General Biology 1
BIO1201 RM 1021
Syllabus & Textbook:
https://openlab.citytech.cuny.edu/oer-biology/lecture-schedule/

Lecturer: **Michael Gotesman, PhD**
Email: **mgotesman@citytech.cuny.edu**

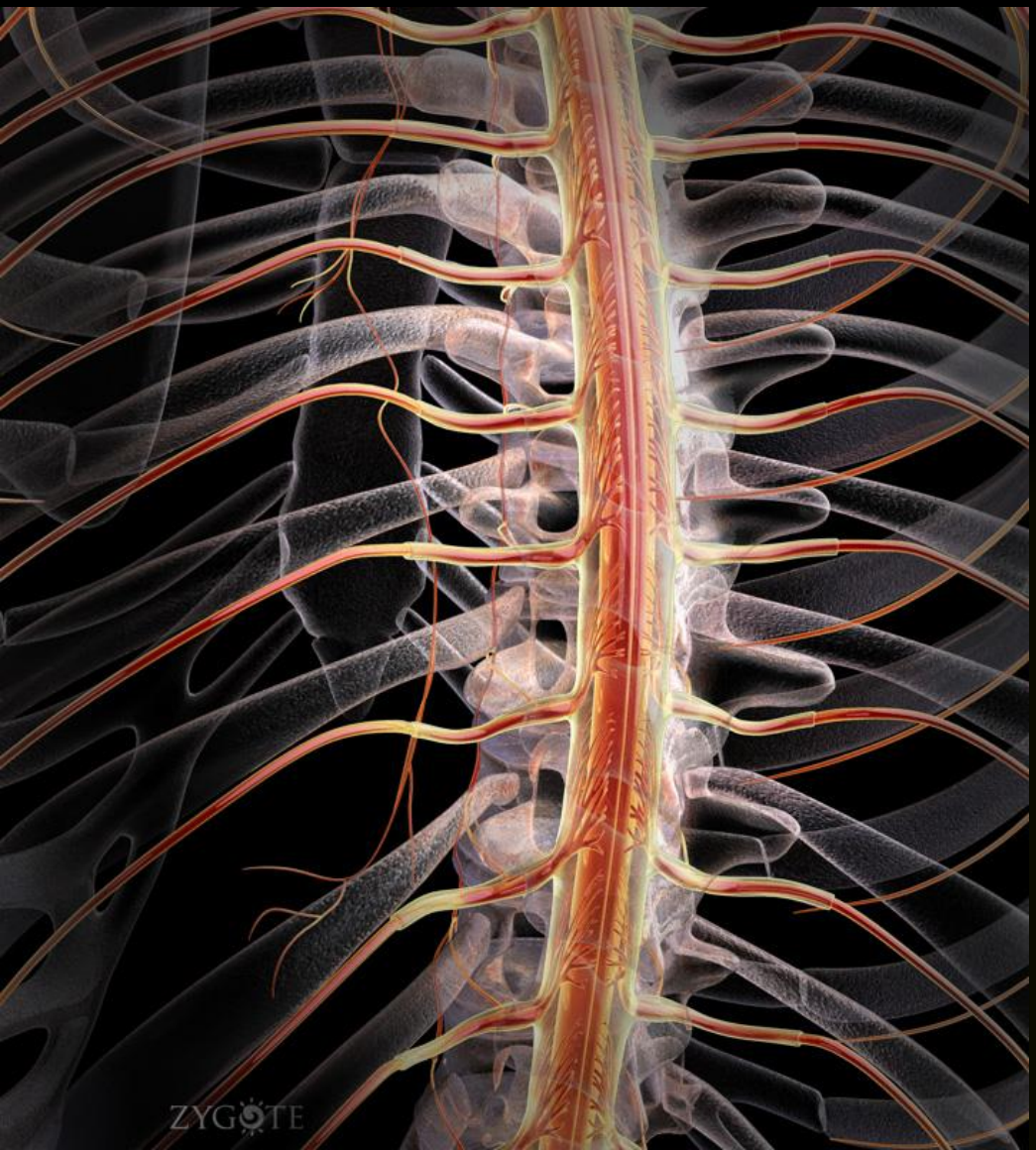
Grade Breakdown:

Lecture (60%)
Exams (4): **22.5% Each**
Pop Quizzes (?): **10% Average**

Lab (40%) – Lab Instructor

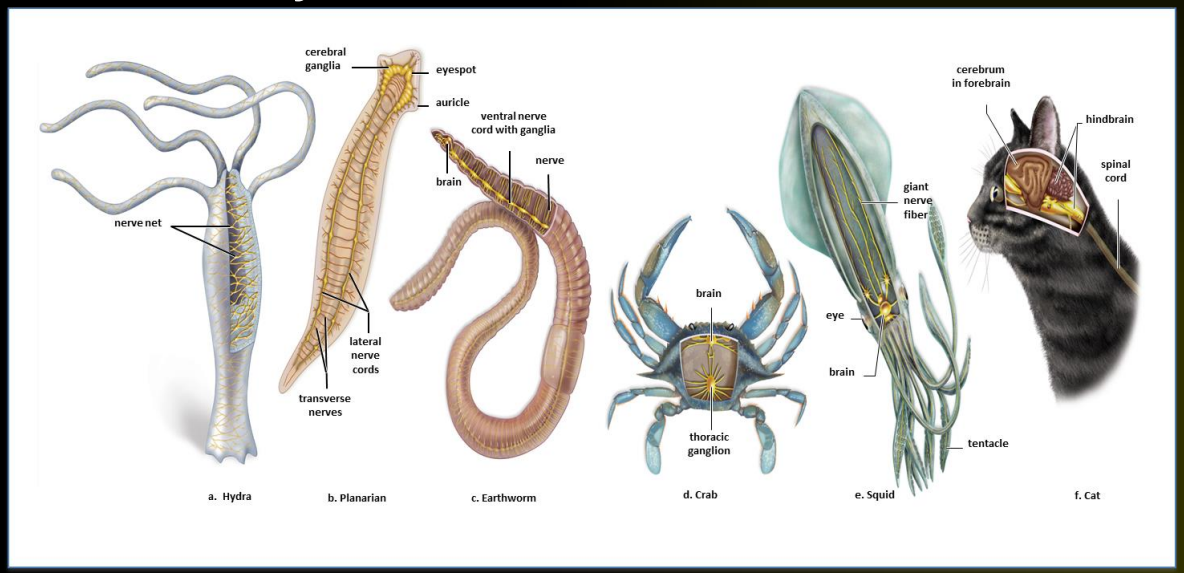
Letter Grade	Numerical Ranges
A	93-100
A-	90-92.9
B+	87-89.9
B	83-86.9
B-	80-82.9
C+	77-79.9
C	70-76.9
D	60-69.9
F	59.9 and below

Nerves and Nervous Systems

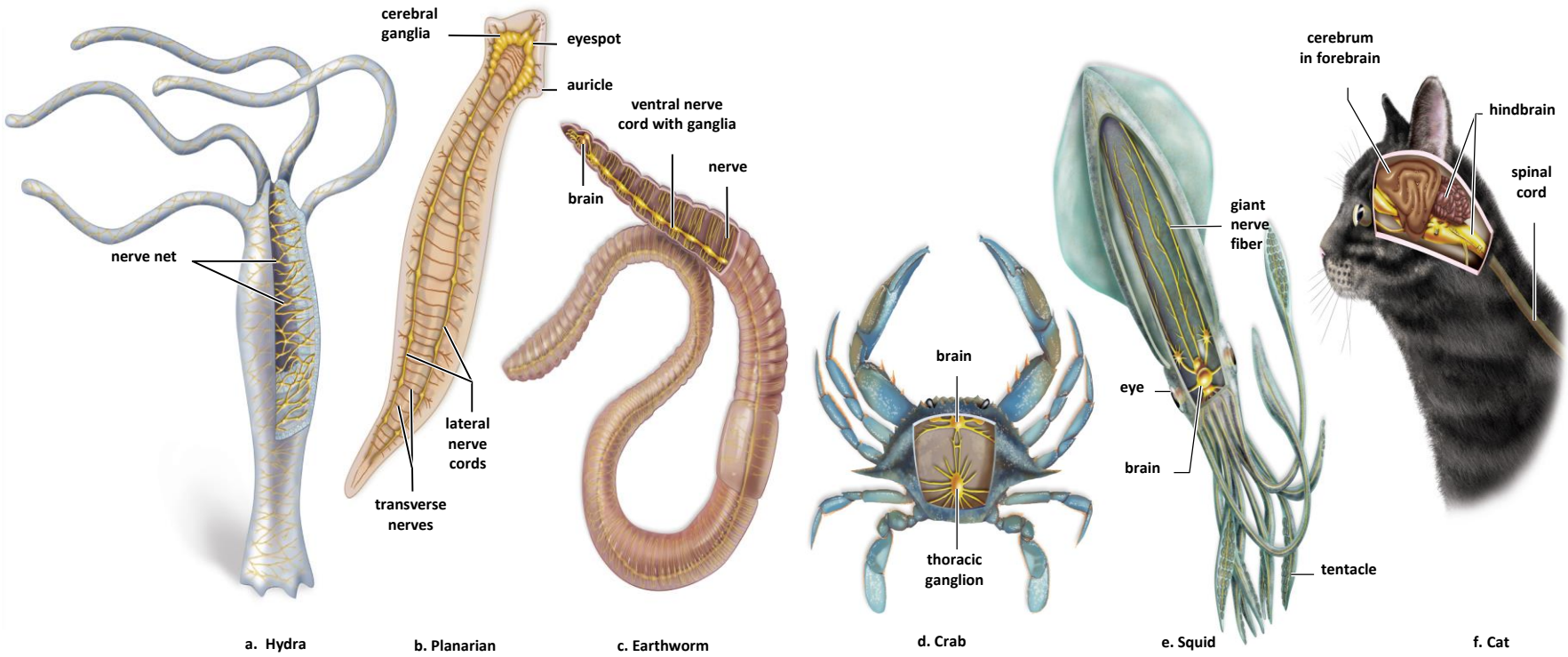


Invertebrate Nervous Organization

- Hydras
  - Nerve net composed of neurons in contact with one another
  - Also in contact with contractile epitheliomuscular cells
- Planarians
  - Ladderlike nervous system
  - Cephalization - a concentration of ganglia and sensory receptors in the head
- Annelids, Arthropods and Mollusks
  - Complex animals
  - True nervous systems



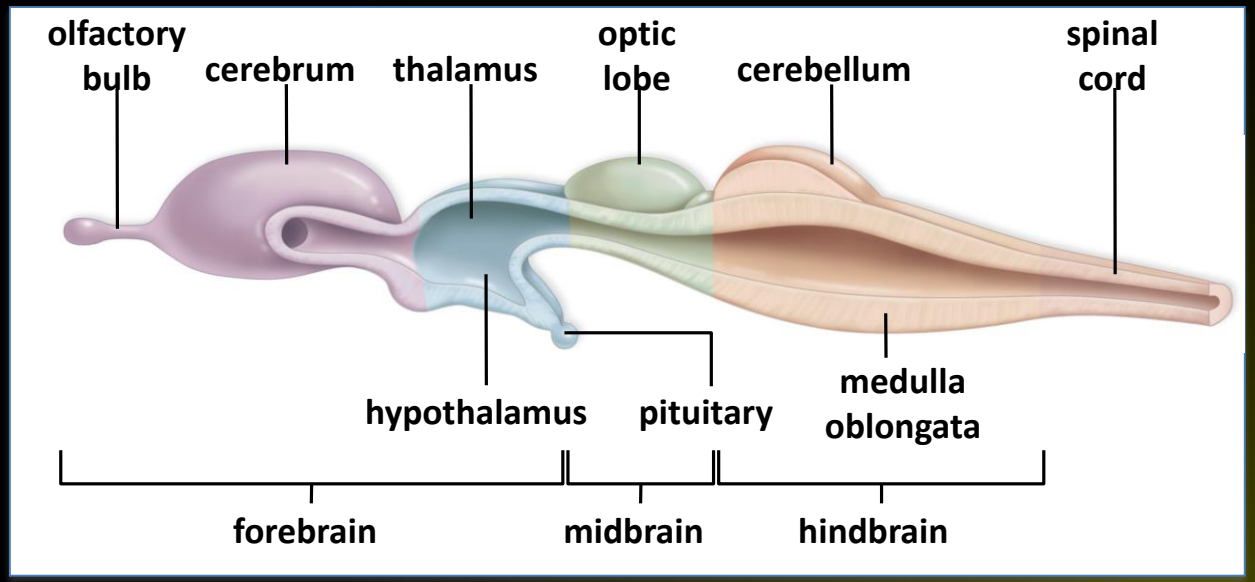
Evolution of the Nervous System



Vertebrate Nervous Organization

- Central nervous system (CNS)
  - Develops from an embryonic dorsal tubular nerve cord
  - Cephalization and bilateral symmetry result in several paired sensory receptors

- Vertebrate brain is organized into three areas
  - Hindbrain
  - Midbrain
  - Forebrain

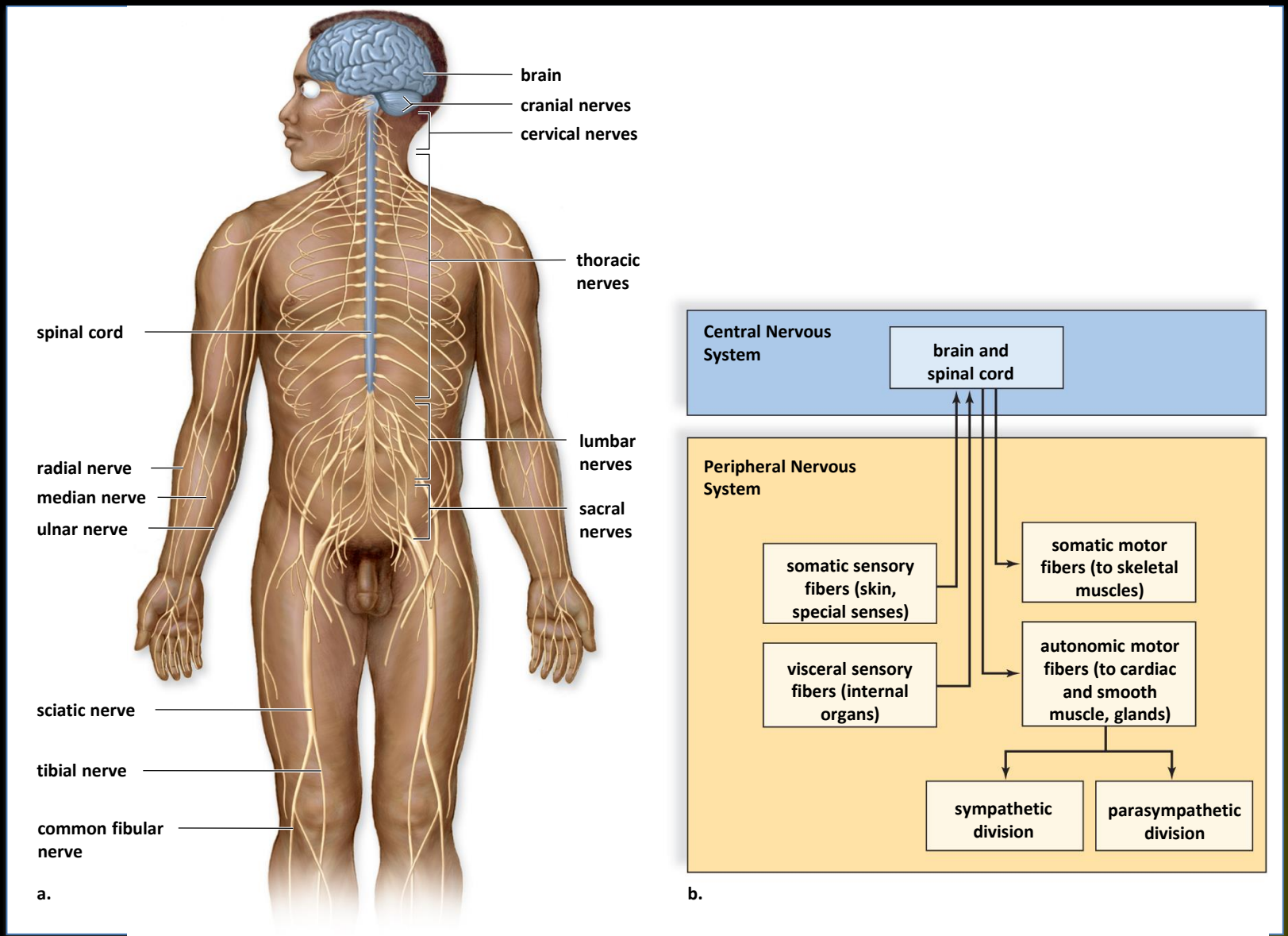


Human Nervous System

- Division of Nervous System:
  - **Central nervous system** (CNS)
    - Includes the brain and spinal cord
    - Lies in the midline of the body
  - **The peripheral nervous system** (PNS)
    - Contains cranial nerves and spinal nerves that:
      - Gather info from sensors and conduct decisions to effectors
      - Lies outside the CNS
- Nervous system has three specific functions
  - Receiving sensory input
  - Performing integration
  - Generating motor output

https://www.youtube.com/watch?v=qPix_X-9t7E

Organization of the Human Nervous System



Question

The general functions of the nervous system include which of the following?

I.integration

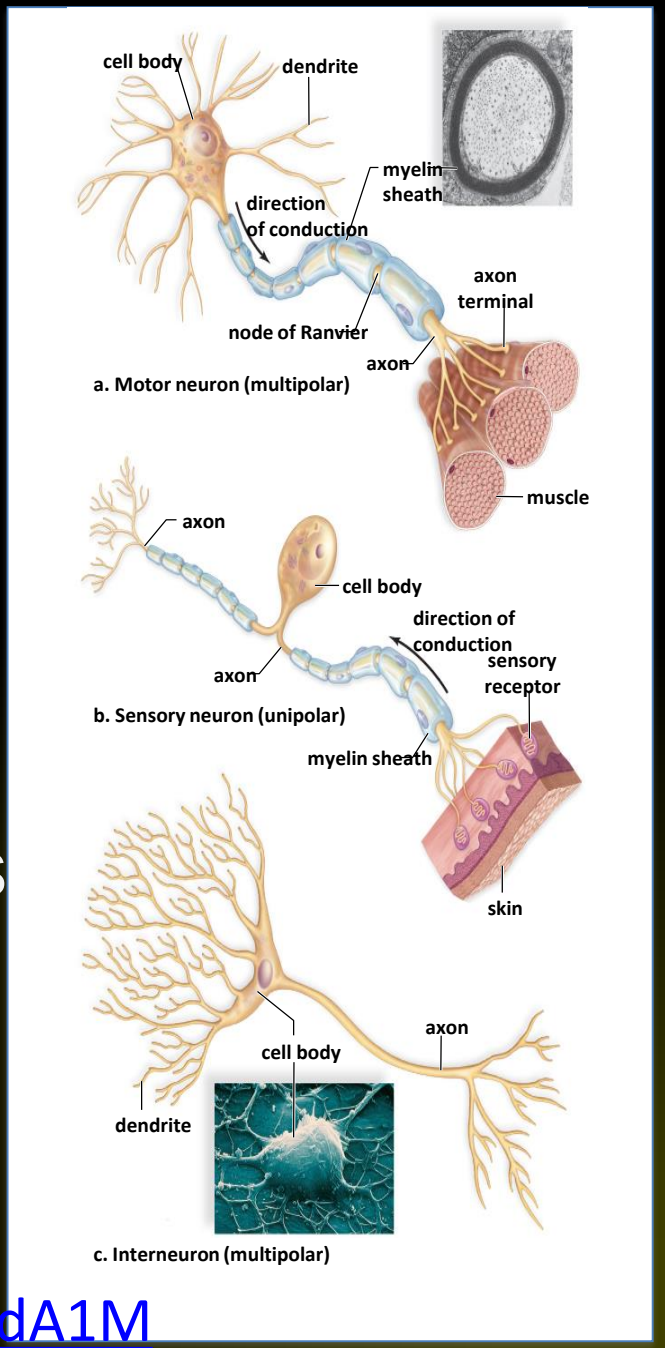
II.motor output

III.sensory input

1) I only
2) II only
3) III only
4) I and II only
5) I, II, and III

Nervous Tissue

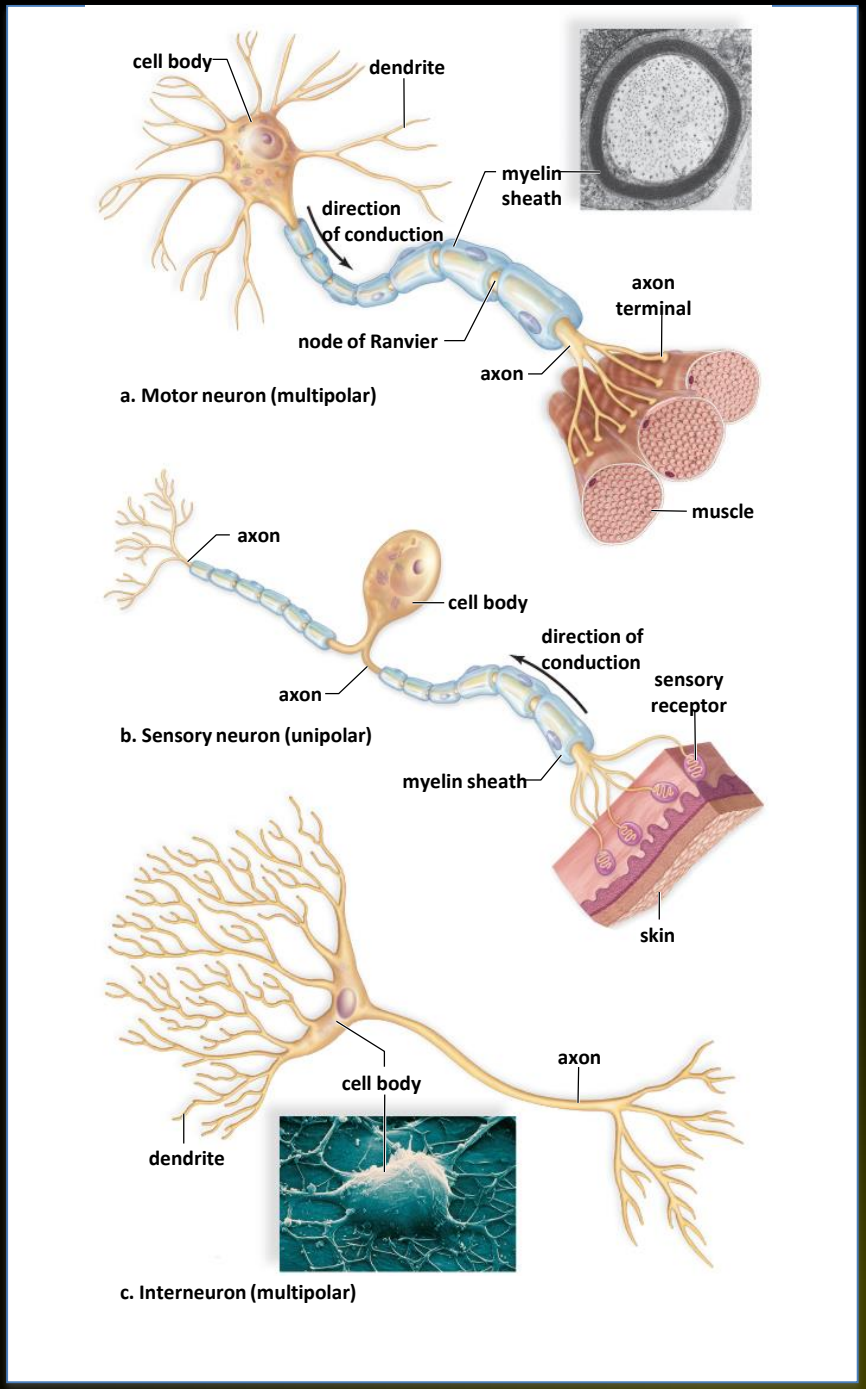
- Neurons
  - Cell body contains nucleus
  - Dendrites receive signals from sensory receptors
  - Axon conducts nerve impulses
    - Covered by myelin sheath
    - Any long axon is also called a nerve fiber



https://www.youtube.com/watch?v=OZG8M_IdA1M

Types of Neurons

- Motor Neurons
  - Accept nerve impulses from the CNS
  - Transmit them to muscles or glands
- Sensory Neurons
  - Accept impulses from sensory receptors
  - Transmit them to the CNS
- Interneurons
  - Convey nerve impulses between various parts of the CNS

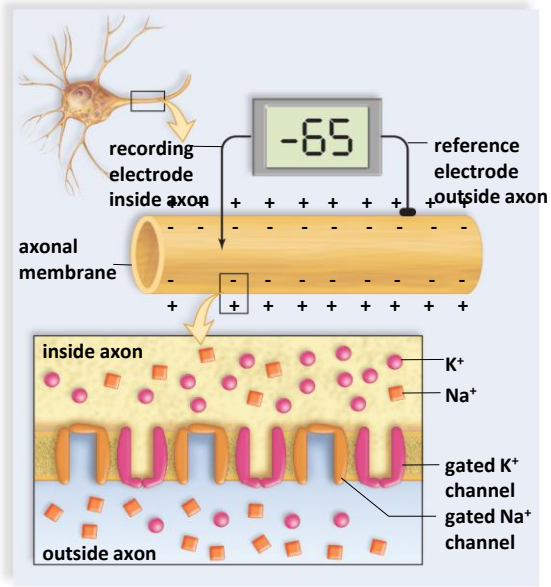


Nerve Impulses: Resting and Action Potentials

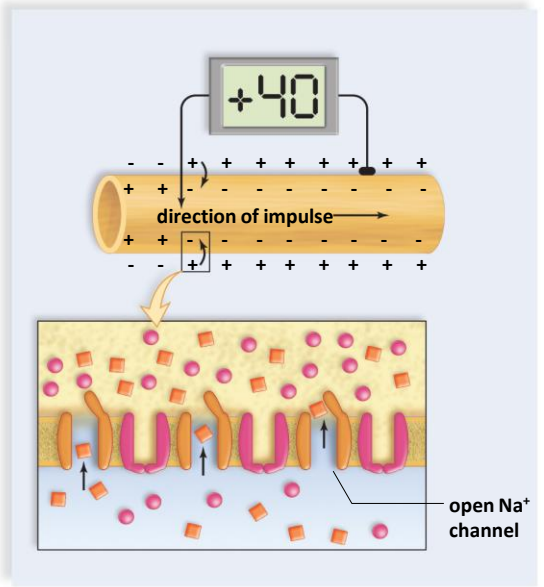
- **Resting Potential**
  - The membrane potential (voltage) when the axon is not conducting an impulse
    - The inside of a neuron is more negative than the outside -65 mV
    - Due in part to the action of the sodium-potassium pump ($3Na^+/2K^+$)
- An **action potential** is generated only after a stimulus larger than the threshold
- Gated channel proteins
  - Suddenly allows sodium to pass through the membrane
  - Another allows potassium to pass through other direction

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

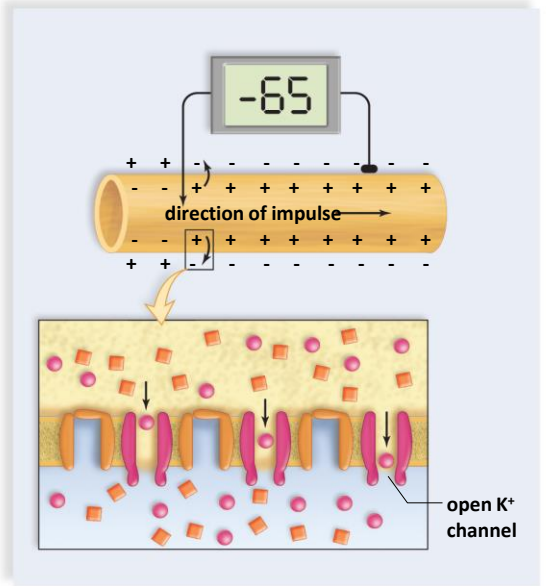
Resting & Action Potential of the Axonal Membrane



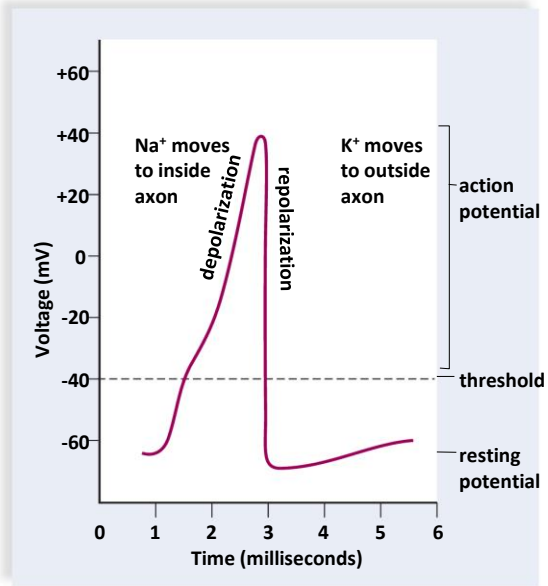
a. Resting potential: more Na^+ outside the axon and more K^+ inside the axon causes polarization.



b. Action potential begins: depolarization occurs when Na^+ gates open and Na+ moves to inside the axon.



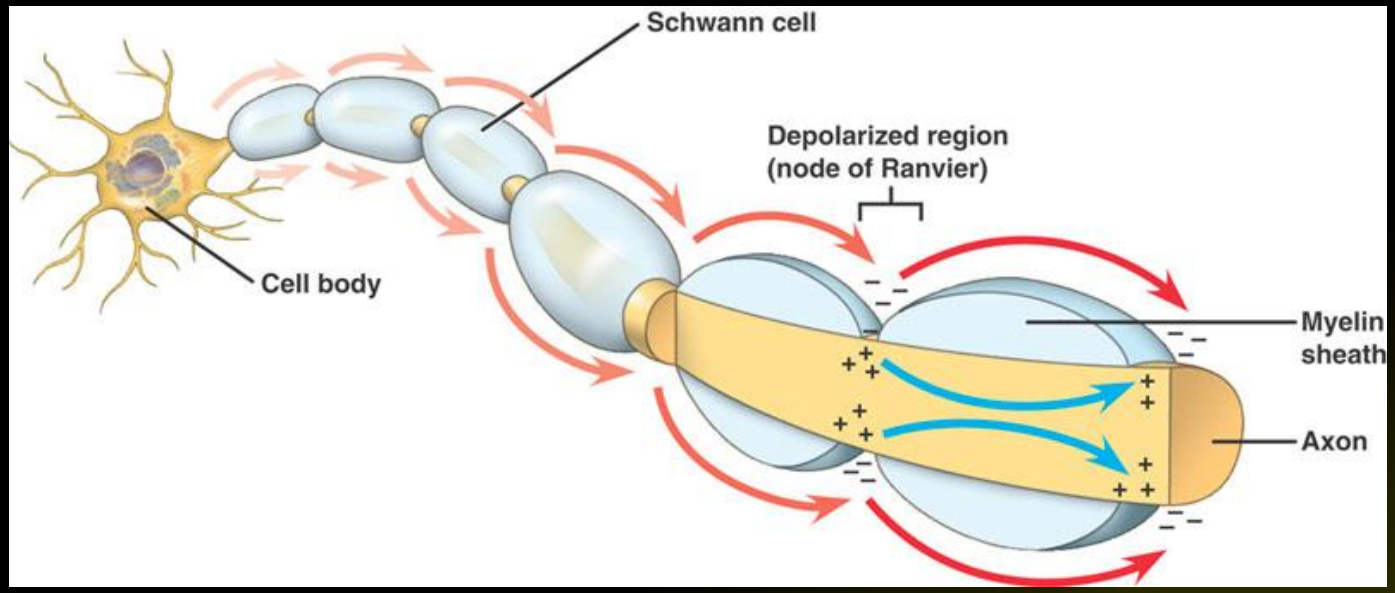
c. Action potential ends: repolarization occurs when K^+ gates open and K^+ moves to outside the axon.



d. An action potential can be visualized if voltage changes are graphed over time.

Propagation of Action Potentials

- In myelinated fibers, an action potential at one node causes an action potential at the next node
  - **Saltatory (jumping) Conduction**

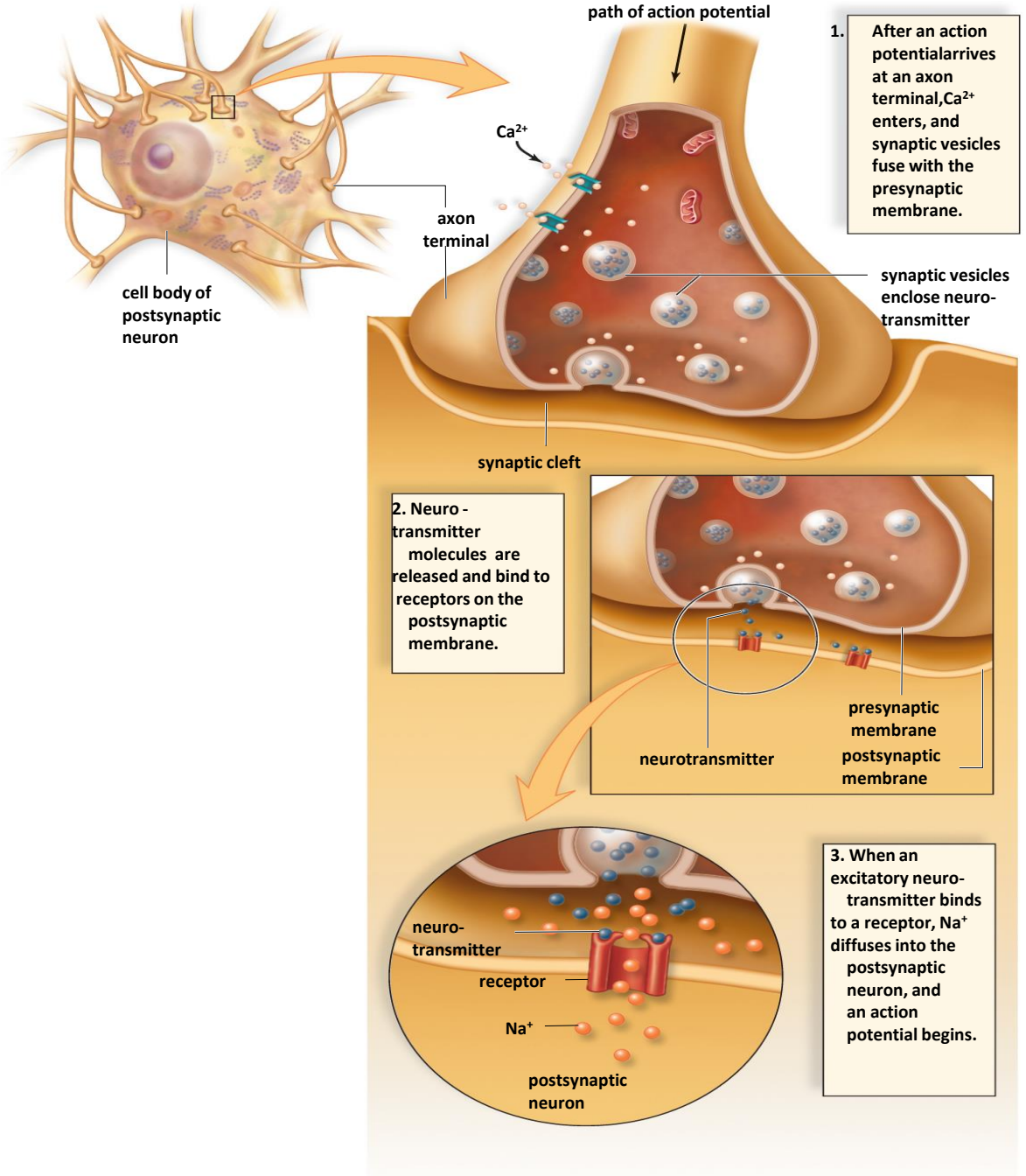


- Conduction of a nerve impulse is an **all-or-nothing** event
  - Intensity of signal is determined by how many impulses are generated within a given time span

Transmission Across a Synapse

- A synapse is a region where neurons nearly touch
- Small gap between neurons is the synaptic cleft
- Transmission across a synapse is carried out by **neurotransmitters**
  - Sudden rise in calcium at end of one neuron
  - Stimulates synaptic vesicles to merge with the presynaptic membrane
  - Neurotransmitter molecules are released into the synaptic cleft

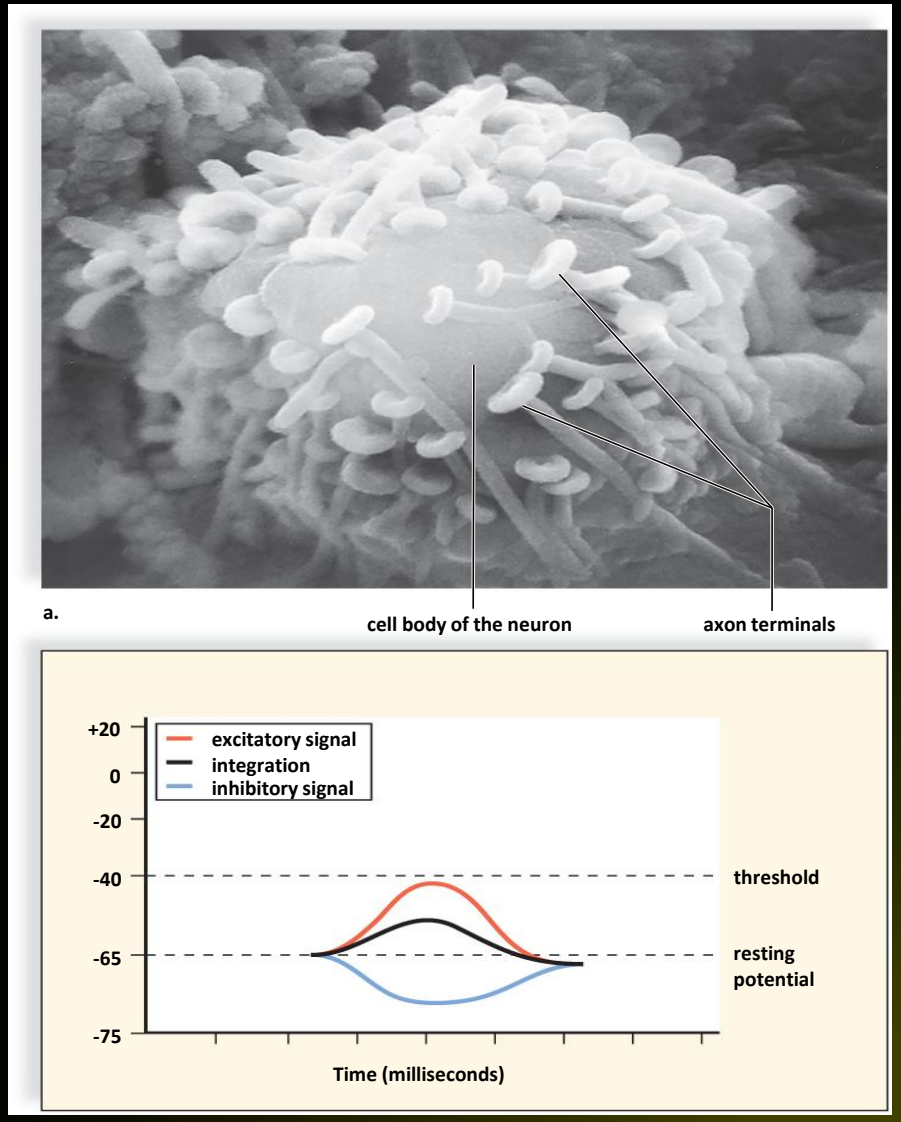
Synapse Structure and Function



Neurotransmitter -- acetylcholine (ACh)

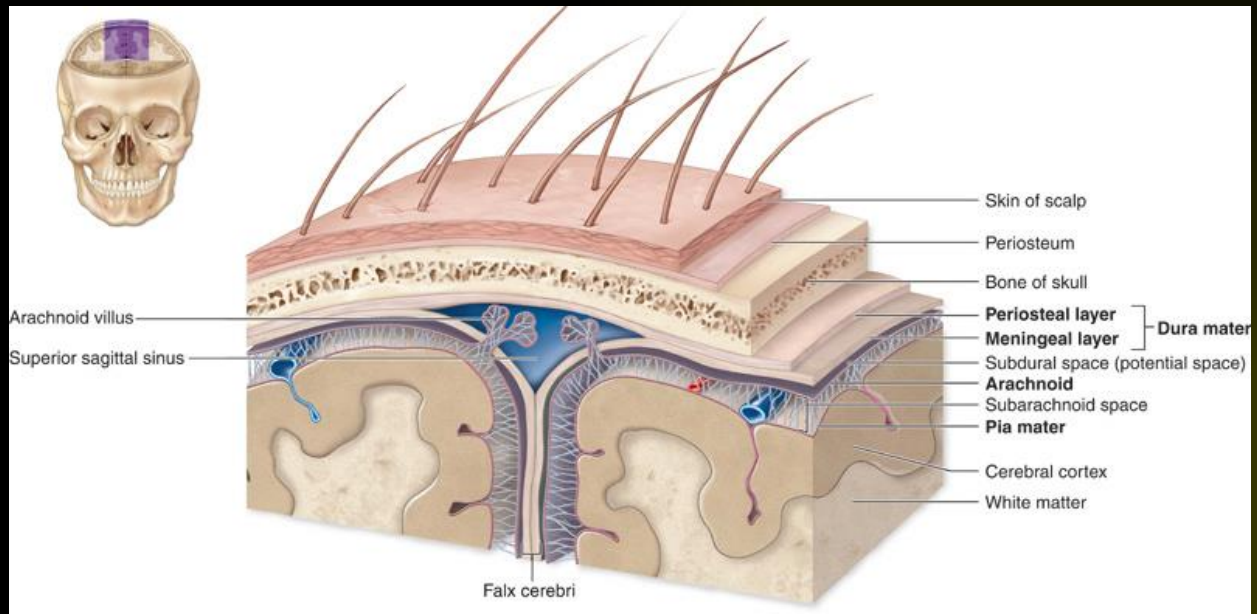
Synaptic Integration

- A single neuron is on the receiving end of
  - Many excitatory signals, and
  - Many inhibitory signals
- Integration
- The summing of signals from
  - Excitatory signals, and
  - Inhibitory signals



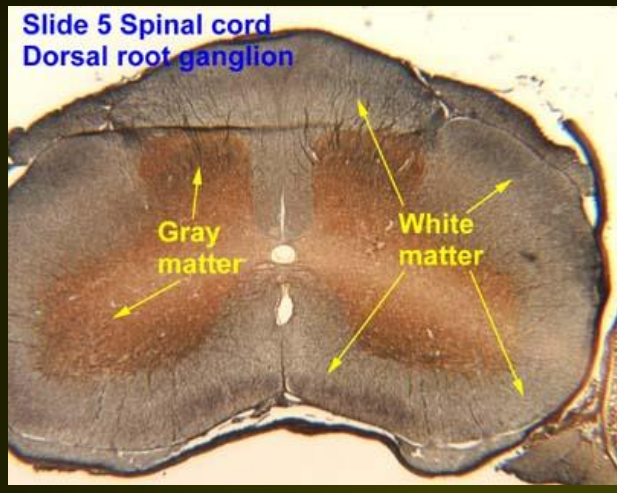
CNS: Brain and Spinal Cord

- Spinal cord and brain are wrapped in three protective membranes, **meninges**
  - Spaces between meninges are filled with **cerebrospinal fluid**
  - Fluid is continuous with that of central canal of spinal cord and the **ventricles** of the brain



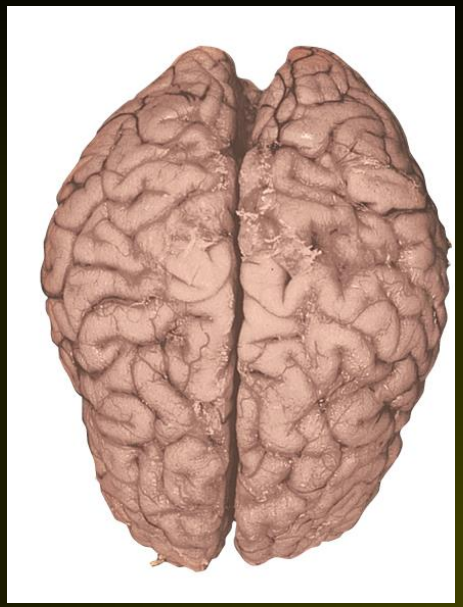
Spinal Cord

- The spinal cord has two main functions
  - Center for many **reflex actions**
  - Means of communication between the brain and spinal nerves
- The spinal cord is composed of **gray matter and white matter**
  - Cell bodies and short **unmyelinated** fibers give the gray matter its color
  - Myelinated long fibers of interneurons running in tracts give white matter its color



The Brain

- **Cerebrum** is the largest portion of the brain in humans
  - Communicates with, and coordinates the activities of, the other parts of the brain
  - **Longitudinal fissure** divides into left and right cerebral hemispheres



The **left cerebral hemisphere** controls movement of the right side of the body and vice-versa.

https://www.youtube.com/watch?v=vHrmiy4W9C0

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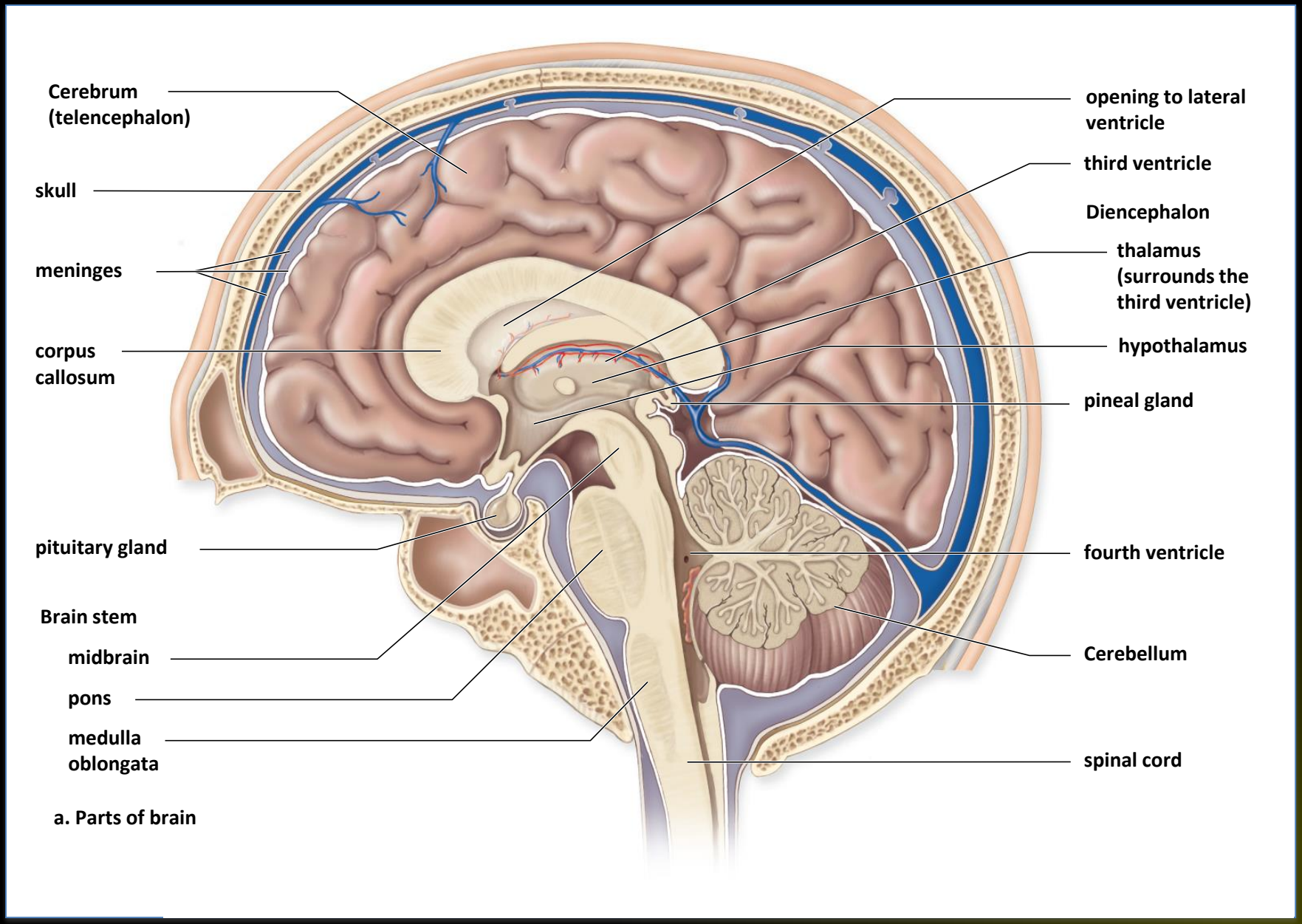
The Human Brain

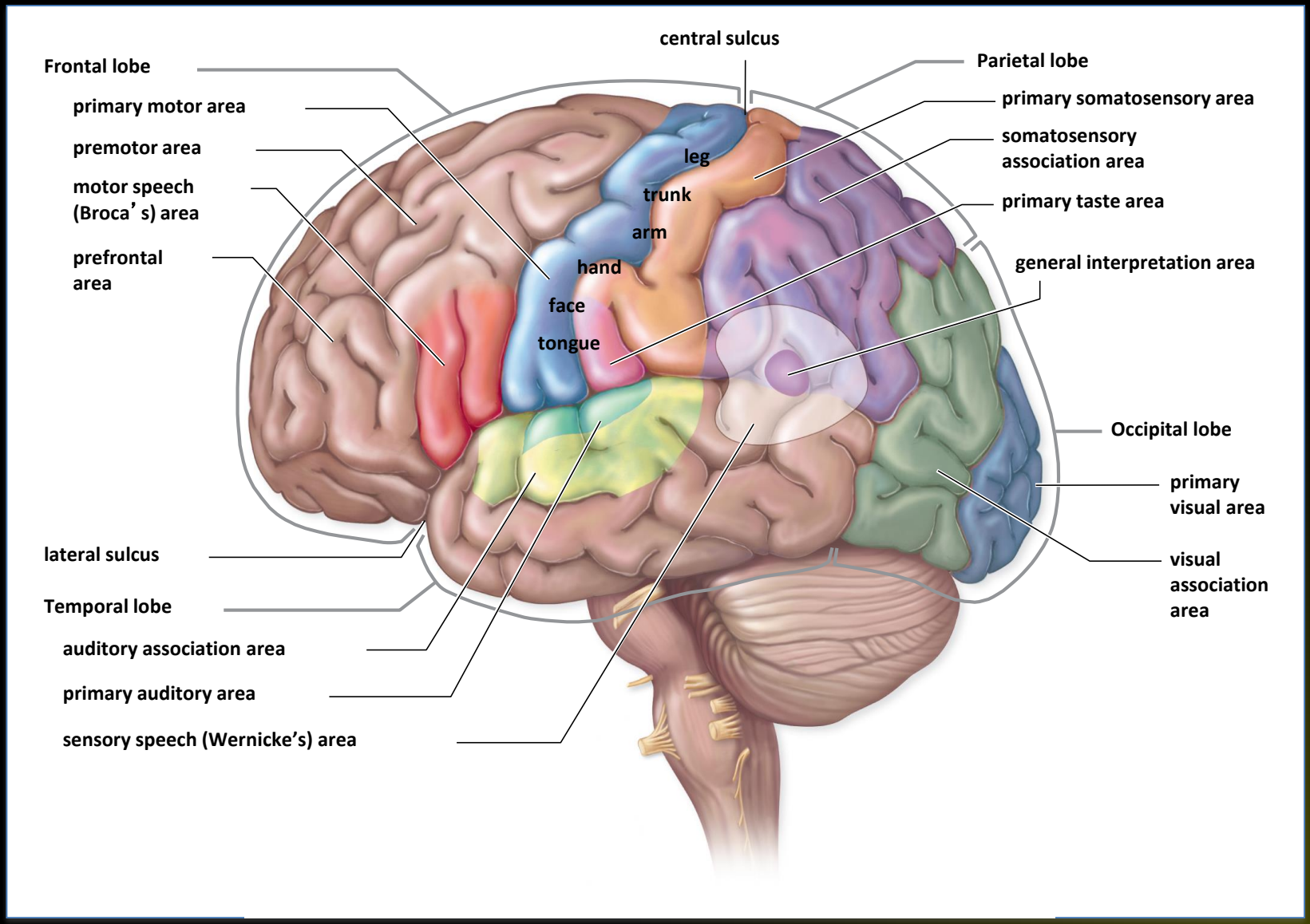


a. Parts of brain

Cerebral Cortex

- A thin but highly convoluted outer layer of gray matter
- Covers the cerebral hemispheres
- Contains motor areas and sensory areas as well as association areas
  - Primary motor area is in the frontal lobe just ventral to central sulcus
  - Primary somatosensory area is just dorsal to central sulcus (senses – excluding vision, hearing, taste)

The Lobes of a Cerebral Hemisphere

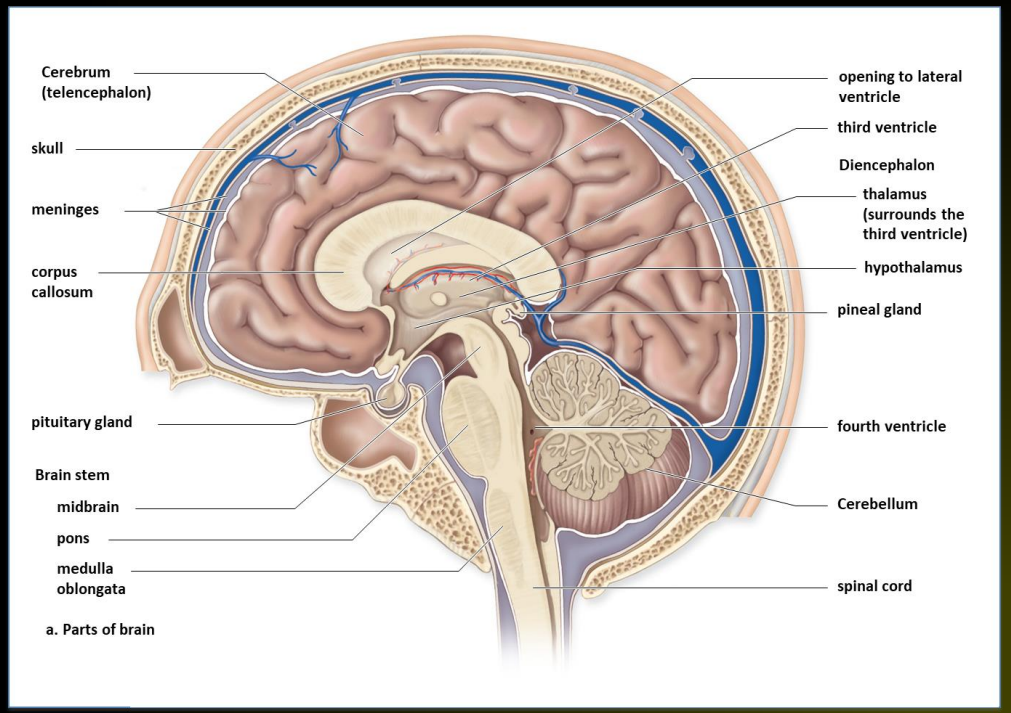


Cerebrum

- Rest of cerebrum is composed of white matter
  - Descending tracts communicate with lower brain centers
  - Ascending tracts send sensory information to primary somatosensory area
  - Basal nuclei
    - Integrate motor commands
    - Ensure that the proper muscle groups are either activated or inhibited

Diencephalon

- A region encircling the third ventricle
- Consists of hypothalamus and thalamus
  - Hypothalamus forms floor of the third ventricle
  - Thalamus consists of two masses of gray matter located in the sides and roof of the third ventricle
- Pineal gland
  - Also located in the diencephalon
  - Secretes melatonin



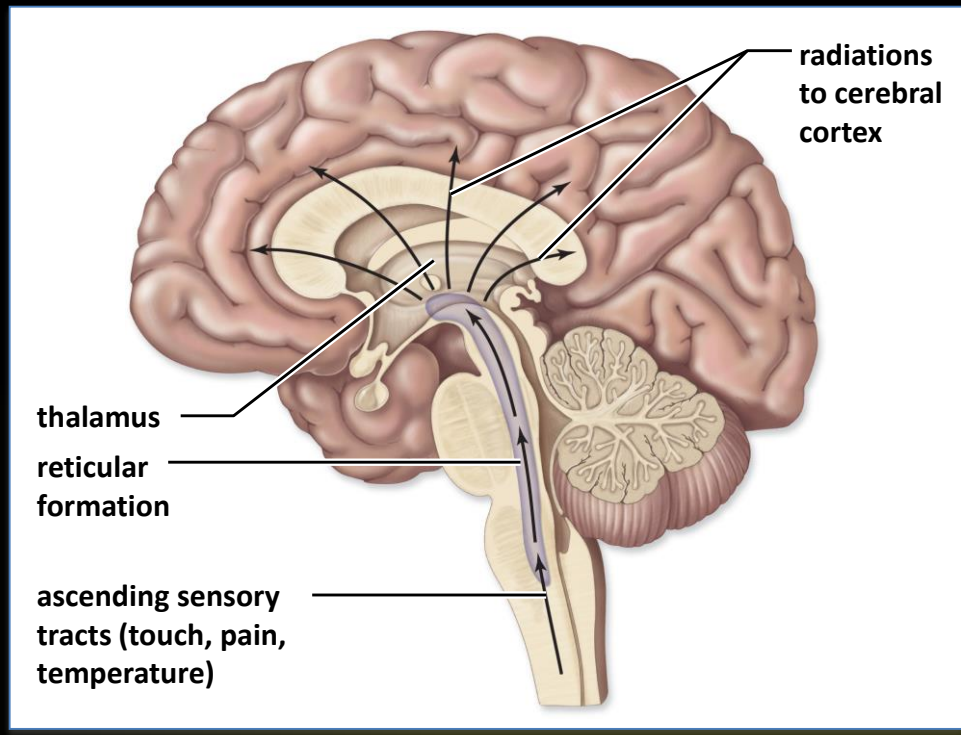
Cerebellum & Brain Stem

- **Cerebellum**: separated from the brain stem by the fourth ventricle
  - Receives sensory input from the eyes, ears, joints, and muscles
  - Sends motor impulses out the brain stem to the skeletal muscles
- **Brain stem** = midbrain, the pons & medulla oblongata
  - Midbrain
    - Acts as a relay station for tracts passing between
      - The cerebrum, and
      - The spinal cord or cerebellum
  - Pons
    - Helps regulate breathing and head movements
  - Medulla oblongata
    - Contains reflex centers for vomiting, coughing, sneezing, hiccuping, and swallowing

The Reticular Activating System (RAS)

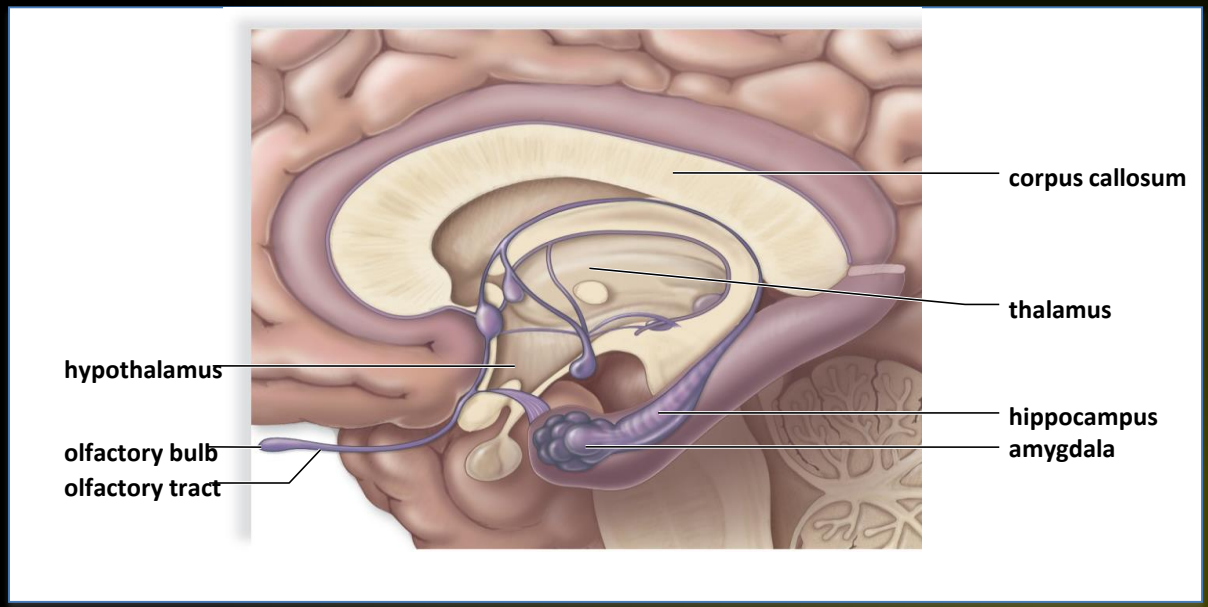
- It is a complex network of:
  - Nuclei (masses of gray matter)
  - Nerve fibers that extend the length of the brain stem

- The reticular formation is a major component of RAS
- The RAS arouses the cerebrum via the thalamus and causes a person to be alert



Limbic System

- Complex network of tracts and “nuclei”
- Incorporates medial portions of
  - The cerebral lobes,
  - The subcortical basal nuclei, and
  - The diencephalon
- Integrates higher mental functions and primitive emotions
  - Hippocampus
  - Amygdala

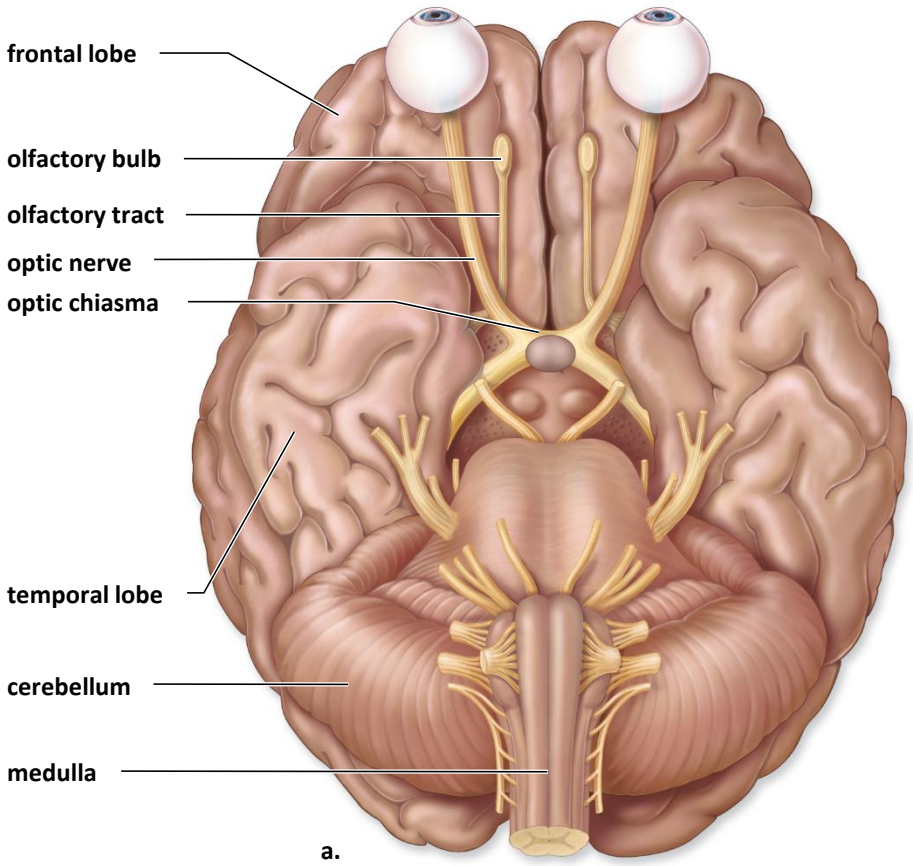


Peripheral Nervous System

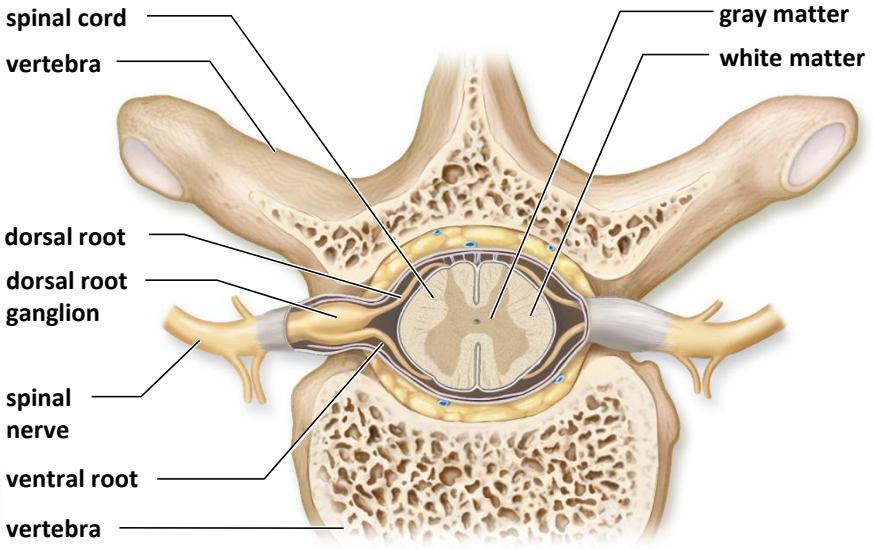
- **Somatic system**
  - Contains cranial nerves and spinal nerves
    - Gather info from sensors and conduct decisions to effectors
    - Controls the skeletal muscles
  - Conscious of its activity

- **Autonomic system**
  - Controls the smooth muscles, cardiac muscles, and glands
  - Usually unaware of its actions
  - Divided into two divisions
    - **Sympathetic** division
    - **Parasympathetic** division

Cranial and Spinal Nerves



a.



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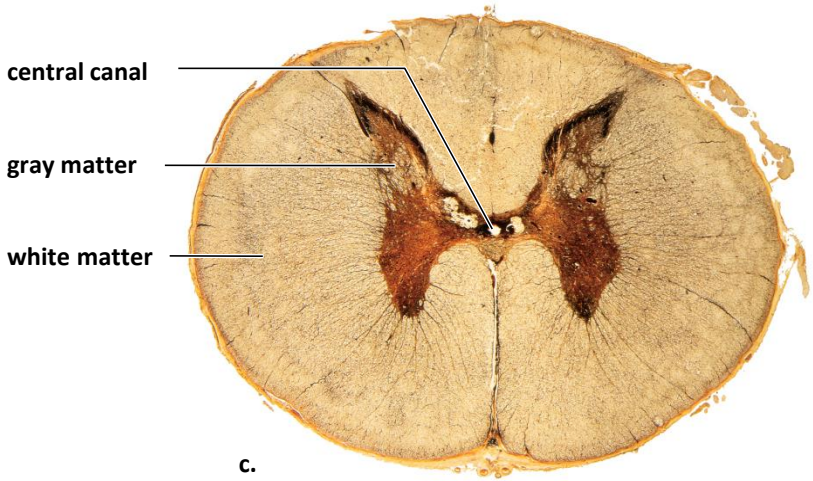


c.

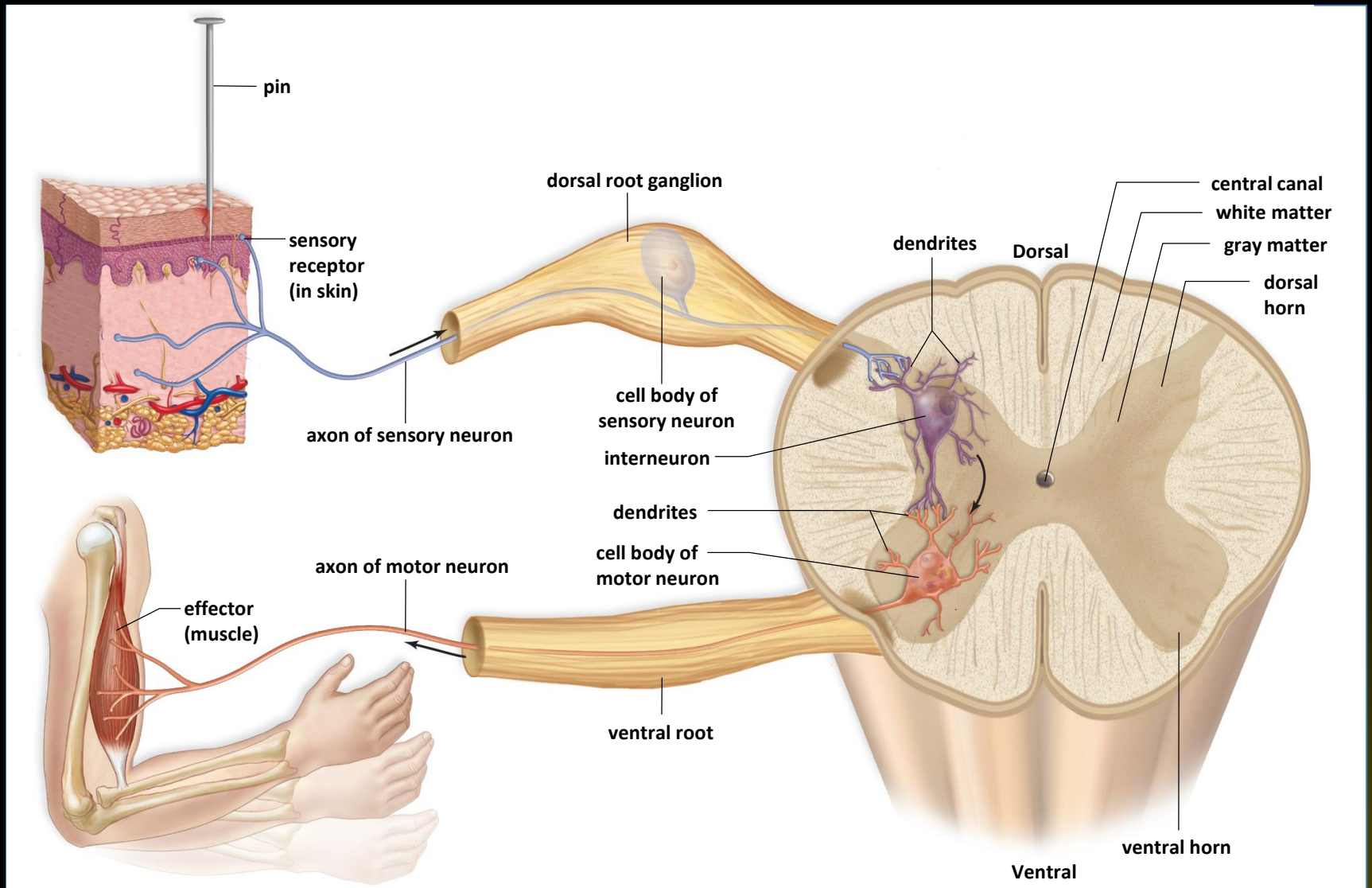
Comparison of Somatic Motor and Autonomic Motor Pathways

TABLE 37.1

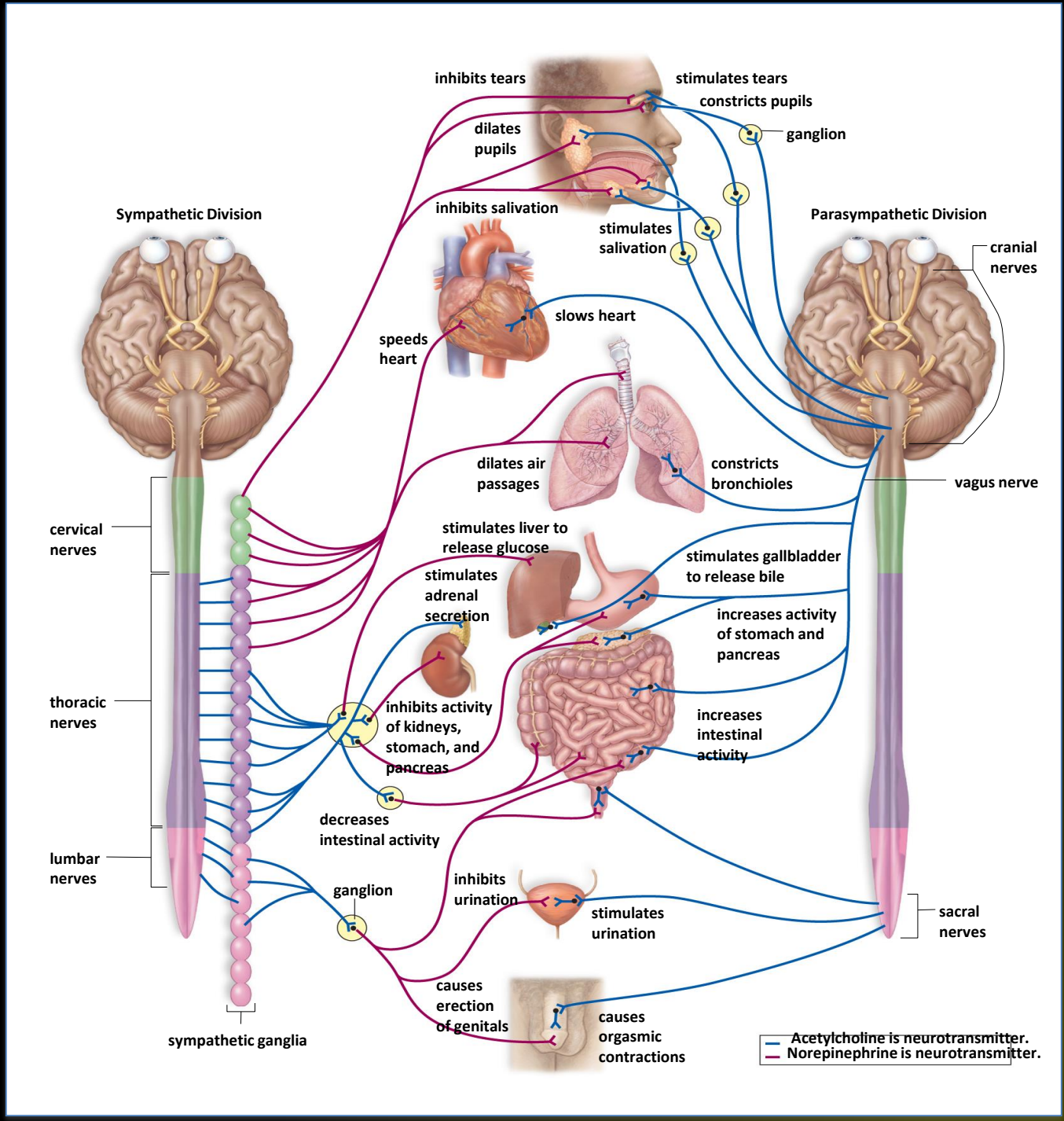
Comparison of Somatic Motor and Autonomic Motor Pathways

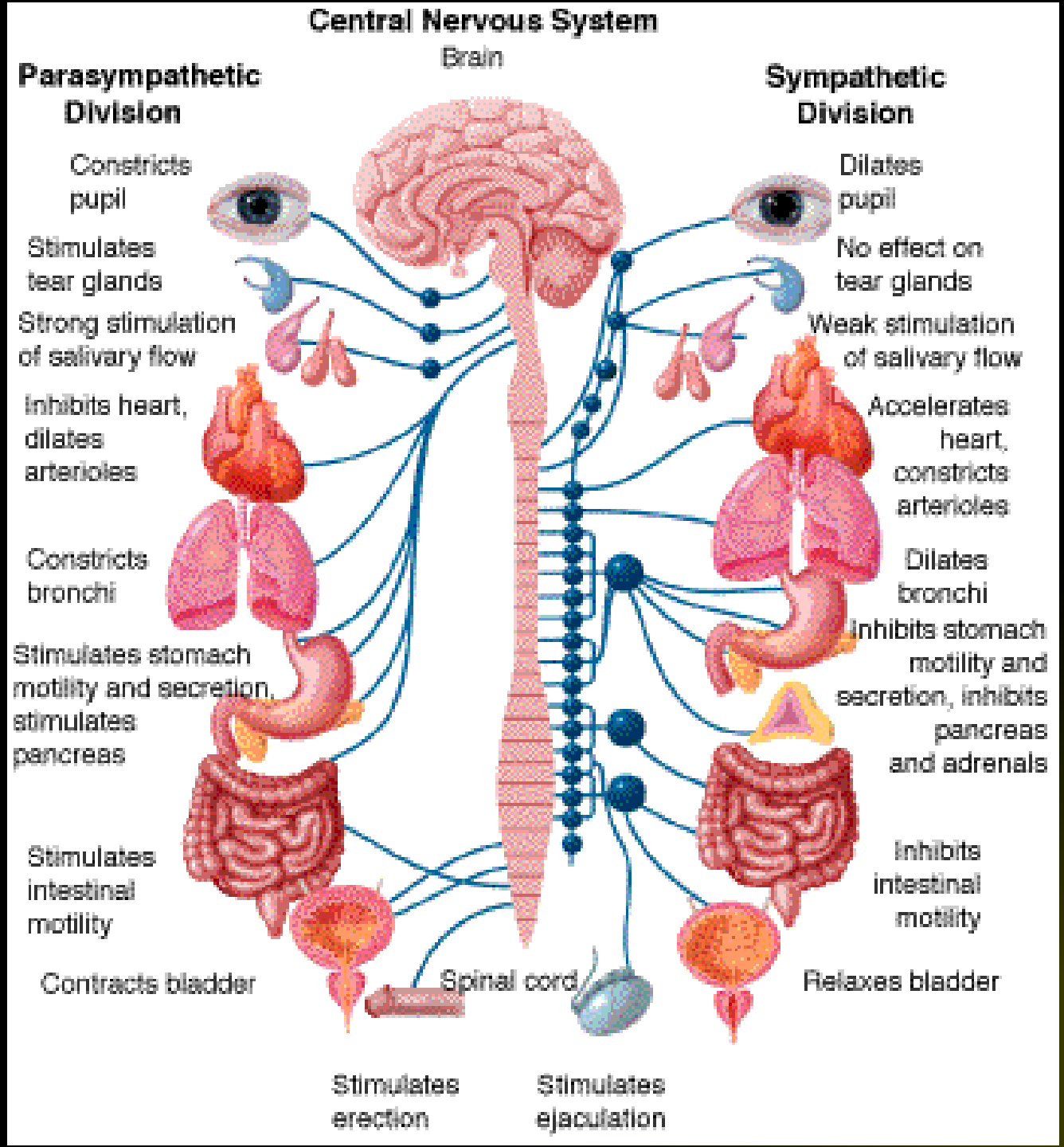
	Somatic Motor Pathway	*Autonomic Motor Pathways*	
		Sympathetic	***Parasympathetic***
Type of control	Voluntary/involuntary	Involuntary	Involuntary
Number of neurons per message	One	Two (preganglionic shorter than postganglionic)	Two (preganglionic longer than postganglionic)
Location of motor fiber	Most cranial nerves and all spinal nerves	Thoracolumbar spinal nerves	Cranial (e.g., vagus) and sacral spinal nerves
Neurotransmitter	Acetylcholine	Norepinephrine	Acetylcholine
Effectors	Skeletal muscles	Smooth and cardiac muscle, glands	Smooth and cardiac muscle, glands

A Reflex Arc Showing the Path of a Spinal Reflex



Autonomic System Structure and Function




Central Nervous System
Brain
Parasympathetic Division
Sympathetic Division
Constricts pupil
Dilates pupil
Stimulates tear glands
No effect on tear glands
Strong stimulation of salivary flow
Weak stimulation of salivary flow
Inhibits heart, dilates arterioles
Accelerates heart, constricts arterioles
Constricts bronchi
Dilates bronchi
Stimulates stomach motility and secretion, stimulates pancreas
Inhibits stomach motility and secretion, inhibits pancreas and adrenals
Stimulates intestinal motility
Inhibits intestinal motility
Contracts bladder
Spinal cord
Relaxes bladder
Stimulates erection
Stimulates ejaculation

Autonomic System

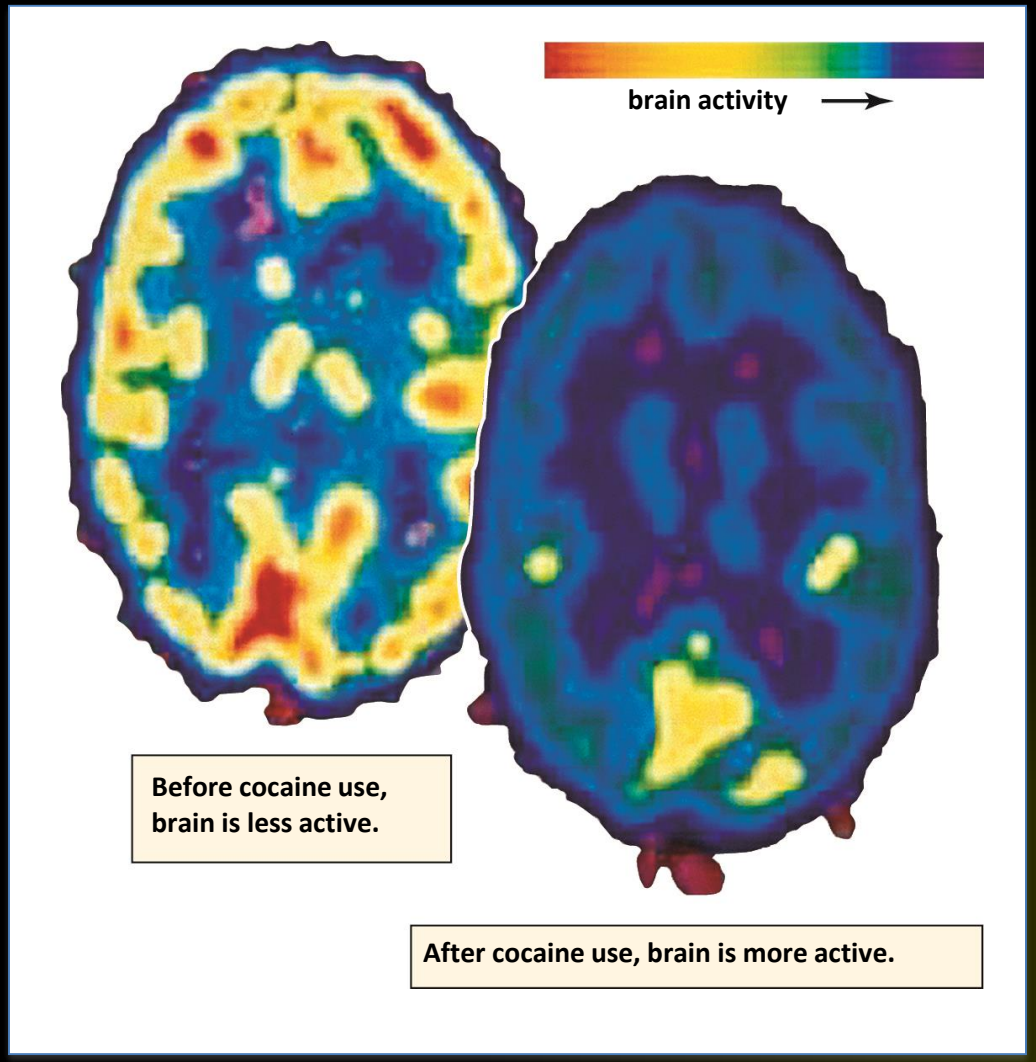
- Regulates activity of cardiac and smooth muscle, and glands
- Divided into sympathetic and parasympathetic
  - Function automatically and usually in an involuntary manner
  - Innervate all internal organs
  - Utilize two neurons and one ganglion for each impulse

- Sympathetic division
  - Especially important during **fight or flight** responses
  - Accelerates heartbeat and dilates bronchi
- Parasympathetic division
  - Promotes all internal responses associated with a **relaxed state**
  - Promotes digestion and retards heartbeat

Science Focus: Drug Abuse

- Drug abuse - person takes a drug at a dose level that increase the potential for a harmful effect.
- Addiction - when more of the drug is needed to get the same effect
- Withdrawal - when the user stops taking the drug
- Alcohol, drugs, and tobacco can all adversely affect the developing embryo, fetus, or newborn.

Drug Use: *Brain Activity Before and After the Use of Cocaine*



Question

When your doctor triggers your patellar tendon reflex by tapping the front of your knee with a rubber hammer, what might she be assessing?

A. The health of the nervous tissue between your knee and spinal cord
B. The healthy functioning of your cerebellum
C. The health of the nervous tissue between your knee and your cerebral cortex
D. The health of the nervous tissue between your knee and your foot