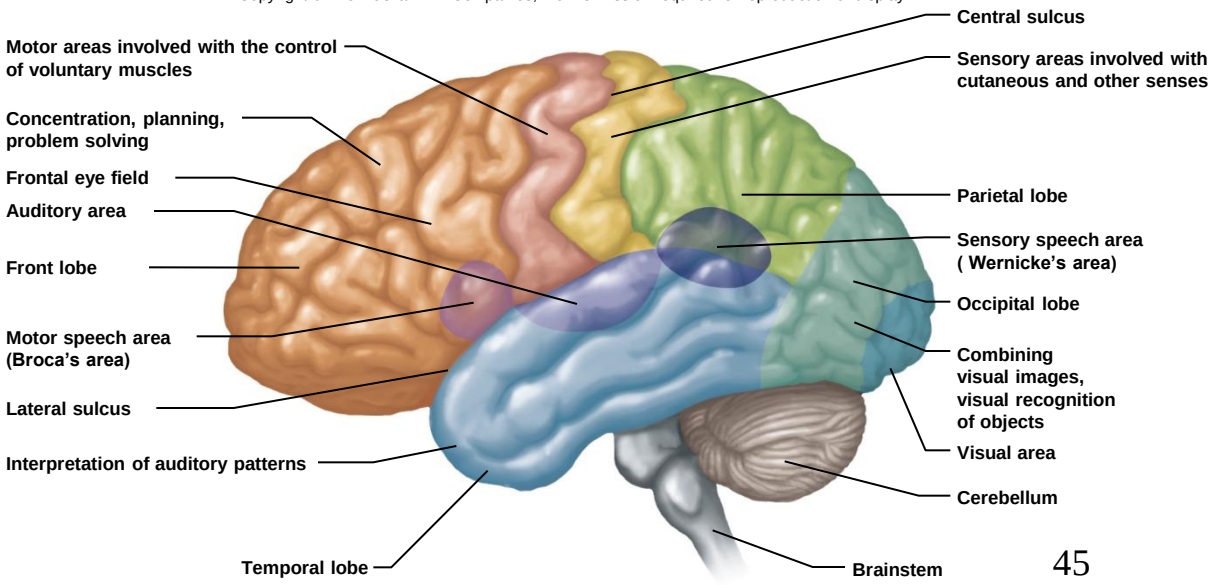
Functions of the Cerebral Lobes
page 410

TABLE 11.5 | Functions of the Cerebral Lobes

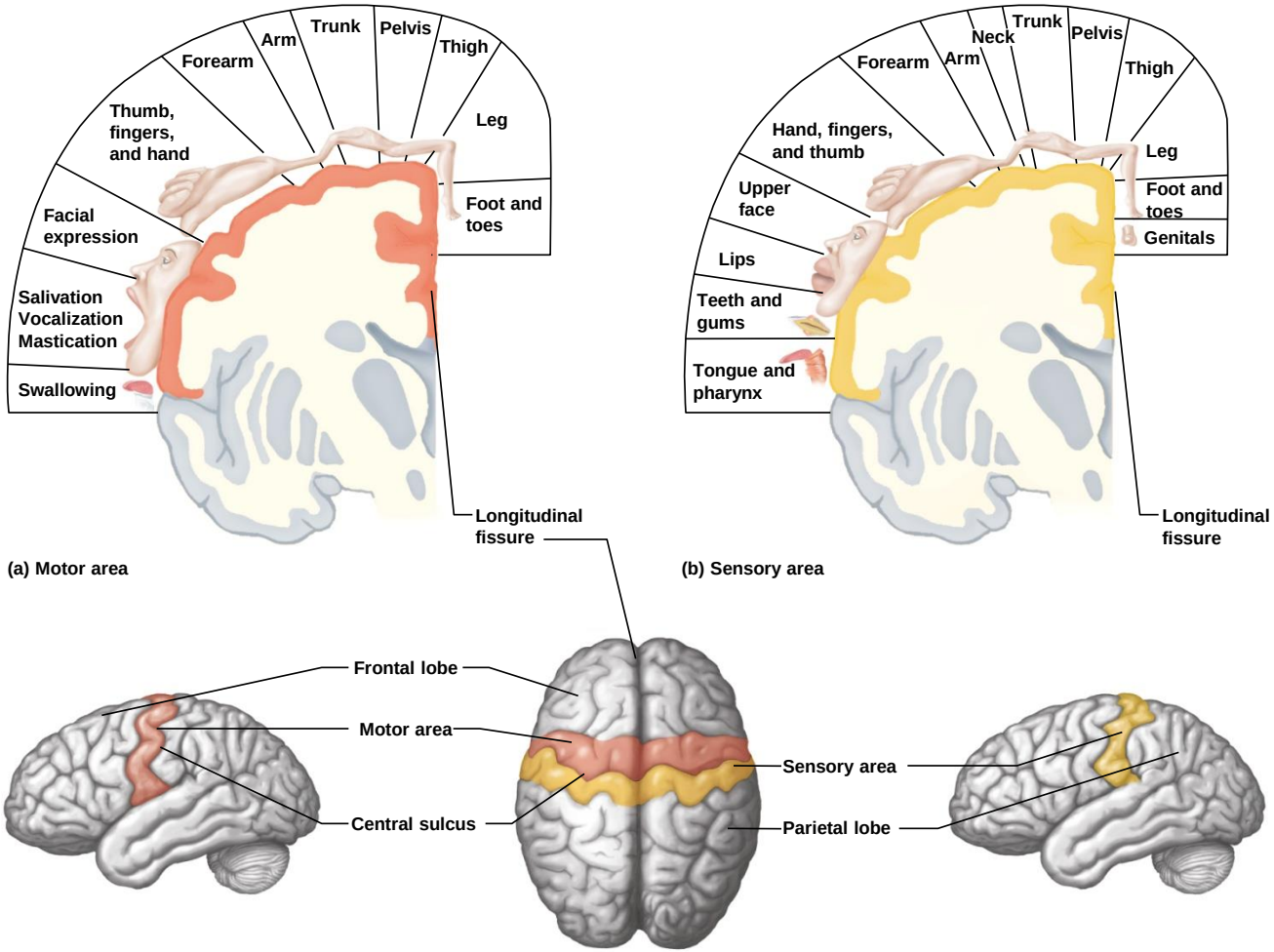
Lobe	Functions
Frontal lobes	Association areas carry on higher intellectual processes for concentrating, planning, complex problem solving, and judging the consequences of behavior.
	Motor areas control movements of voluntary skeletal muscles.
Parietal lobes	Sensory areas provide sensations of temperature, touch, pressure, and pain involving the skin.
	Association areas function in understanding speech and in using words to express thoughts and feelings.
Temporal lobes	Sensory areas are responsible for hearing.
	Association areas interpret sensory experiences and remember visual scenes, music, and other complex sensory patterns.
Occipital lobes	Sensory areas are responsible for vision.
	Association areas combine visual images with other sensory experiences.

Sensory Areas (post-central sulcus)

- Cutaneous sensory area
  - Parietal lobe
  - Interprets sensations on skin
- Visual area
  - Occipital lobe
  - Interprets vision
- Auditory area
  - Temporal lobe
  - Interprets hearing
- Sensory area for taste
  - Near base of the central sulcus
- Sensory area for smell
  - Arises from centers deep within the cerebrum



Motor & Sensory Areas p409

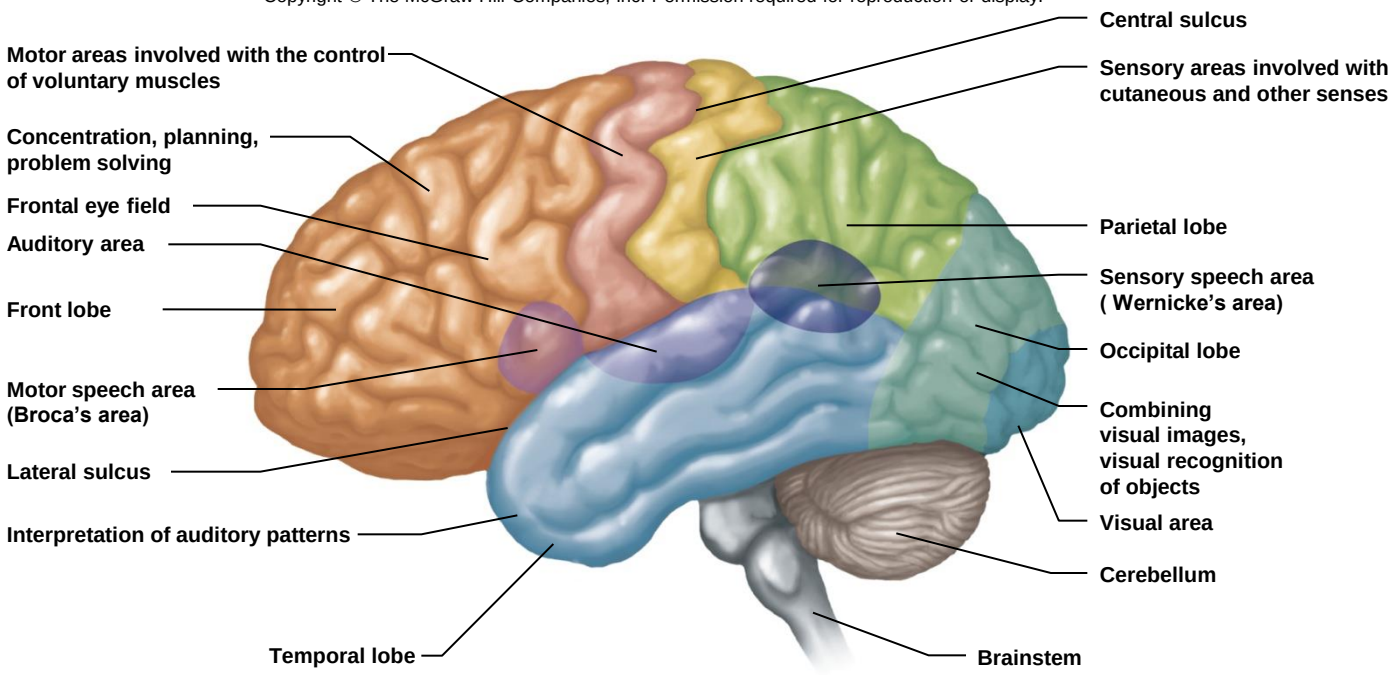


Impulses from pyramidal cells move downward through the brainstem and into the spinal cord on the corticospinal tracts. Most of the nerve fibers in these tracts cross over from one side of the brain to the other within the brainstem and descend as lateral corticospinal tracts.

Other fibers, in the anterior corticospinal tracts, cross over at various levels of the spinal cord.

Association Areas

- Regions that are not primary motor or primary sensory areas
- Widespread throughout the cerebral cortex
- Analyze and interpret sensory experiences
- Provide memory, reasoning, verbalization, judgment, emotions



Association Areas p408

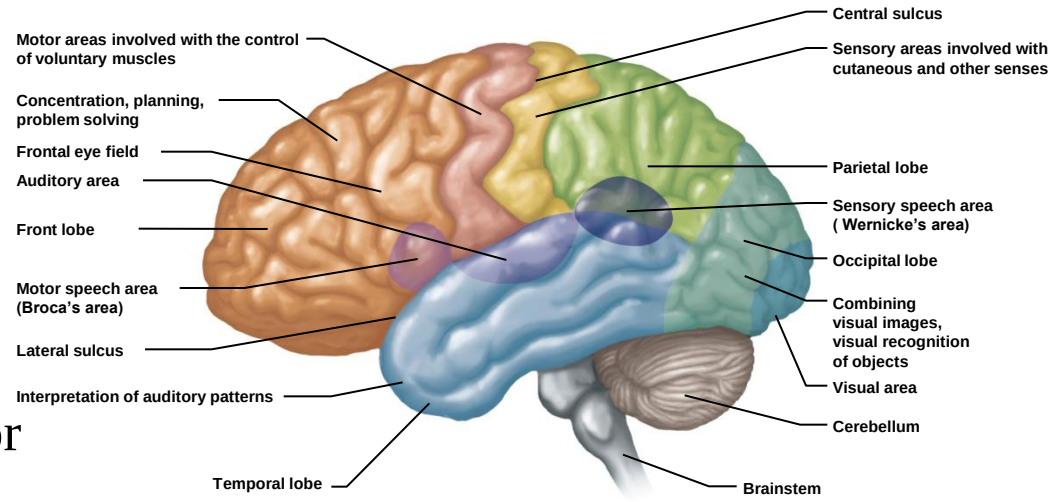
- Frontal lobe association areas
  - Concentrating
  - Planning
  - Complex problem solving

Most of the nerve fibers in these tracts cross over from one side of the brain to the other within the brainstem and descend as lateral corticospinal tracts.

- Temporal lobe association areas
  - Interpret complex sensory experiences
  - Store memories of visual scenes, music, and complex patterns
- Occipital lobe association areas
  - Analyze and combine visual images with other sensory experiences

Motor Areas (pre-central sulcus)

- Primary motor areas
  - Frontal lobes
  - Control voluntary muscles
- Broca's area
  - Anterior to primary motor cortex
  - Usually in left hemisphere
  - Controls muscles needed for speech
- Frontal eye field
  - Above Broca's area
  - Controls voluntary movements of eyes and eyelids



Hemisphere Dominance p410

- The left hemisphere is dominant in most individuals

Dominant hemisphere controls:

- Speech
- Writing
- Reading
- Verbal skills
- Analytical skills
- Computational skills

- Nondominant hemisphere controls:
  - Nonverbal tasks
  - Motor tasks
  - Understanding and interpreting musical and visual patterns
  - Provides emotional and intuitive thought processes

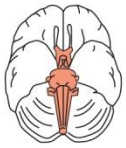
Memory p410

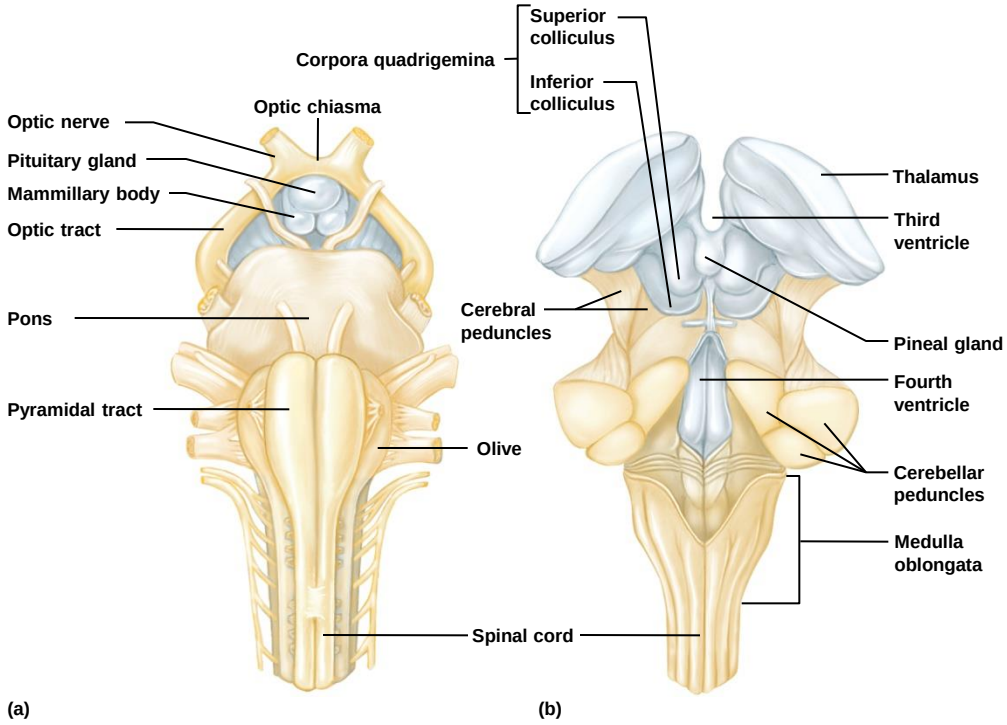
- Short term memory
  - Working memory
  - Closed neuronal circuit
  - Circuit is stimulated over and over
  - When impulse flow ceases, memory does also unless it enters long-term memory via memory consolidation
  - Limited to 7 bits of information
- Long term memory
  - Changes structure or function of neurons
  - Enhances synaptic transmission

Diencephalon p413

- Between cerebral hemispheres and above the brainstem
- Surrounds the third ventricle

- Thalamus
- Epithalamus
- Hypothalamus
- Optic tracts
- Optic chiasm
- Infundibulum
- Posterior pituitary
- Mammillary bodies
- Pineal gland





Diencephalon

- Thalamus
  - Gateway for sensory impulses heading to cerebral cortex
  - Receives all sensory impulses (except smell)
  - Channels impulses to appropriate part of cerebral cortex for interpretation
- Epithalamus
  - Functions to connect the limbic system to other parts of the brain.
- Hypothalamus
  - Maintains homeostasis by regulating visceral activities (next slide)
  - Links nervous and endocrine systems (hence some say the neuroendocrine system)

Page 413

The hypothalamus regulates:

heart rate and arterial blood pressure

body temperature

water and electrolyte balance

control of hunger and body weight

control of movements and glandular secretions of the stomach and intestines

Diencephalon p413

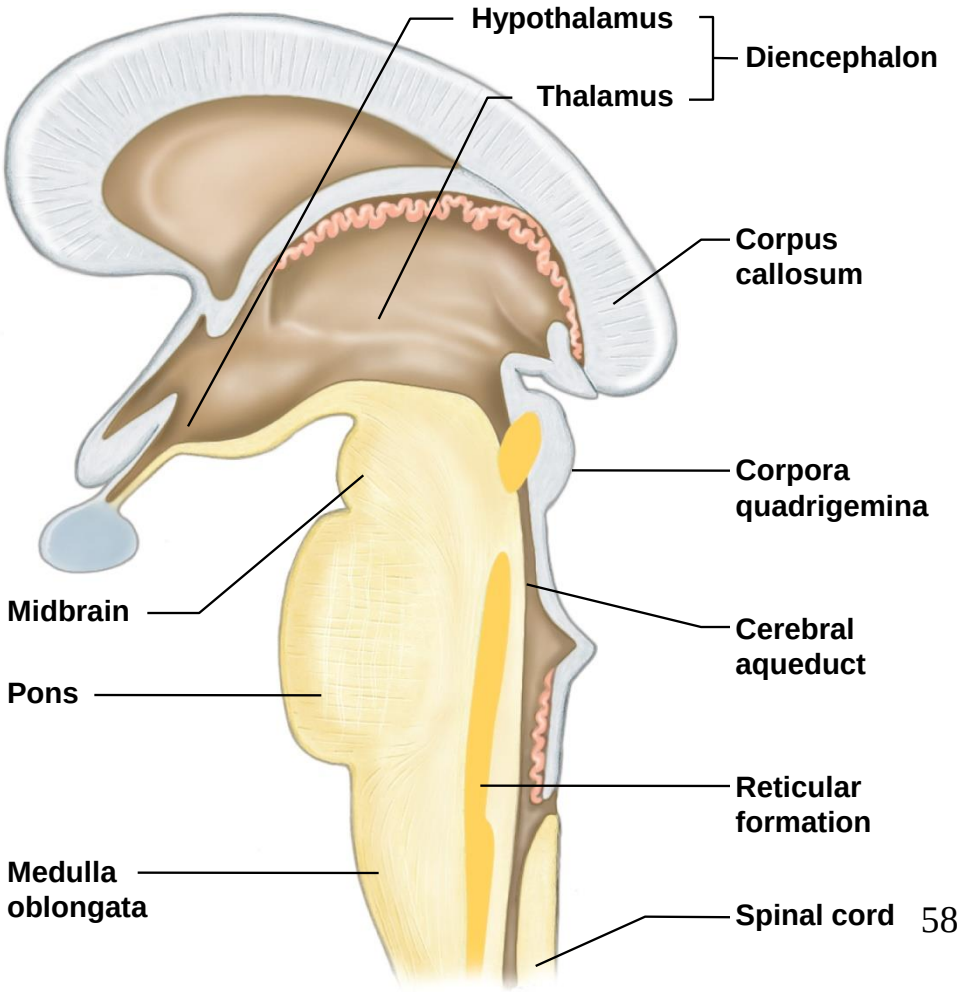
The Limbic System

- Consists of:
  - Portions of frontal lobe
  - Portions of temporal lobe
  - Hypothalamus
  - Thalamus
  - Basal nuclei
  - Other deep nuclei
- Functions:
  - Controls emotions
  - Produces feelings
  - Interprets sensory impulses

Brainstem p413

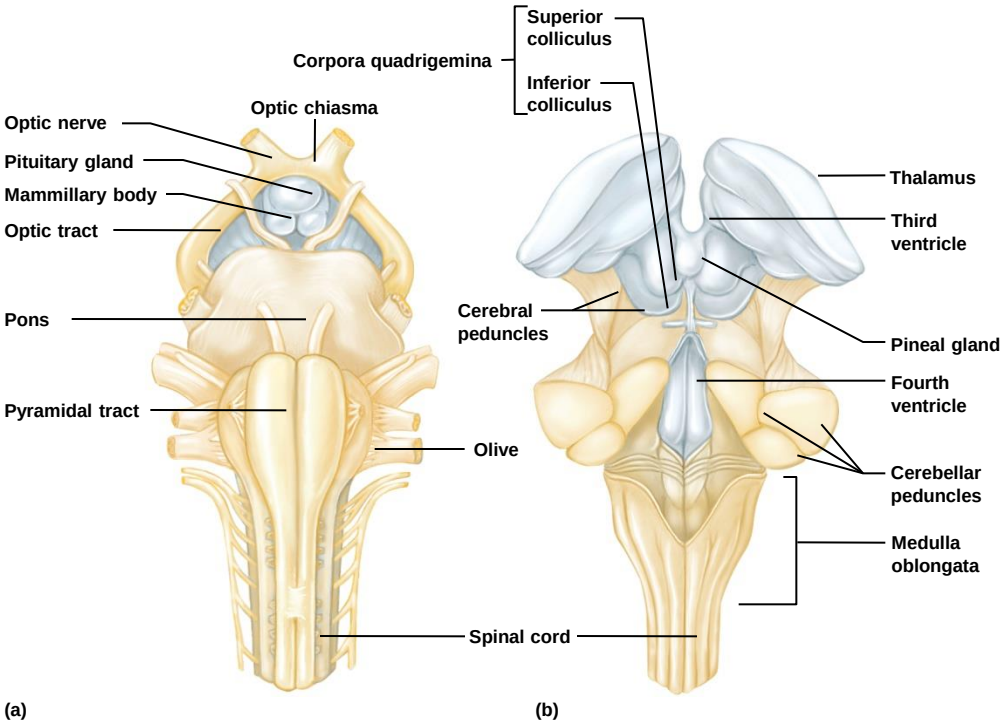
Three parts:

1. Midbrain
2. Pons
3. Medulla Oblongata



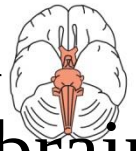
Midbrain p413

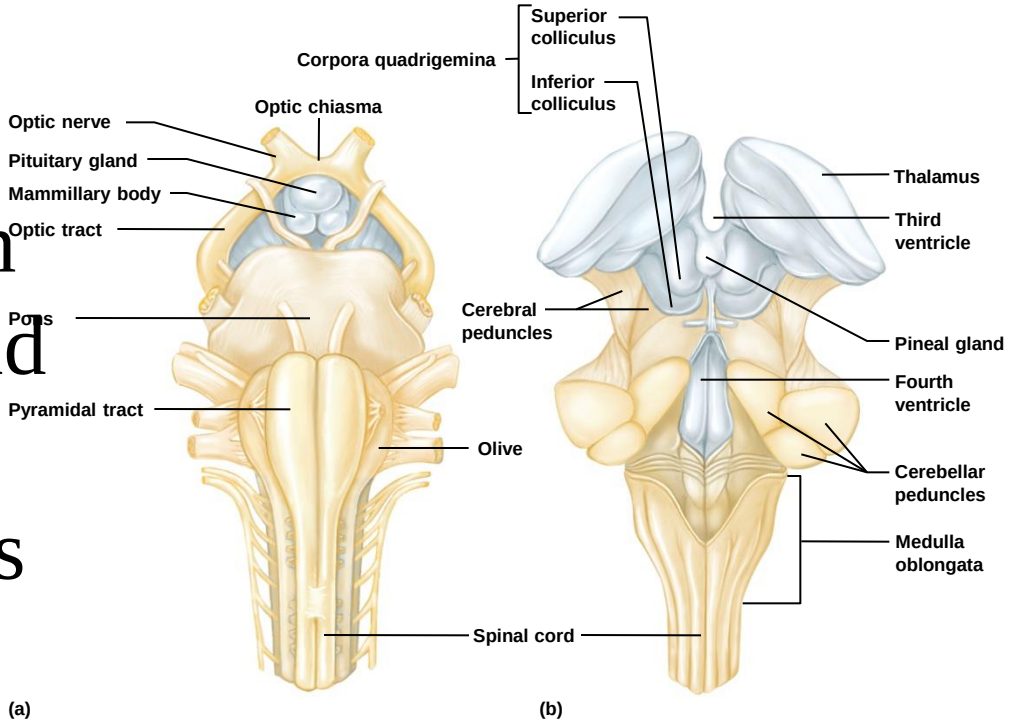
- Between diencephalon and pons
- Contains bundles of fibers that join lower parts of brainstem and spinal cord with higher parts of the brain
- Cerebral aqueduct
- Cerebral peduncles (bundles of nerve fibers)
- Corpora quadrigemina (centers for visual and auditory reflexes)



Pons p 414

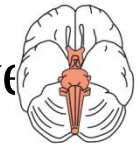
- Rounded bulge on underside of brainstem
- Between medulla oblongata and midbrain
- Helps regulate rate and depth of breathing
- Relays nerve impulses to and from medulla oblongata and cerebellum (bridge)

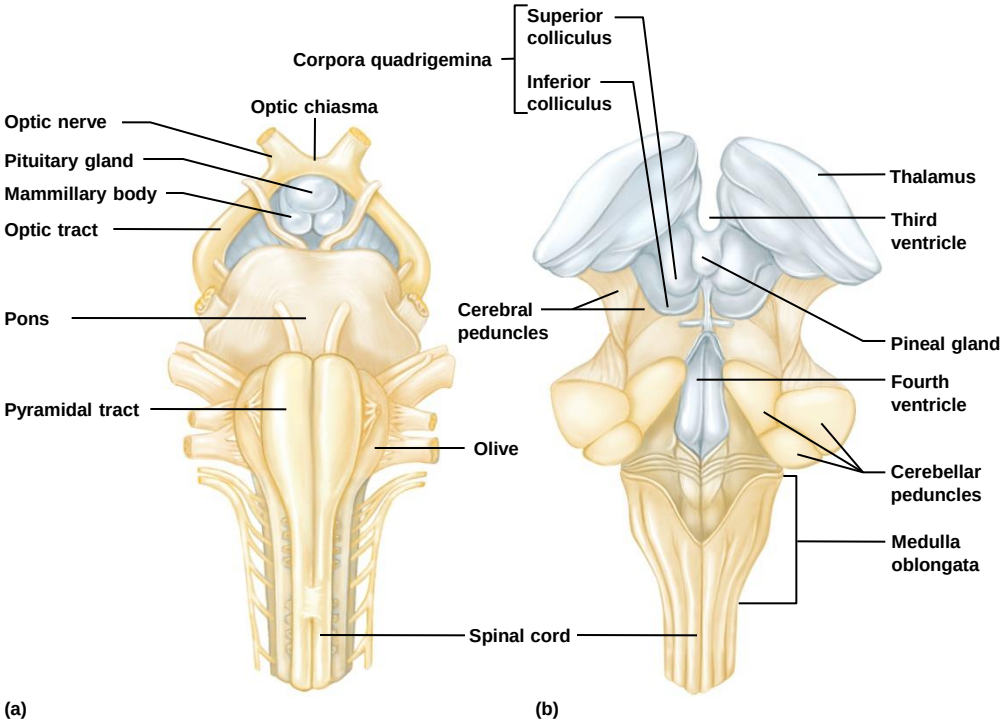




Medulla Oblongata p414

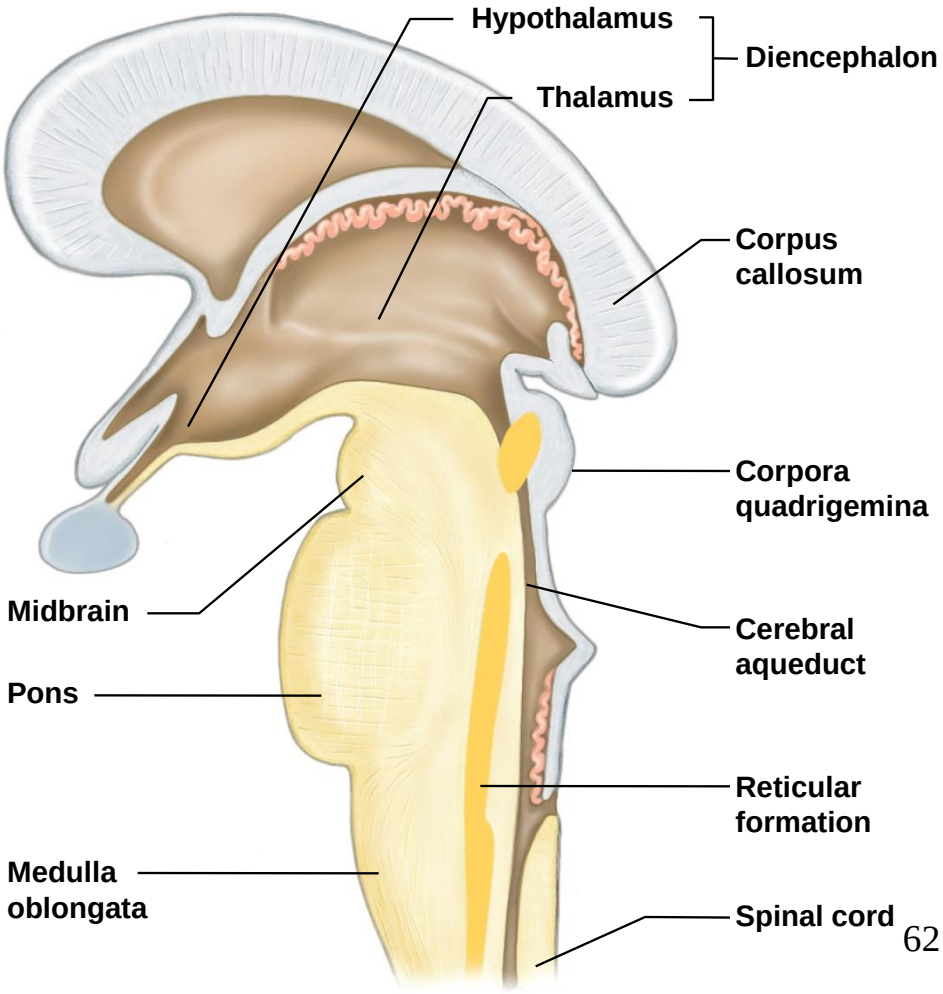
- Enlarged continuation of spinal cord
- Conducts ascending and descending impulses betwe brain and spinal cord
- Contains cardiac, vasomotor, and respiratory control centers
- Contains various nonvita reflex control centers (coughing, sneezing, swallowing, and vomiting)





Reticular Formation p415

- Complex network of nerv fibers scattered throughout the brain stem
- Extends into the diencephalon
- Connects to centers of hypothalamus, basal nuclei, cerebellum, and cerebrum
- Filters incoming sensory information
- Arouses cerebral cortex into state of wakefulness

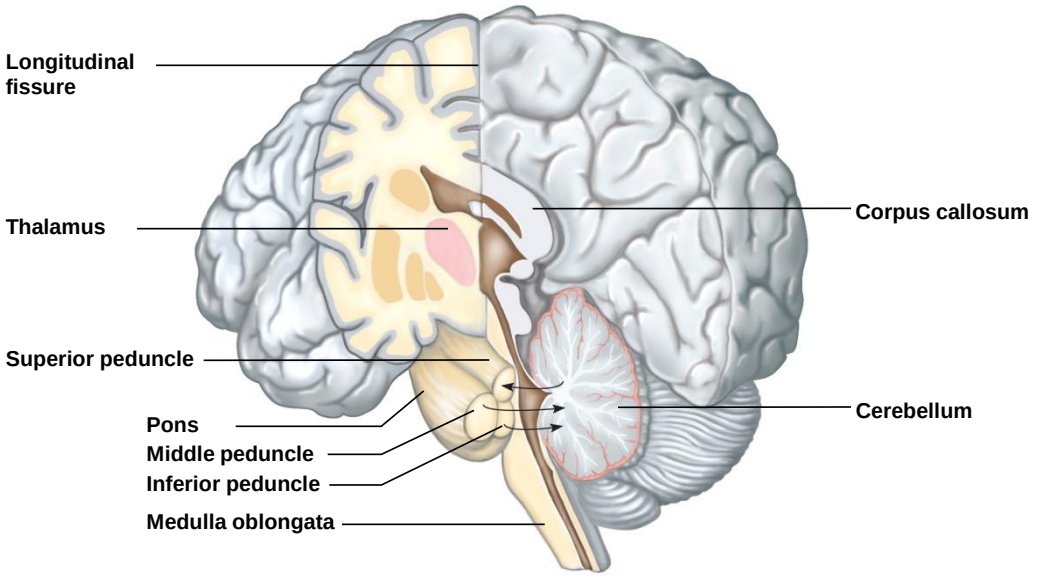


Types of Sleep p415

- Slow wave
  - Non-REM sleep
  - Person is tired
  - Decreasing activity of reticular system
  - Restful
  - Dreamless
  - Reduced blood pressure and respiratory rate
  - Ranges from light to heavy
  - Alternates with REM sleep
- Rapid Eye Movement (REM)
  - Paradoxical sleep
  - Some areas of brain active
  - Heart and respiratory rates irregular
  - Dreaming occurs

Cerebellum p417

- Inferior to occipital lobes
- Posterior to pons and medulla oblongata
- Two hemispheres like cerebrum
- Vermis connects hemispheres
- Cerebellar cortex (gray matter)
- Arbor vitae (white matter)
- Cerebellar peduncles (nerve fiber tracts)
- Dentate nucleus (largest nucleus in cerebellum)
- Integrates sensory information concerning position of body parts
- Coordinates skeletal muscle activity
- Maintains posture



Major Parts of the Brain p417

TABLE 11.7 | Major Parts of the Brain

Part	Characteristics	Functions
1. Cerebrum	Largest part of the brain; two hemispheres connected by the corpus callosum	Controls higher brain functions, including interpreting sensory impulses, initia muscular movements, storing memory, reasoning, and determining intelligen
2. Basal nuclei (ganglia)	Masses of gray matter deep within the cerebral hemispheres	Relay stations for motor impulses originating in the cerebral cortex and pass into the brainstem and spinal cord
3. Diencephalon	Includes masses of gray matter (thalamus and hypothalamus)	The thalamus is a relay station for sensory impulses ascending from other pa of the nervous system to the cerebral cortex; the hypothalamus helps maint homeostasis by regulating visceral activities and by linking the nervous and endocrine systems
4. Brainstem	Connects the cerebrum to the spinal cord	
a. Midbrain	Contains masses of gray matter and bundles of nerve fibers that join the spinal cord to higher regions of the brain	Contains reflex centers that move the eyes and head, and maintains posture
b. Pons	A bulge on the underside of the brainstem that contains masses of gray matter and nerve fibers	Relays nerve impulses to and from the medulla oblongata and cerebrum; he regulate rate and depth of breathing
c. Medulla oblongata	An enlarged continuation of the spinal cord that extends from the foramen magnum to the pons and contains masses of gray matter and nerve fibers	Conducts ascending and descending impulses between the brain and spina cord; contains cardiac, vasomotor, and respiratory control centers and variou nonvital reflex control centers
5. Cerebellum	A large mass of tissue inferior to the cerebrum and posterior to the brainstem; includes two lateral hemispheres connected by the vermis	Communicates with other parts of the CNS by nerve tracts; integrates senso information concerning the position of body parts; and coordinates muscle activities and maintains posture

11.6: Peripheral Nervous System page 417

- Cranial nerves arising from the brain

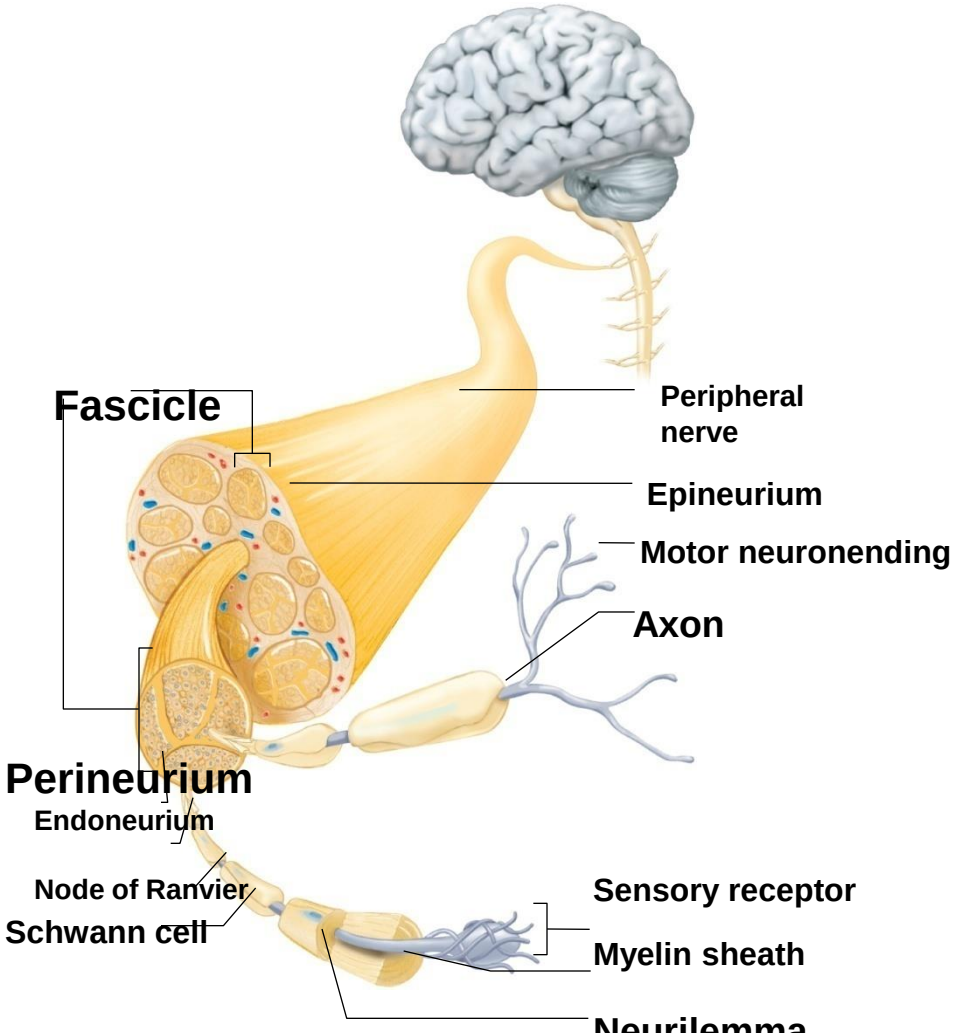
- Spinal nerves arising from the spinal cord

Nervous System Subdivisions page 417

TABLE 11.8 | Subdivisions of the Nervous System

1. Central nervous system (CNS)
   a. Brain
   b. Spinal cord
2. Peripheral nervous system (PNS)
   a. Cranial nerves arising from the brain
      (1) Somatic fibers connecting to the skin and skeletal muscles
      (2) Autonomic fibers connecting to viscera
   b. Spinal nerves arising from the spinal cord
      (1) Somatic fibers connecting to the skin and skeletal muscles
      (2) Autonomic fibers connecting to viscera

Structure of a Peripheral Nerve p419



Nerve and Nerve Fiber Classification p418

- Sensory nerves
  - Conduct impulses into brain or spinal cord
- Motor nerves
  - Conduct impulses to muscles or glands
- Mixed (both sensory and motor) nerves
  - Contain both sensory nerve fibers and motor nerve fibers
  - Most nerves are mixed nerves
  - ALL spinal nerves are mixed nerves (except the first pair)

Nerve Fiber Classification p420

- General somatic efferent (GSE) fibers
  - Carry motor impulses from CNS to skeletal muscles

General somatic afferent (GSA) fibers
  - Carry sensory impulses to CNS from skin and skeletal muscles

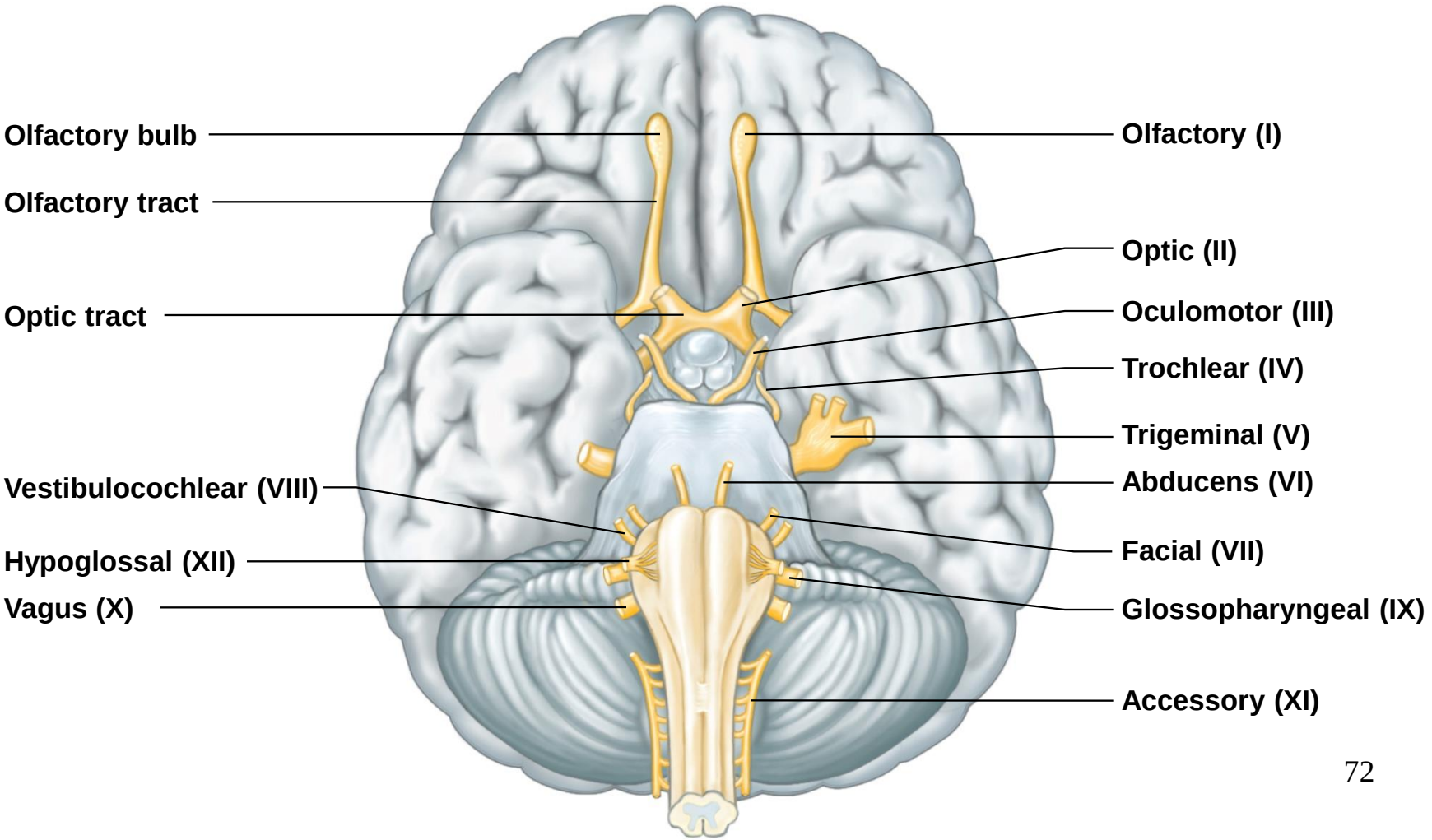
- General visceral efferent (GVE) fibers
  - Carry motor impulses away from CNS to smooth muscles and glands

- General visceral afferent (GVA) fibers
  - Carry sensory impulses to CNS from blood vessels and internal organs

Nerve Fiber Classification p420

- Special somatic efferent (SSE) fibers
  - Carry motor impulses from brain to muscles used in chewing, swallowing, speaking and forming facial expressions
- Special visceral afferent (SVA) fibers
  - Carry sensory impulses to brain from olfactory and taste receptor
- Special somatic afferent (SSA) fibers
  - Carry sensory impulses to brain from receptors of sight, hearing and equilibrium

Cranial Nerves p420



Cranial Nerves I and II p421

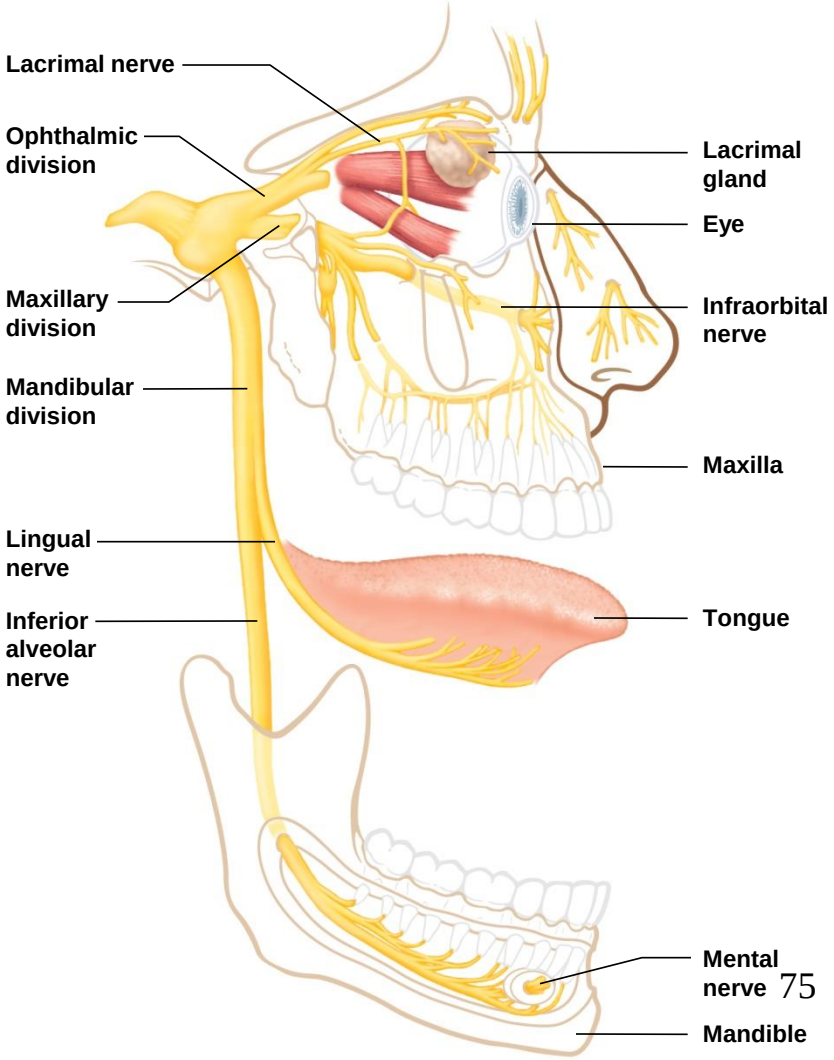
- Olfactory nerve (CN I)
  - Sensory nerve
  - Fibers transmit impulses associated with smell
- Optic nerve (CN II)
  - Sensory nerve
  - Fibers transmit impulses associated with vision

Cranial Nerves III and IV

- Oculomotor nerve (CN III)
  - Primarily motor nerve
  - Motor impulses to muscles that:
    - Raise eyelids
    - Move the eyes
    - Focus lens
    - Adjust light entering eye
  - Some sensory
    - Proprioceptors
- Trochlear nerve (CN IV)
  - Primarily motor nerve
  - Motor impulses to muscles that move the eyes
  - Some sensory
    - Proprioceptors

Cranial Nerve V p421

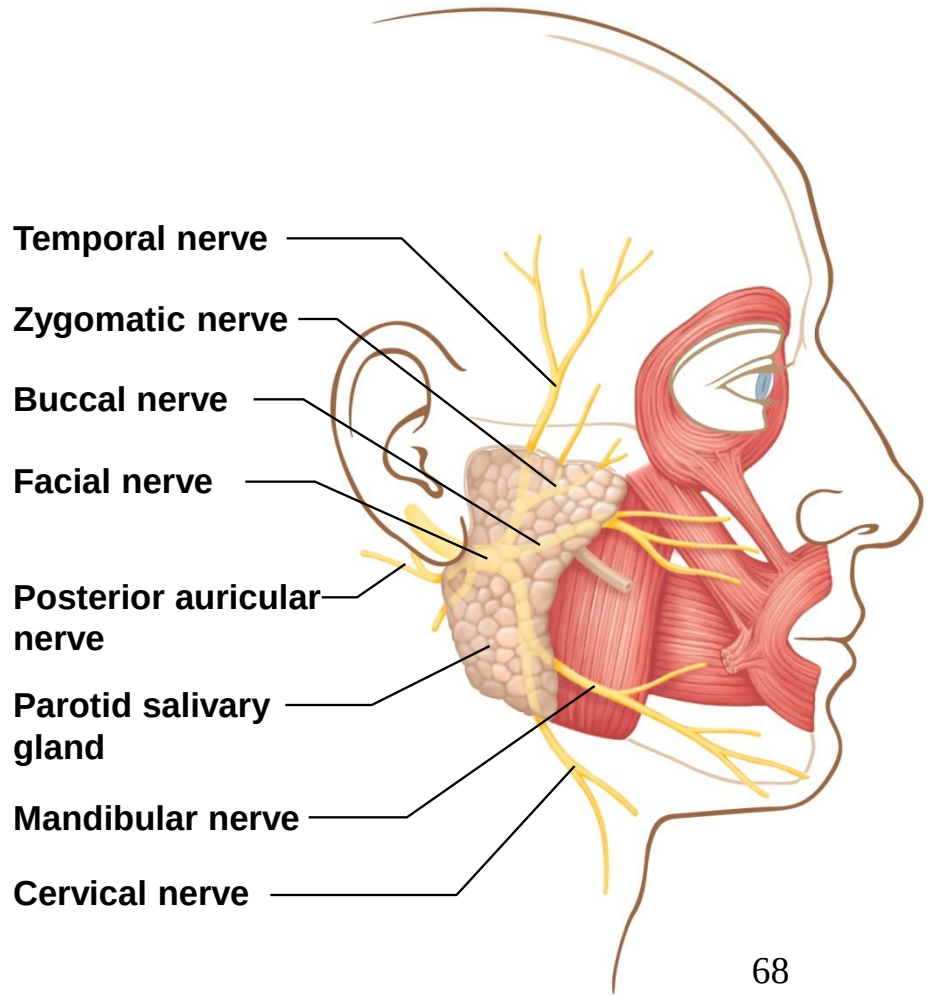
- Trigeminal nerve (CN V)
  - Mixed nerve
  - "Three (3) sisters"
  - (1) Ophthalmic division
    - Sensory from surface of eyes, tear glands, scalp, forehead, and upper eyelids
  - (2) Maxillary division
    - Sensory from upper teeth, upper gum, upper lip, palate, and skin of face
  - (3) Mandibular division
    - Sensory from scalp, skin of jaw, lower teeth, lower gum, and lower lip
    - Motor to muscles of mastication and muscles in floor of mouth



Cranial Nerves VI and VII p422

- Abducens nerve (CN VI)
  - Primarily motor nerve
  - Motor impulses to muscles that move the eyes
  - Some sensory
    - Proprioceptors

- Facial nerve (CN VII)
  - Mixed nerve
  - Sensory from taste receptors
  - Motor to muscles of facial expression, tear glands, and salivary glands



Cranial Nerves VIII and IX

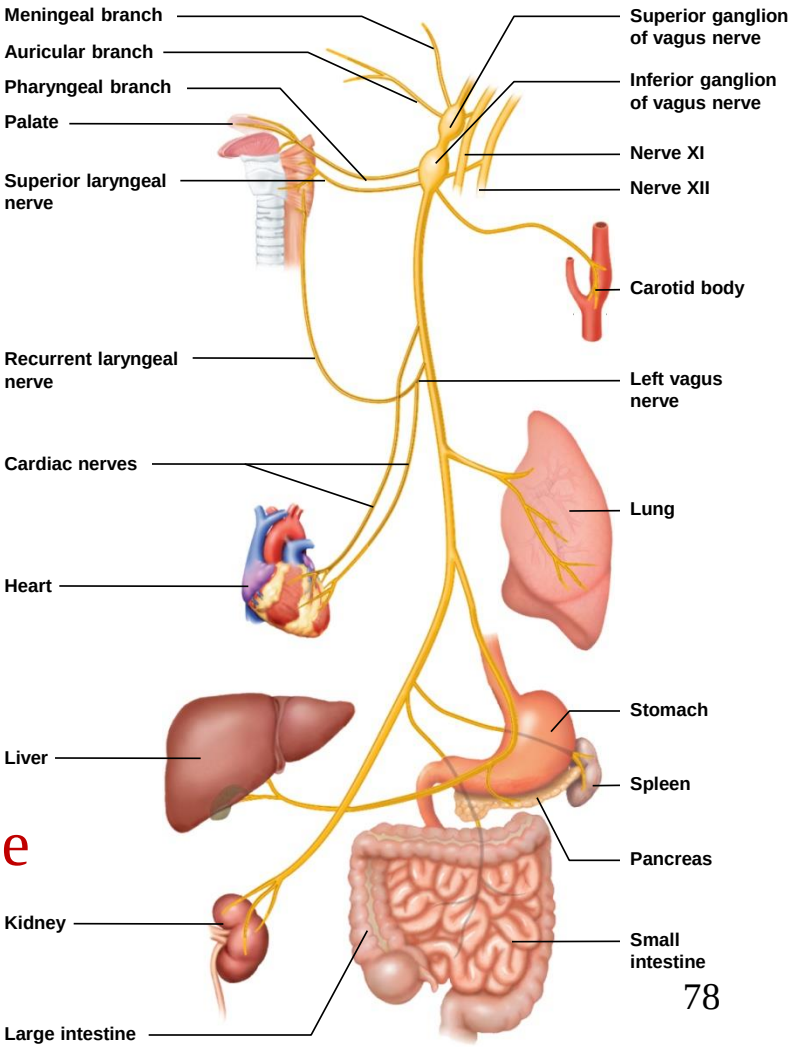
- Vestibulocochlear nerve (CN VIII)
  - Aka acoustic or auditory nerve
  - Sensory nerve
  - Two (2) branches:
    - Vestibular branch
      - Sensory from equilibrium receptors of ear
    - Cochlear branch
      - Sensory from hearing receptors

- Glossopharyngeal nerve (CN IX)
  - Mixed nerve
  - Sensory from pharynx, tonsils, tongue and carotid arteries
  - Motor to salivary glands and muscles of pharynx

Cranial Nerve X

- **Vagus nerve (CN X)**
  - Mixed nerve
  - Somatic motor to muscles of speech and swallowing
  - Autonomic motor to viscera of thorax and abdomen
  - Sensory from pharynx, larynx, esophagus, and viscera of thorax and abdomen

Affects the heart rate by influence on the atria of the heart.



Cranial Nerves XI and XII

- Accessory nerve (CN XI)
  - Primarily motor nerve
  - We called this "Spinal" Accessory because:
    - Cranial branch
      - Motor to muscles of soft palate, pharynx and larynx
    - Spinal branch
      - Motor to muscles of neck and back
      - Some sensory
        - Proprioceptor

- Hypoglossal nerve (CN XII)
  - Primarily motor
  - Motor to muscles of the tongue
  - Some sensory
    - Proprioceptor

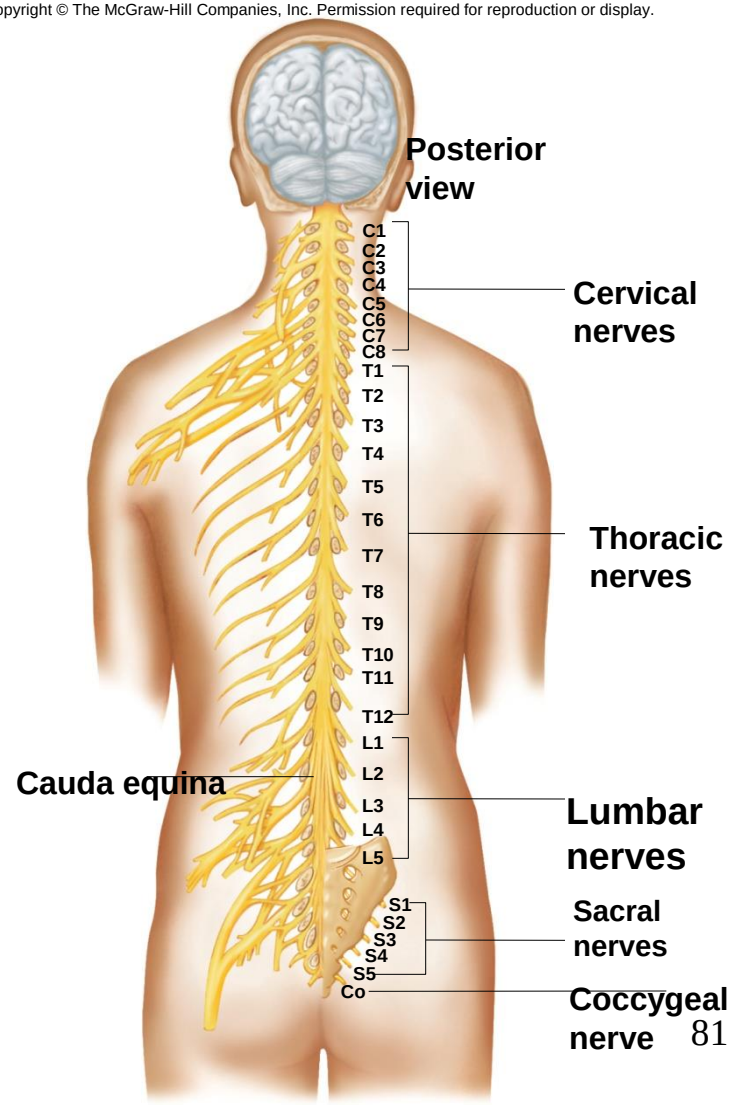
Functions of Cranial Nerves p423

TABLE 11.9 | Functions of Cranial Nerves

Nerve		Type	Function
I	Olfactory	Sensory	Sensory fibers transmit impulses associated with the sense of smell.
II	Optic	Sensory	Sensory fibers transmit impulses associated with the sense of vision.
III	Oculomotor	Primarily motor	Motor fibers transmit impulses to muscles that raise the eyelids, move the eyes, adjust the amount of light entering the eyes, and focus the lenses.
			Some sensory fibers transmit impulses associated with proprioceptors.
IV	Trochlear	Primarily motor	Motor fibers transmit impulses to muscles that move the eyes.
			Some sensory fibers transmit impulses associated with proprioceptors.
V	Trigeminal	Mixed	
	Ophthalmic division		Sensory fibers transmit impulses from the surface of the eyes, tear glands, scalp, forehead, and upper eyelids.
	Maxillary division		Sensory fibers transmit impulses from the upper teeth, upper gum, upper lip, lining of the palate, and skin of the face.
	Mandibular division		Sensory fibers transmit impulses from the scalp, skin of the jaw, lower teeth, lower gum, and lower lip.
			Motor fibers transmit impulses to muscles of mastication and to muscles in the floor of the mouth.
VI	Abducens	Primarily motor	Motor fibers transmit impulses to muscles that move the eyes.
			Some sensory fibers transmit impulses associated with proprioceptors.
VII	Facial	Mixed	Sensory fibers transmit impulses associated with taste receptors of the anterior tongue.
			Motor fibers transmit impulses to muscles of facial expression, tear glands, and salivary glands.
VIII	Vestibulocochlear	Sensory	
	Vestibular branch		Sensory fibers transmit impulses associated with the sense of equilibrium.
	Cochlear branch		Sensory fibers transmit impulses associated with the sense of hearing.
IX	Glossopharyngeal	Mixed	Sensory fibers transmit impulses from the pharynx, tonsils, posterior tongue, and carotid arteries.
			Motor fibers transmit impulses to salivary glands and to muscles of the pharynx used in swallowing.
X	Vagus	Mixed	Somatic motor fibers transmit impulses to muscles associated with speech and swallowing; autonomic motor fibers transmit impulses to the viscera of the thorax and abdomen.
			Sensory fibers transmit impulses from the pharynx, larynx, esophagus, and viscera of the thorax and abdomen.
XI	Accessory	Primarily motor	
	Cranial branch		Motor fibers transmit impulses to muscles of the soft palate, pharynx, and larynx.
	Spinal branch		Motor fibers transmit impulses to muscles of the neck and back; some proprioceptor input.

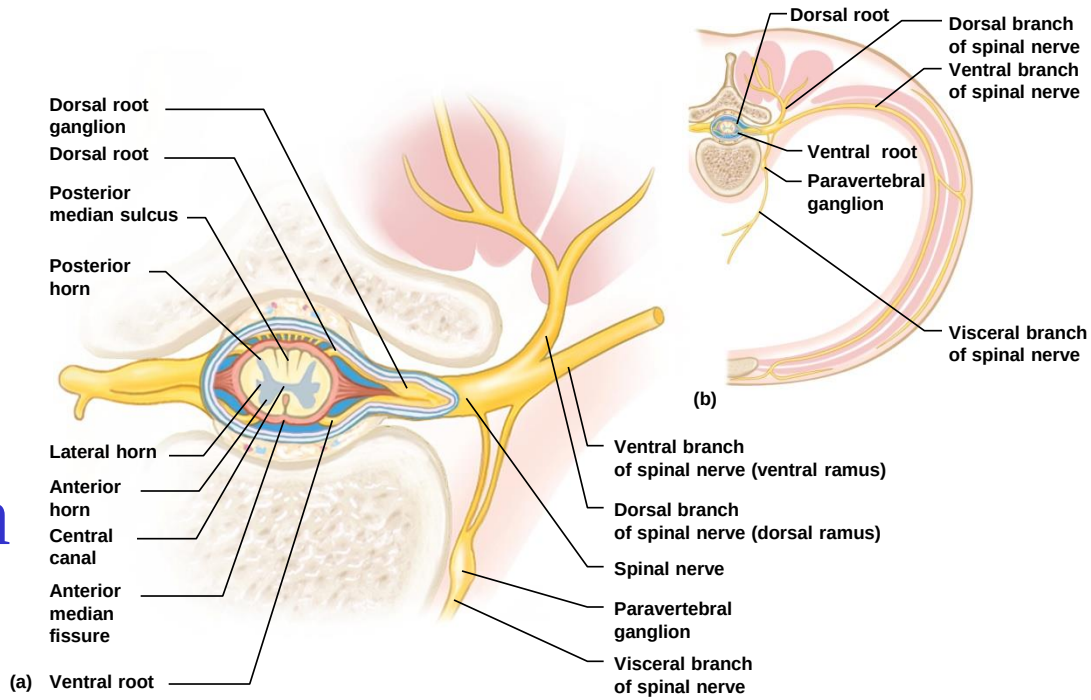
Spinal Nerves p 424

- ALL are mixed nerves (except the first pair)
- 31 pairs of spinal nerves:
  - 8 cervical nerves
    - (C1 to C8)
  - 12 thoracic nerves
    - (T1 to T12)
  - 5 lumbar nerves
    - (L1 to L5)
  - 5 sacral nerves
    - (S1 to S5)
  - 1 coccygeal nerve
    - (Co or Cc)



Spinal Nerves p426

- Dorsal root (aka posterior root)
  - Sensory root
  - Axons of sensory neurons are in the dorsal root ganglion

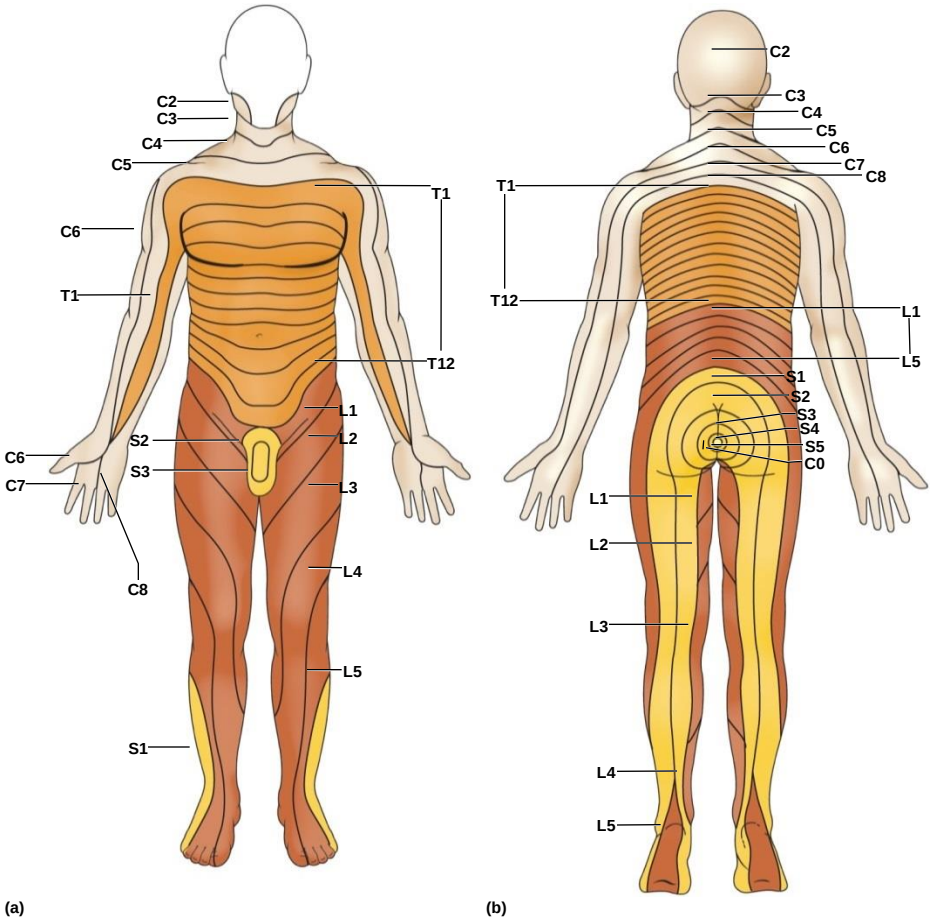


Dorsal root ganglion

- Aka DRG
- Cell bodies of sensory neurons whose axons conduct impulses inward from peripheral body parts

Dermatome p425

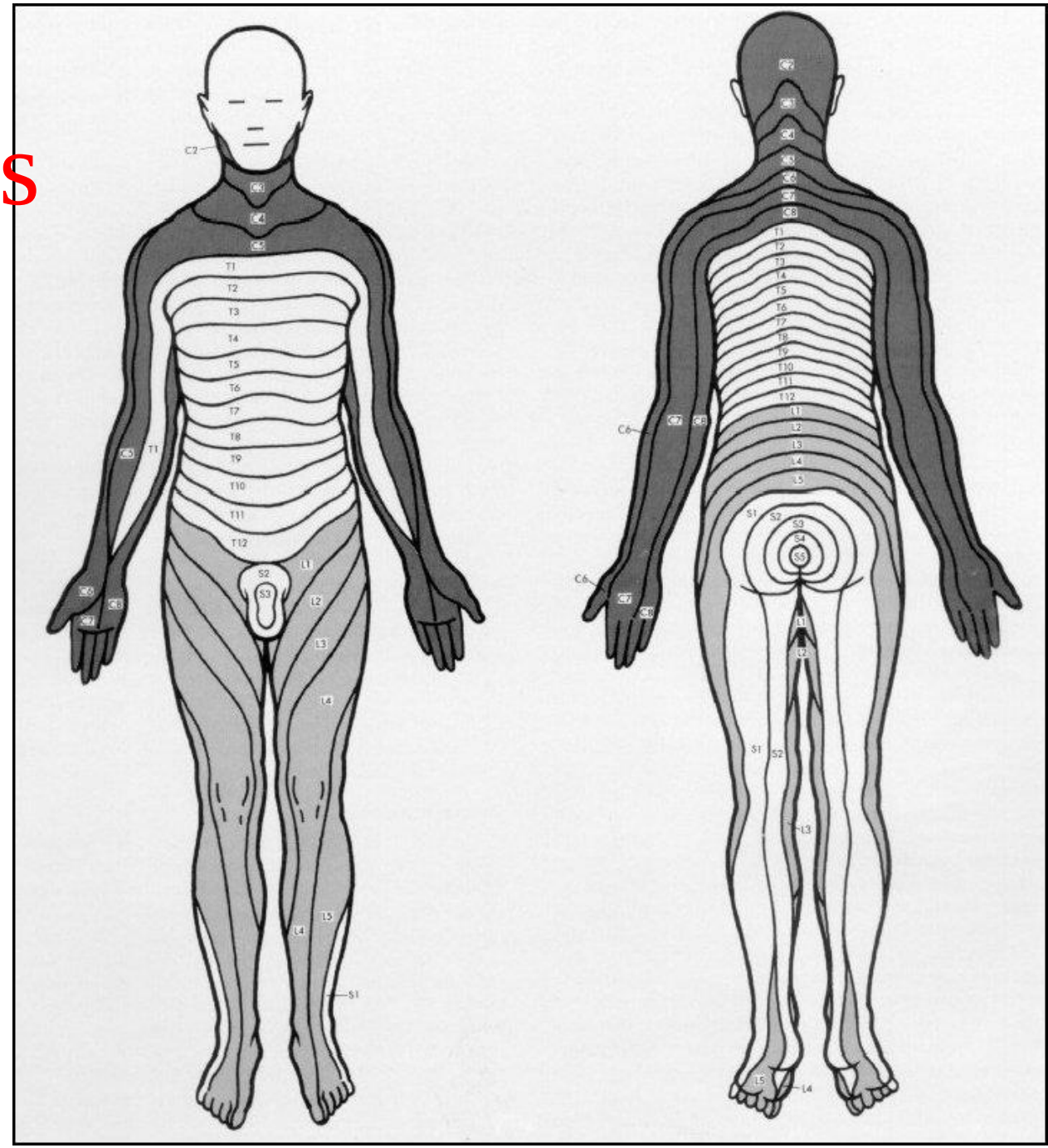
- An area of skin that the sensory nerve fibers of a particular spinal nerve innervate



Another view of

Dermatomes

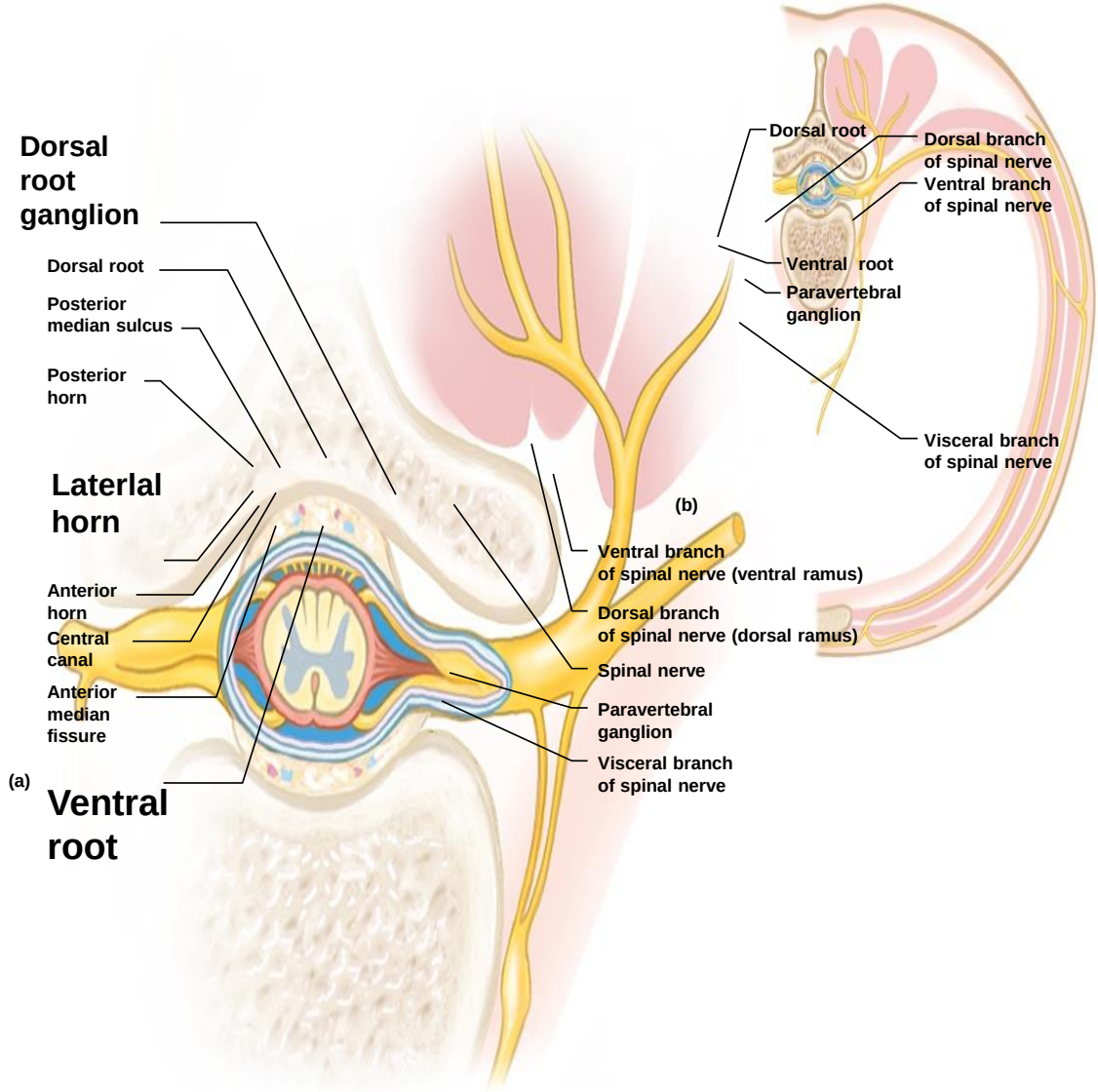
Each is sensory area of **one** spinal nerve



Spinal Nerves

- Ventral root (aka anterior root)
  - Motor root
  - Axons of motor neurons whose cell bodies are in the spinal cord

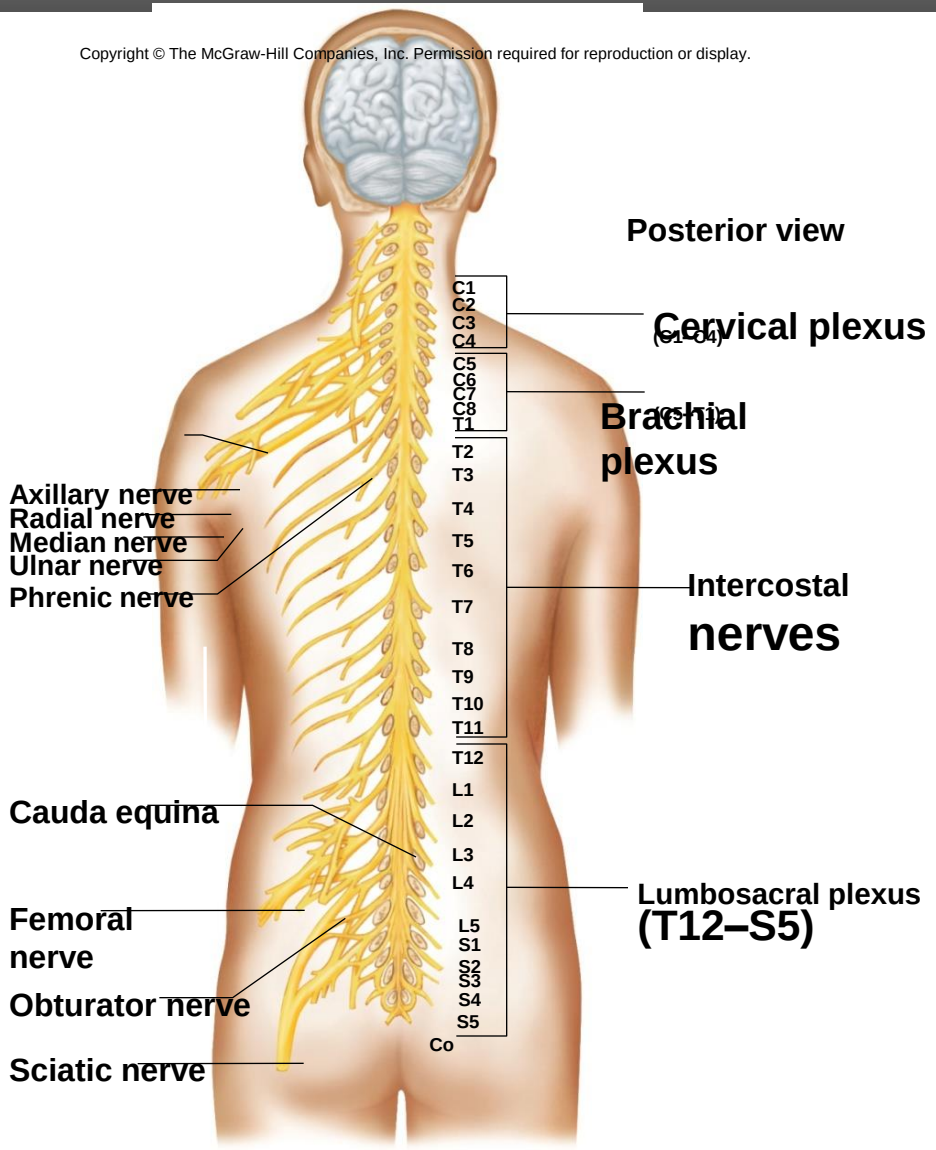
- Spinal nerve
  - Union of ventral root and dorsal roots
  - Hence we now have a “mixed” nerve



The three Nervous Plexuses

- (1) Cervical plexus – Lies deep within the neck
- (2) Brachial plexus – Lies deep within shoulders
- (3) Lumbosacral plexus – Extends from lumbar region into pelvic cavity

Plexuses p427



11.7: Autonomic Nervous System

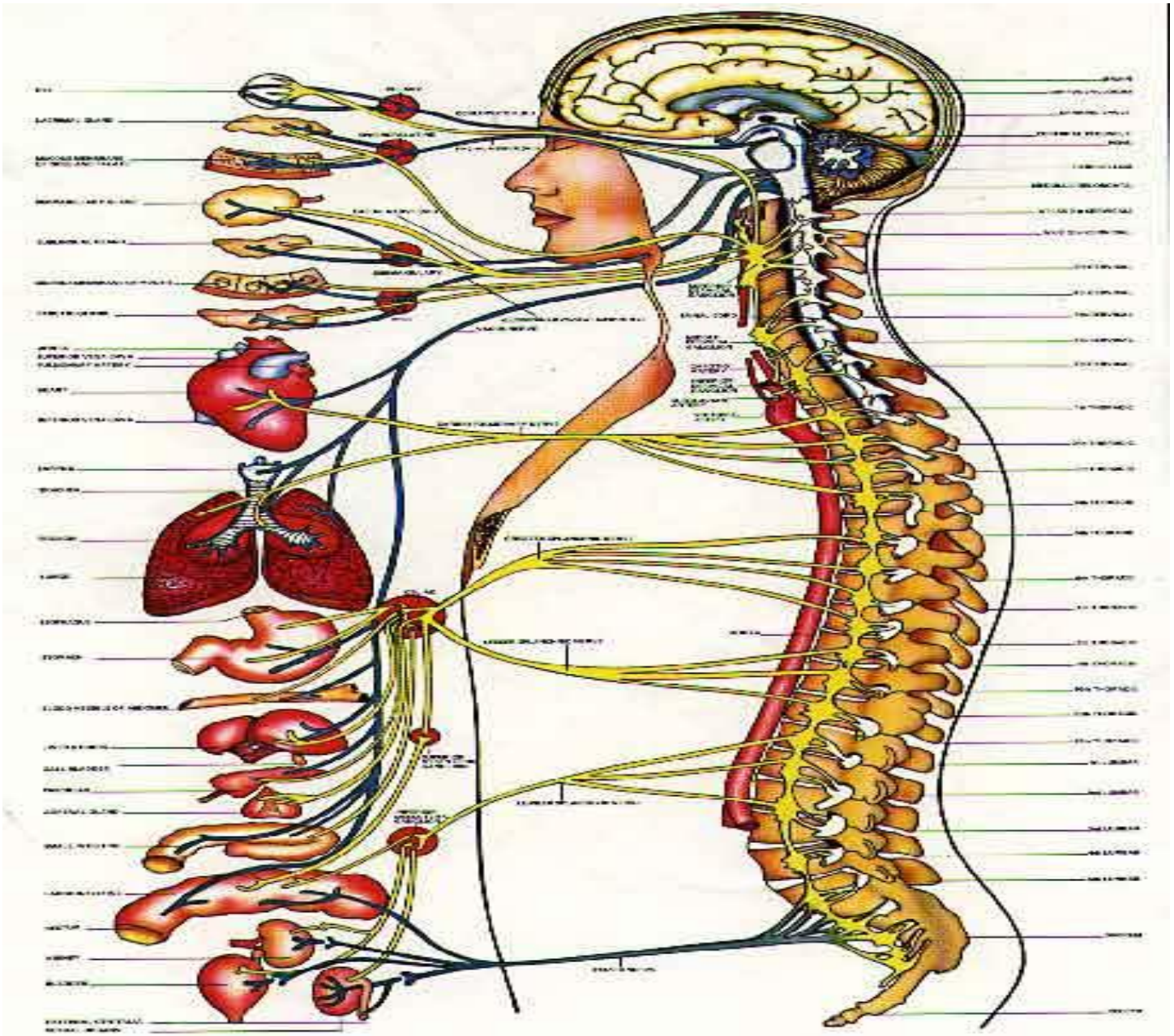
❖ Functions without conscious effort

- Controls visceral activities
- Regulates smooth muscle, cardiac muscle, and glands
- Efferent fibers typically lead to ganglia outside of the CNS

❖ Two autonomic divisions regulate:

✓ Sympathetic division (speeds up)
  - Prepares body for ‘fight or flight’ situations

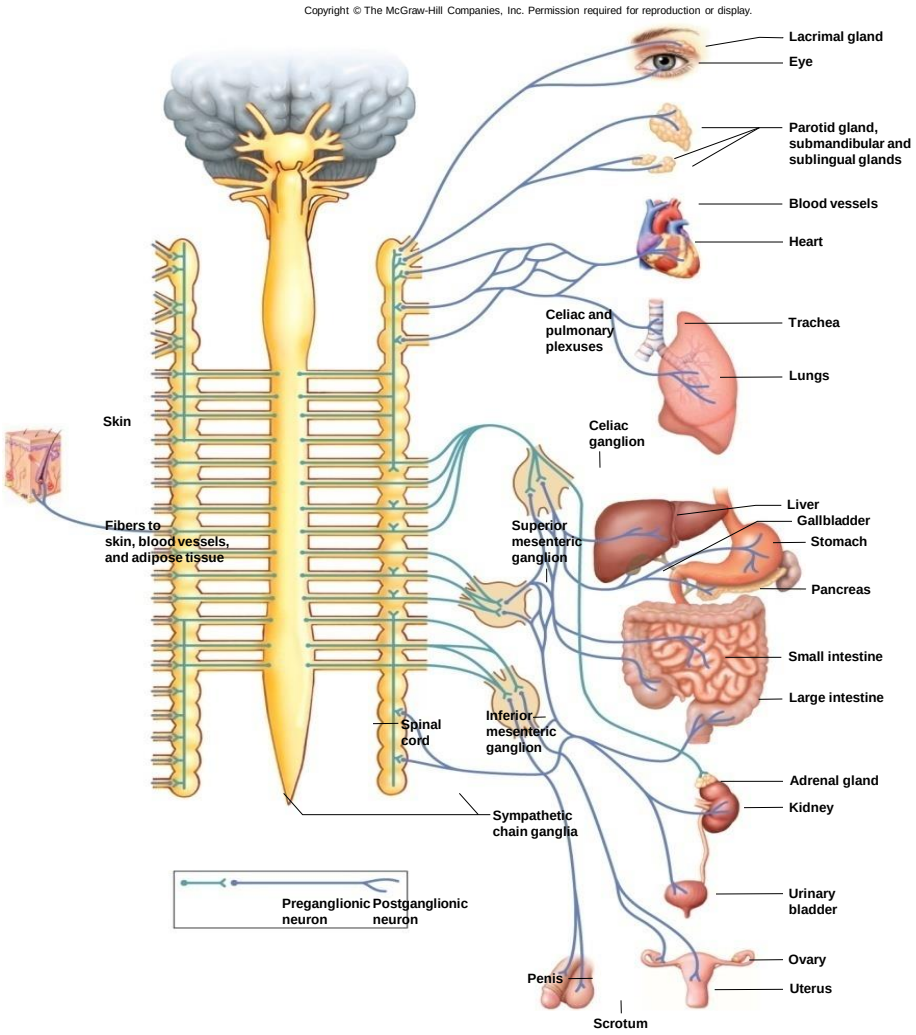
✓ Parasympathetic division (pauses or slows down)
  - Prepares body for ‘resting and digesting’ activities



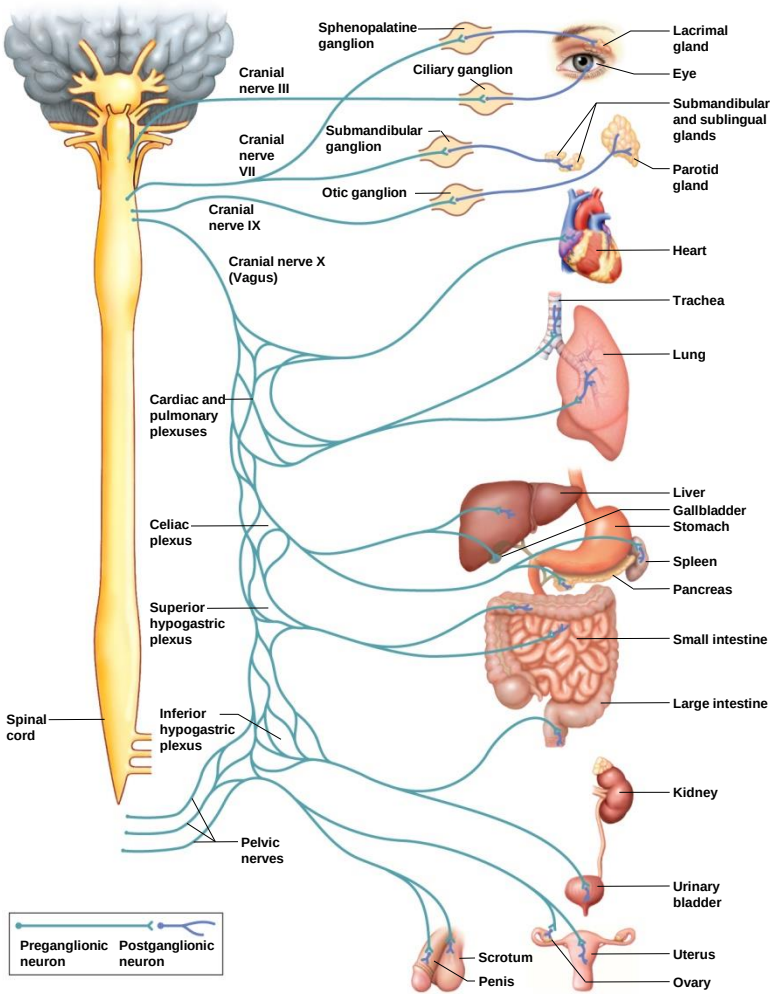
AUTONOMIC NERVOUS SYSTEM

Sympathetic — Yellow Parasympathetic — Green

Sympathetic Division p433



Parasympathetic Division p434



Control of Autonomic Activity p437

- Controlled largely by CNS

- Medulla oblongata regulates cardiac, vasomotor and respiratory activities

- Hypothalamus regulates visceral functions, such as body temperature, hunger, thirst, and water and electrolyte balance

- Limbic system and cerebral cortex control emotional responses

11.8: Lifespan Changes p437

- Brain cells begin to die before birth
- Over average lifetime, brain shrinks 10%
- Most cell death occurs in temporal lobes
- By age 90, frontal cortex has lost half its neurons
- Number of dendritic branches decreases
- Decreased levels of neurotransmitters
- Fading memory
- Slowed responses and reflexes
- Increased risk of falling
- Changes in sleep patterns that result in fewer sleeping hours

Important Points in Chapter 11:
Outcomes to be Assessed

11.1: Introduction

✓ Describe the general structure of the brain.

✓ Describe the relationship among the brain, brainstem, and spinal cord.

11.2: Meninges

✓ Describe the coverings of the brain and spinal cord.

11.3: Ventricles and Cerebrospinal Fluid

✓ Describe the formation and function of cerebrospinal fluid.

11.4: Spinal Cord

✓ Describe the structure of the spinal cord and its major functions.

✓ Describe a reflex arc.

✓ Describe reflex behavior.

11.5: Brain

✓ Name the major parts of the brain and describe the functions of each.

✓ Distinguish among motor, sensory, association areas of the cerebral cortex.

Important Points in Chapter 11:
Outcomes to be Assessed

✓ Explain hemisphere dominance.
✓ Explain stages in memory storage.
✓ Explain the functions of the limbic system and reticular formation.

11.6: Peripheral Nervous System

✓ List the major parts of the peripheral nervous system.
✓ Describe the structure of a peripheral nerve and how its fibers are classified.
✓ Name the cranial nerves and list their major functions.
✓ Explain how spinal nerves are named and their functions

11.7: Autonomic Nervous System

✓ Describe the general characteristics of the autonomic nervous system.
✓ Distinguish between the sympathetic and the parasympathetic divisions of the autonomic nervous system.
✓ Describe a sympathetic and a parasympathetic nerve pathway.
✓ Explain how the autonomic neurotransmitters differently affect visceral effectors