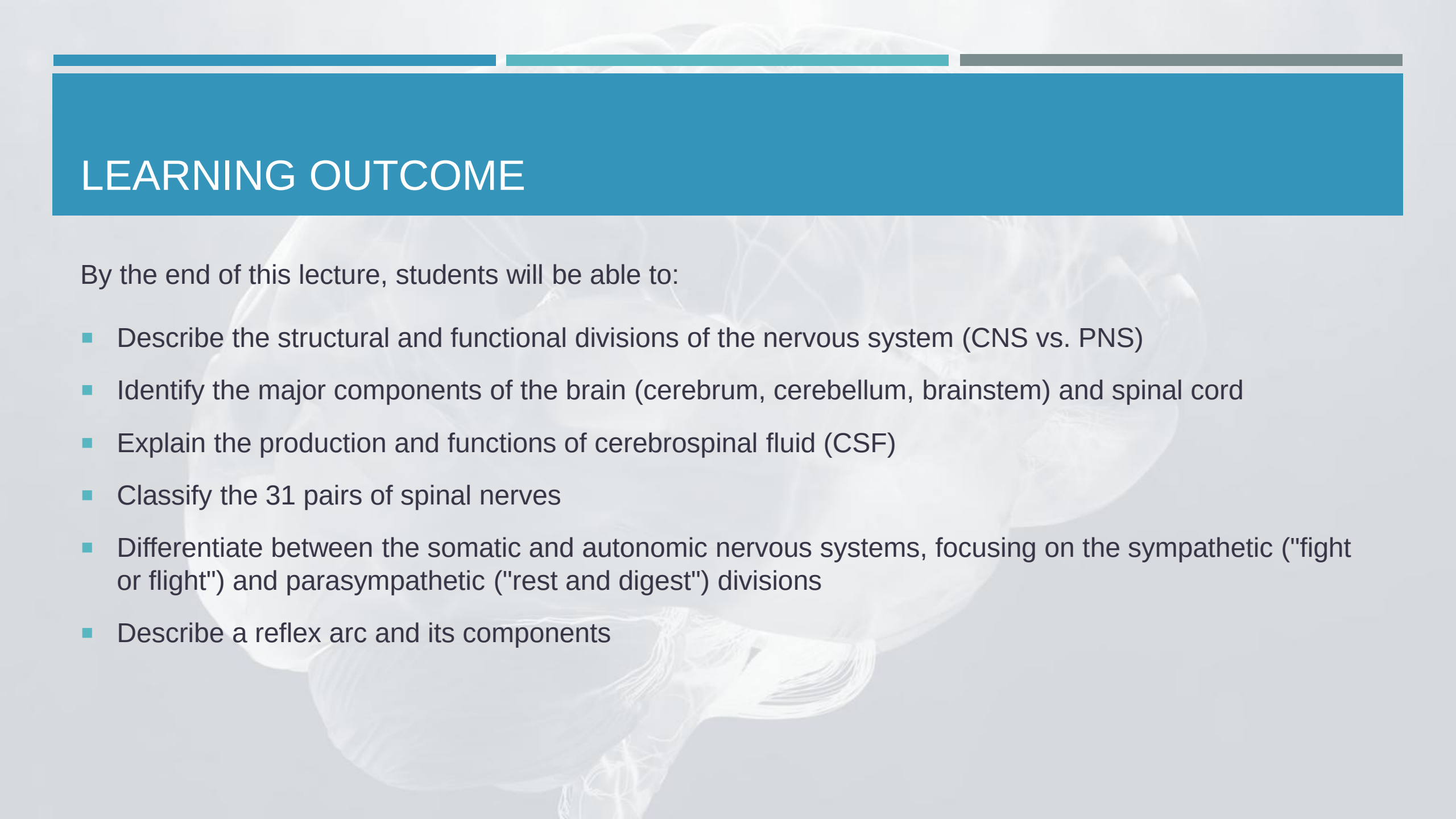




ANATOMY OF THE NERVOUS SYSTEM

HUMAN ANATOMY
College of Pharmacy
Dr. Abeer Abdullah



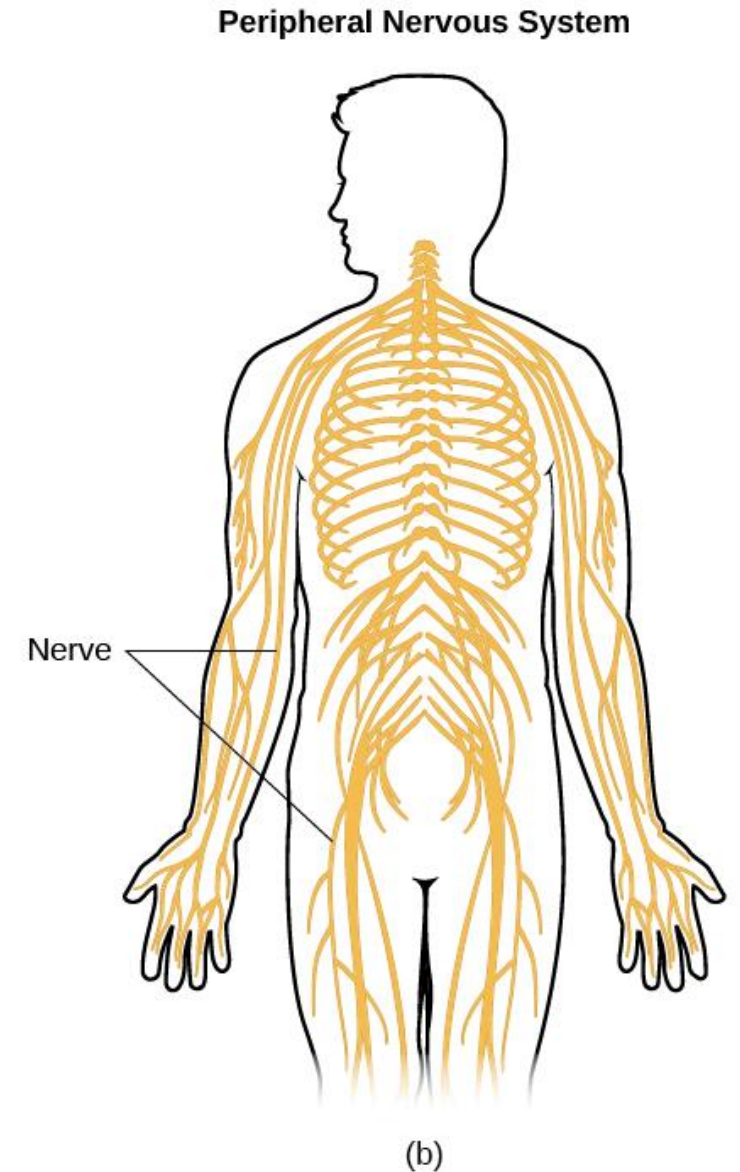
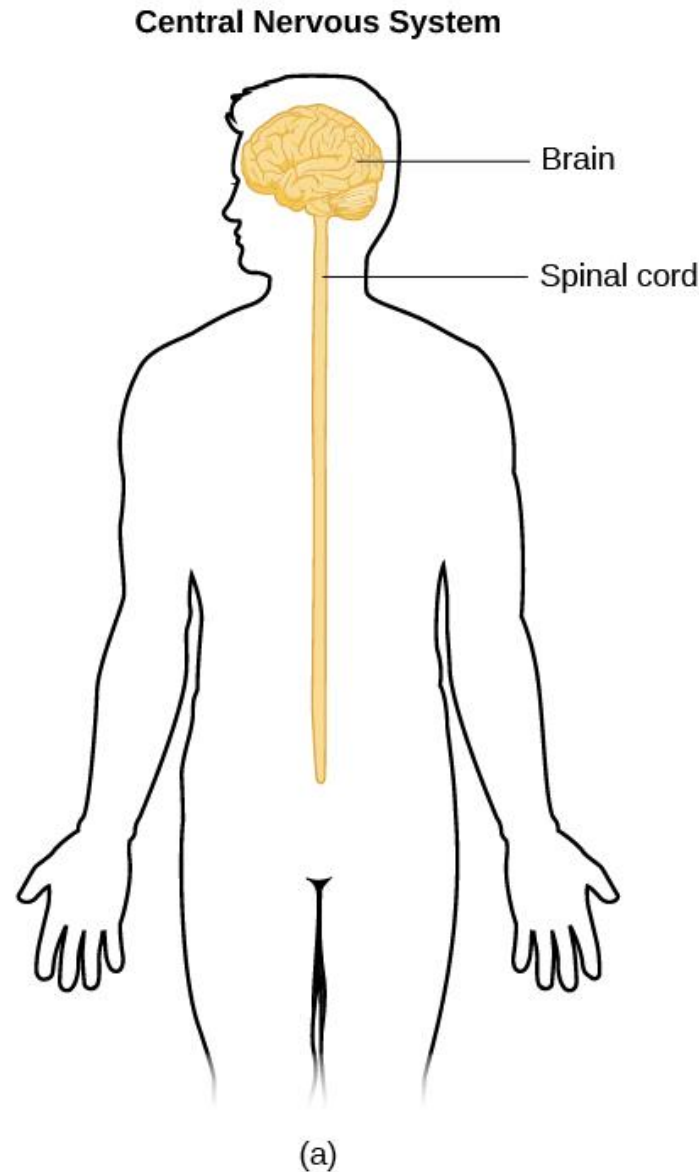
LEARNING OUTCOME

By the end of this lecture, students will be able to:

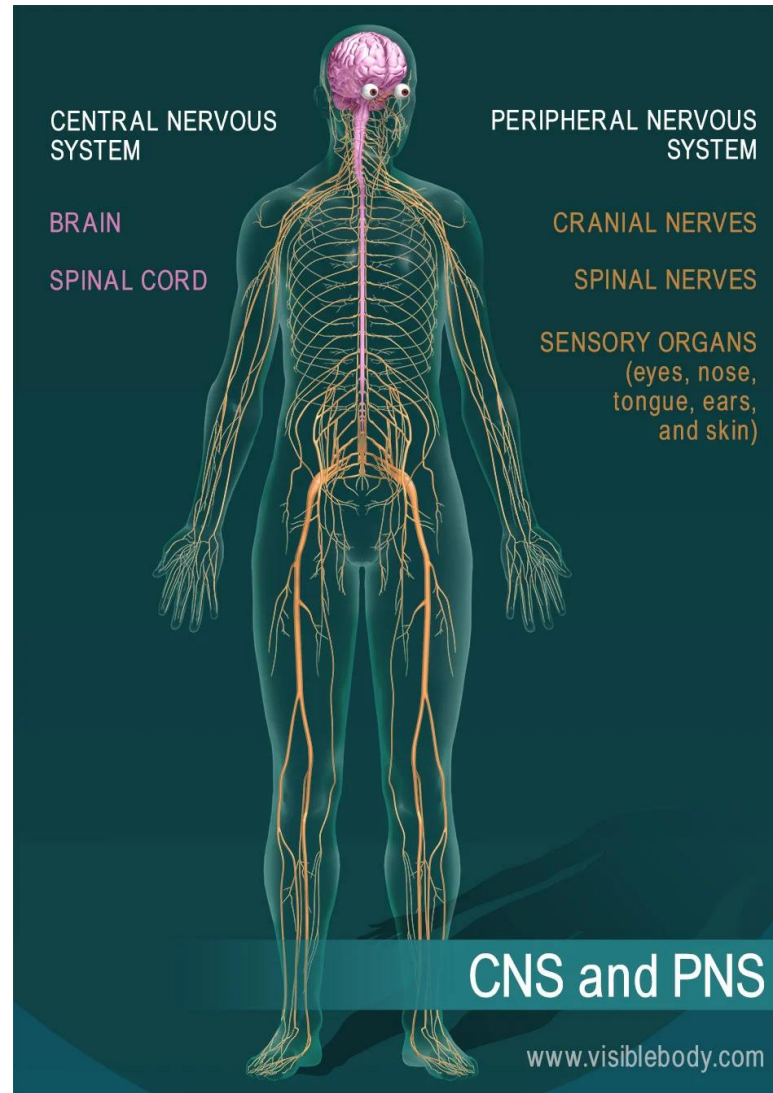
- Describe the structural and functional divisions of the nervous system (CNS vs. PNS)
- Identify the major components of the brain (cerebrum, cerebellum, brainstem) and spinal cord
- Explain the production and functions of cerebrospinal fluid (CSF)
- Classify the 31 pairs of spinal nerves
- Differentiate between the somatic and autonomic nervous systems, focusing on the sympathetic ("fight or flight") and parasympathetic ("rest and digest") divisions
- Describe a reflex arc and its components

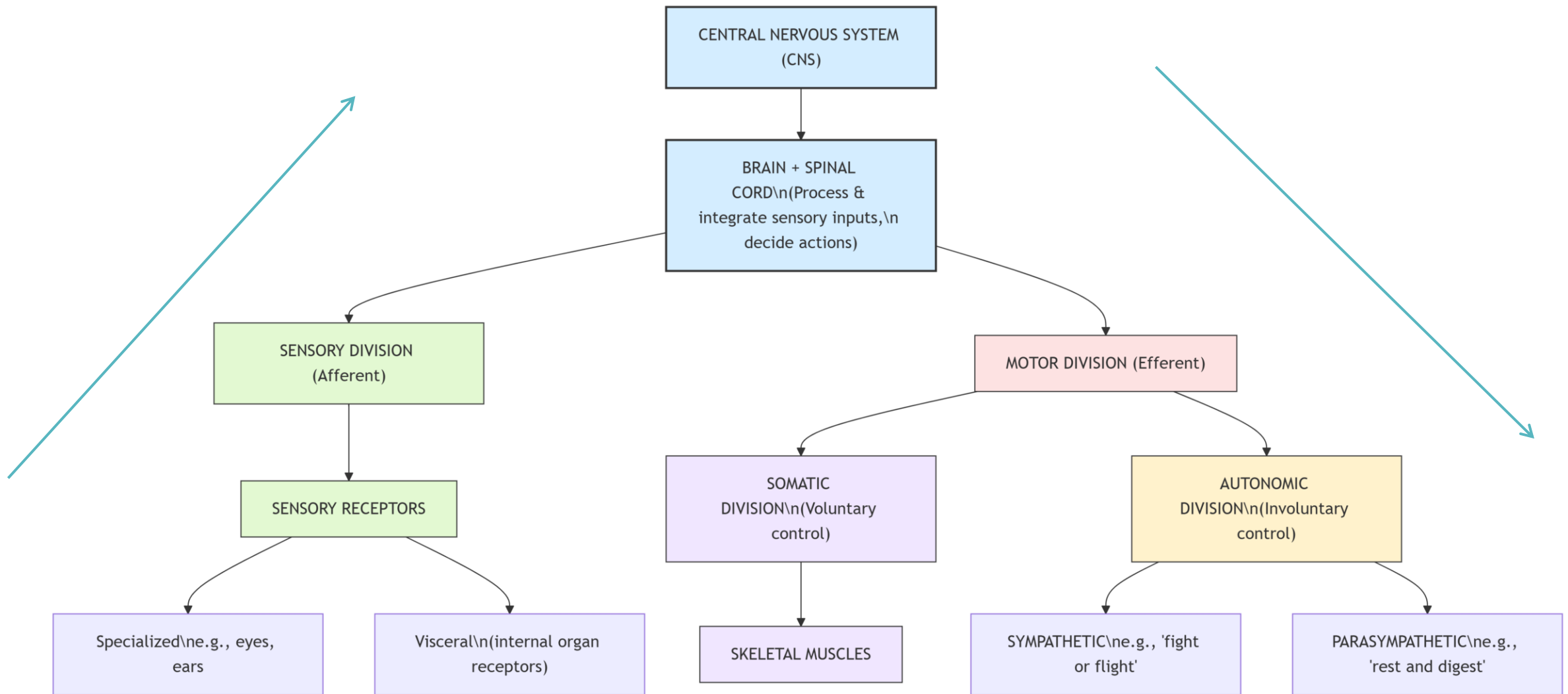
NERVOUS SYSTEM

- The nervous system serves as the body's **main communication and regulatory (control) network**, coordinating functions and responses
- **Major Divisions:**
 1. **Central Nervous System (CNS)**
 - Brain
 - Spinal Cord
 2. **Peripheral Nervous System (PNS)**
 - Peripheral Nerves

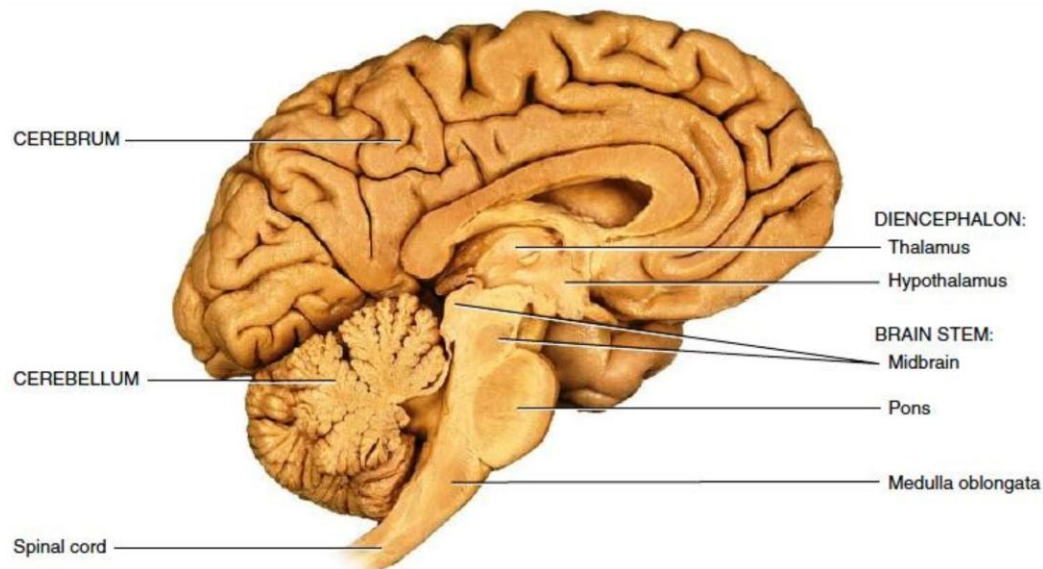


Clinical Relevance: Understanding drug targets (e.g., neuropharmacology).





CENTRAL NERVOUS SYSTEM

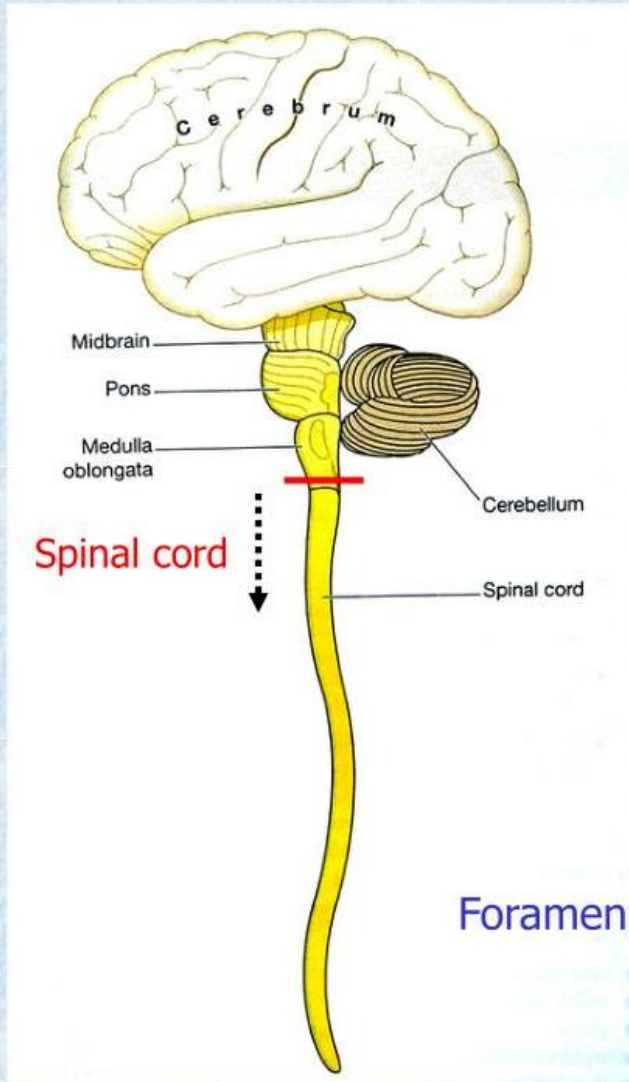


- The brain is the **central nervous system (CNS) organ** housed within the **cranial cavity**. It is continuous with the **spinal cord** via the **foramen magnum**

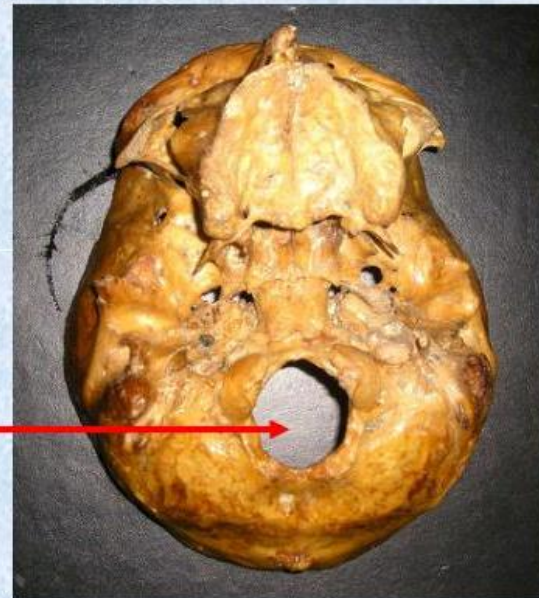
Major Divisions:

- **Cerebrum** - Composed of **two cerebral hemispheres** (left & right)
- **Cerebellum**
- **Brainstem** (Connects brain to spinal cord)
 1. **Midbrain**
 2. **Pons**
 3. **Medulla Oblongata** (Directly continuous with the **spinal cord**)

Brain and the spinal cord



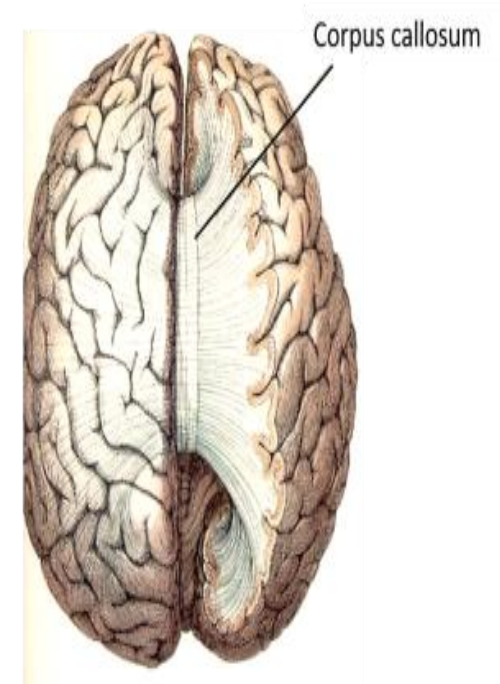
Foramen magnum

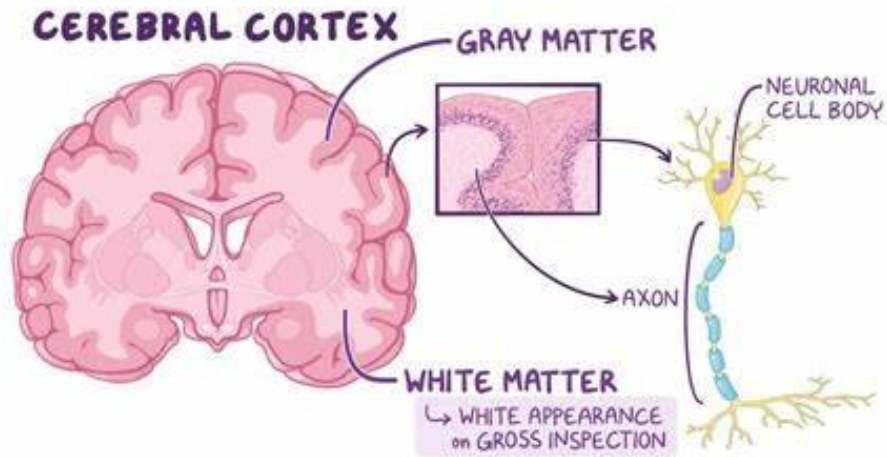


FORAMEN MAGNUM

CEREBRUM

- **Largest brain structure**, making up most of the brain's mass. Located in the **superior part of the brain**
- Composed of **two hemispheres (left & right)**, separated by the **longitudinal cerebral fissure**
- Each hemisphere controls the **opposite side of the body** (contralateral function)
- The two halves of the brain communicate through the **corpus callosum** (a thick bundle of white matter nerve fibers)
- **Function:**
 - Responsible for **higher cognitive functions** (Reasoning, memory, sensory processing, voluntary movement)





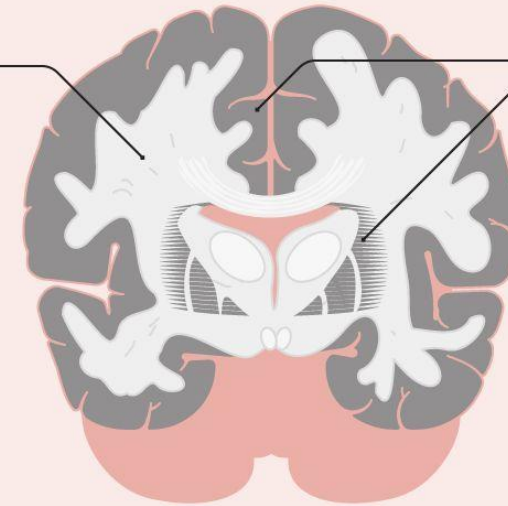
What Are Gray Matter and White Matter of the brain?

White Matter

Mostly heavily myelinated axons

Connects brain regions to help with learning, attention, and motor control

Peaks in middle age



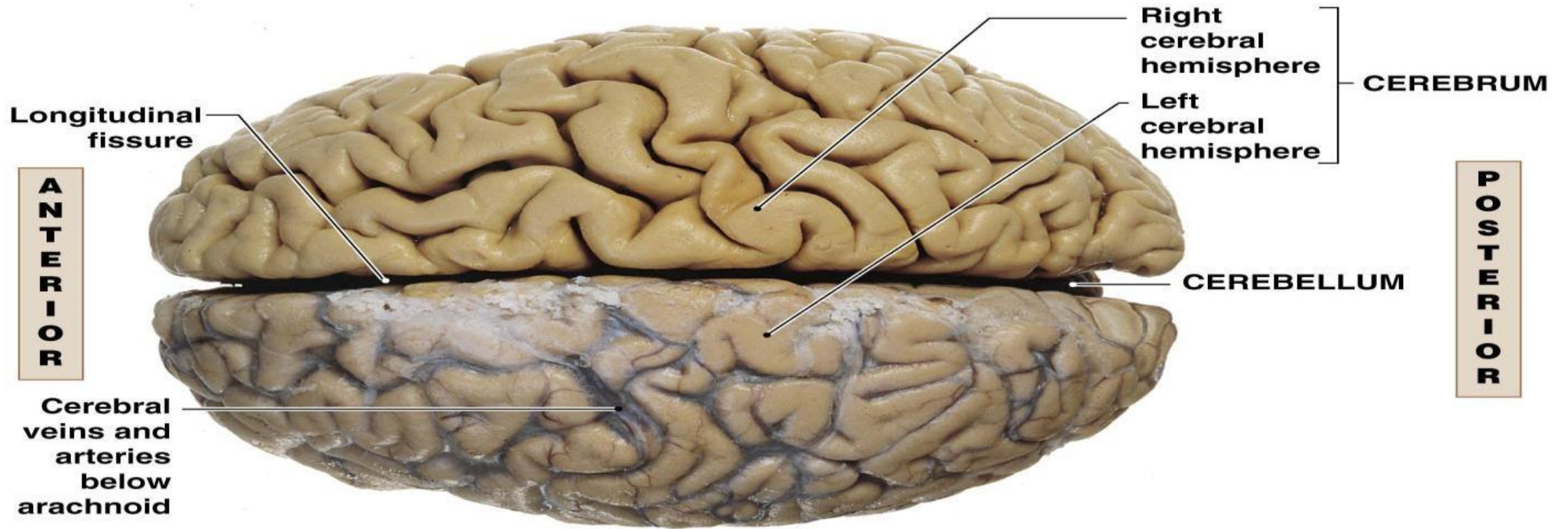
Gray Matter

Mostly neuronal cell bodies

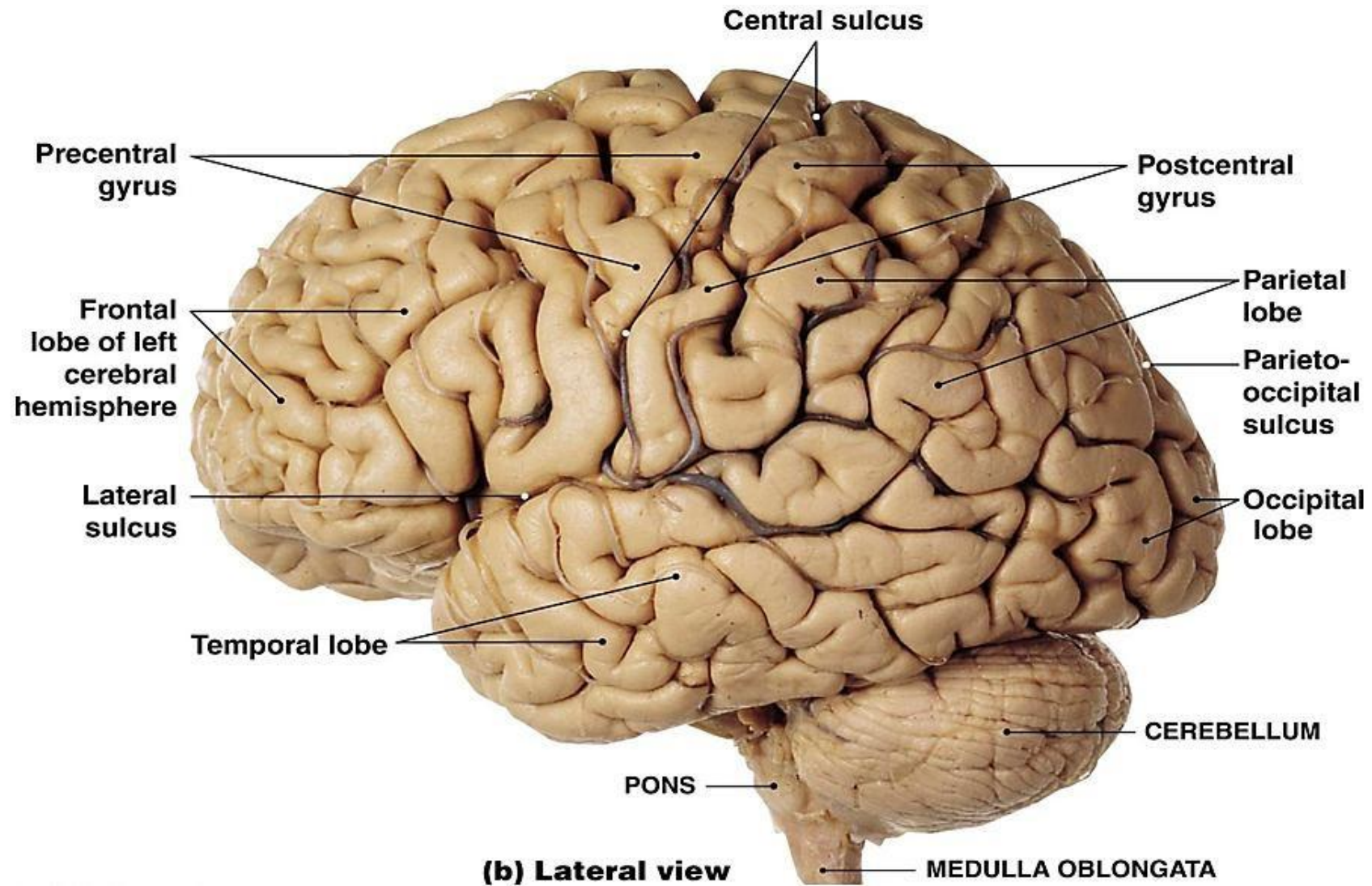
Processes and transmits information; controls movement, memory, and emotion

Fully develops in your 20s

healthline



(a) Superior view



CEREBRUM

CEREBELLUM

Spinal cord

DIENCEPHALON:

Thalamus

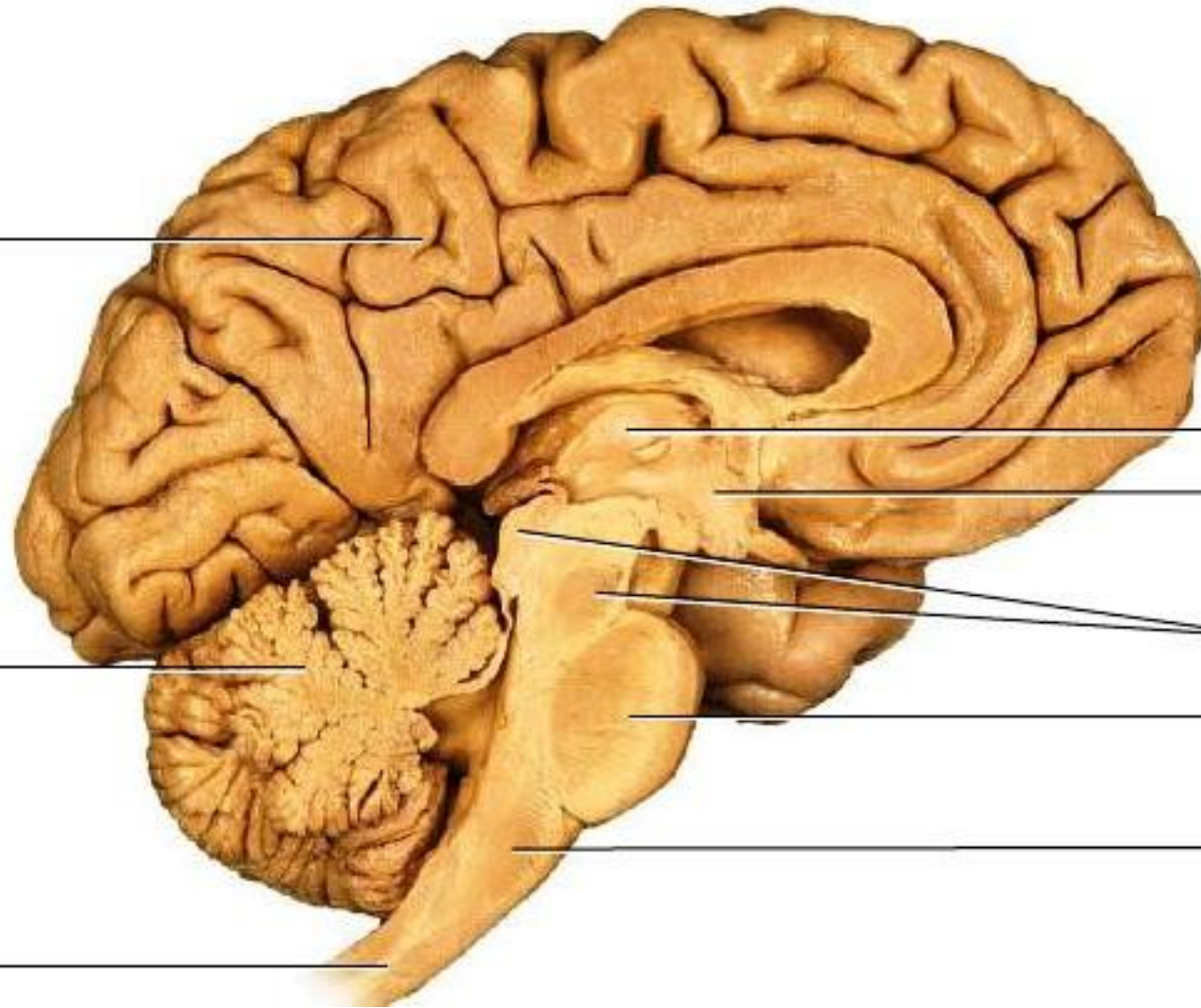
Hypothalamus

BRAIN STEM:

Midbrain

Pons

Medulla oblongata

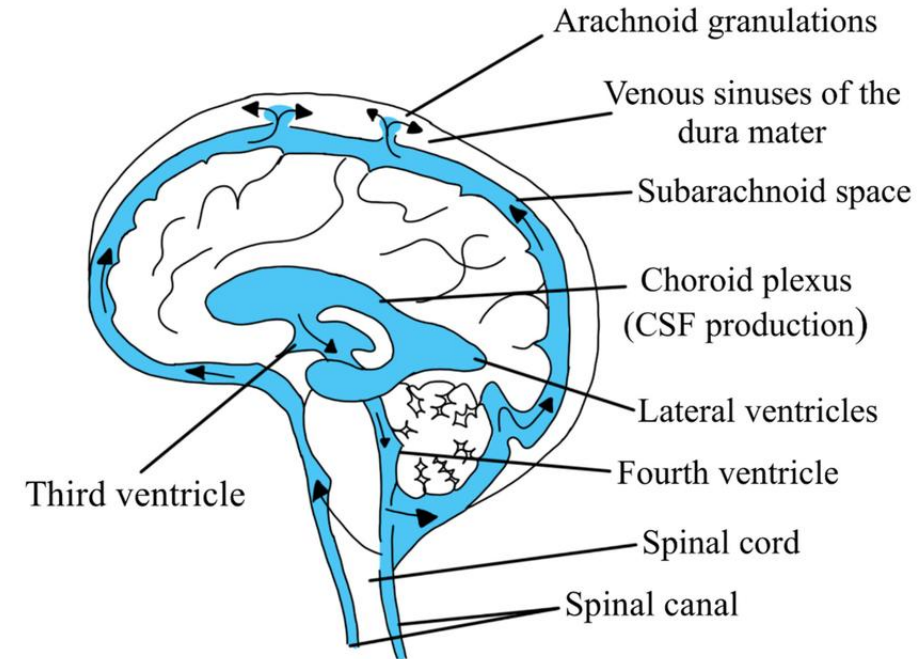


CEREBROSPINAL FLUID (CSF)

- **A clear, colorless bodily fluid** that forms a **protective liquid barrier** within the CNS
- **Production Site:** Choroid plexus (ventricles of the brain)
- **Total Volume:** ~150 mL in adults
- **Composition:** Plasma-like (but with selective permeability)

Key Functions:

- **Protective Cushioning** : Absorbs impact, **preventing brain damage** from sudden movements
- **Pressure Regulation** : Maintains **stable intracranial pressure**
- **Metabolic Support** : Facilitates **limited nutrient/waste exchange** with neurons



SPINAL CORD

- Cylinder of nervous tissue that arises from the brainstem, extending downward through the vertebral canal
- Ends at inferior margin of **L1/L2** (conus medullaris)
- **Size:** ~45 cm long, ~1.8 cm thick (occupies upper $\frac{2}{3}$ of **vertebral canal**)

The spinal cords exhibit longitudinal grooves:

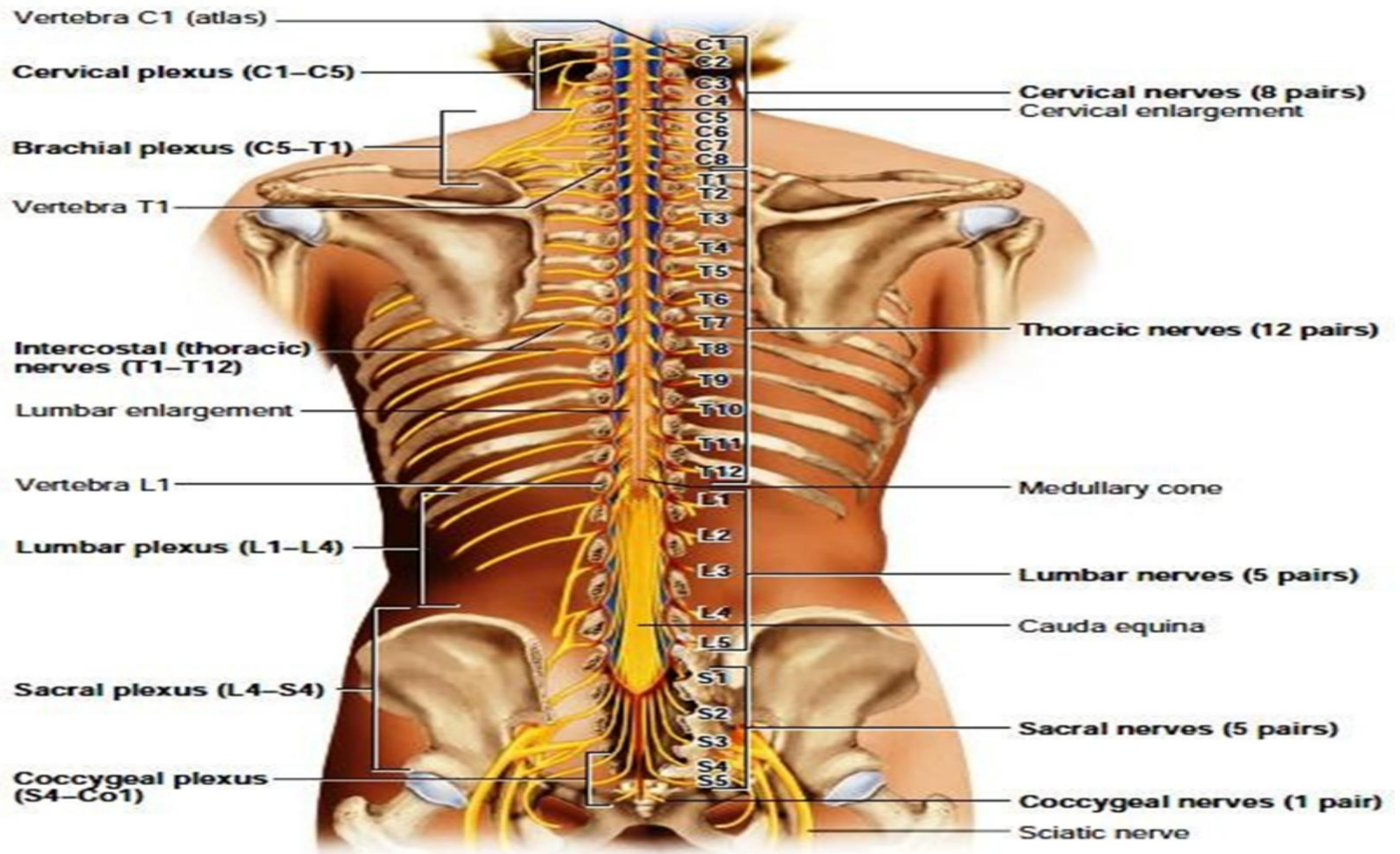
- **Anterior median fissure** (deep) & **Posterior median sulcus** (shallow)

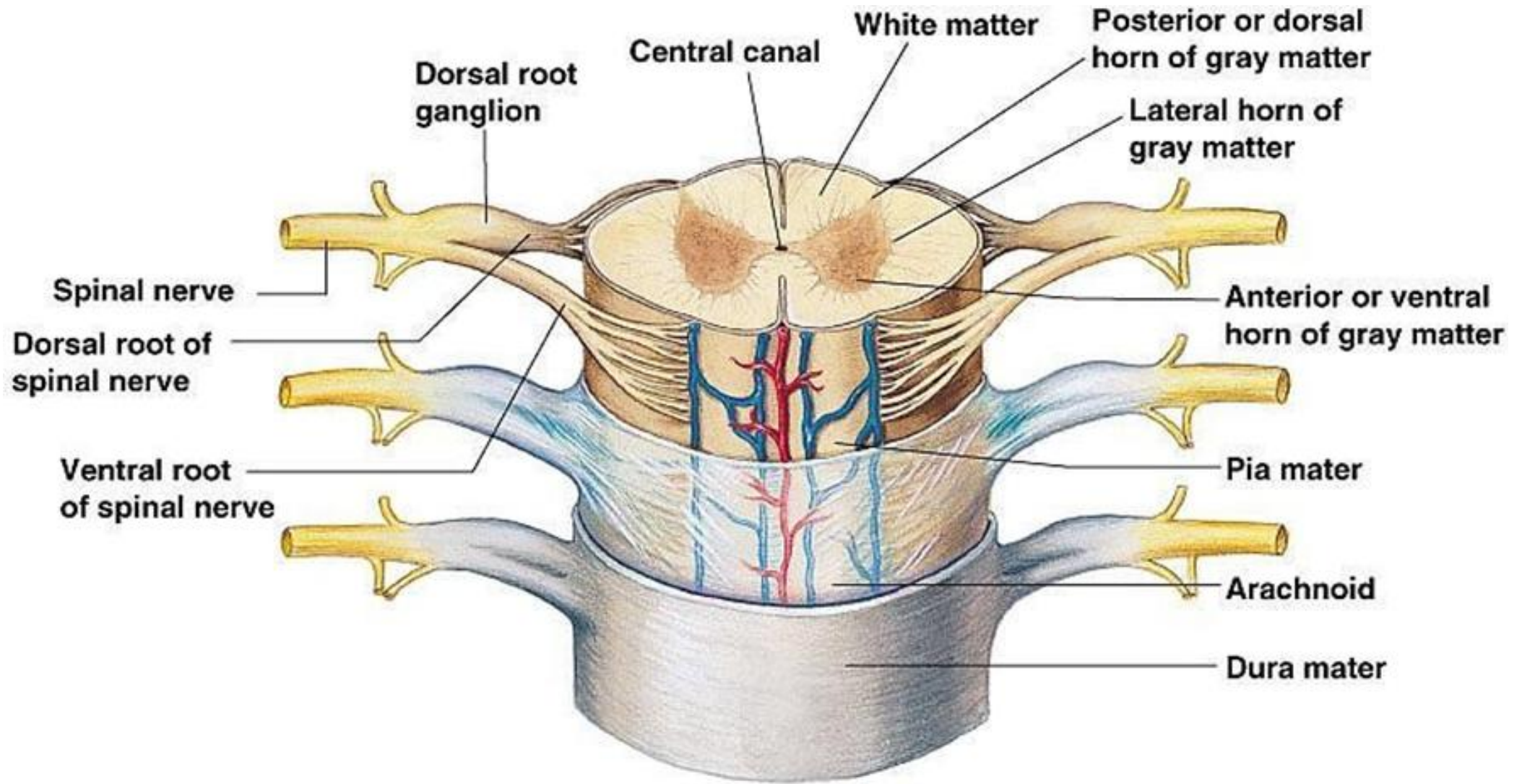
The cord widens at two points:

1. **Cervical enlargement** → Nerves to **upper limbs**
2. **Lumbar enlargement** (lumbosacral region) → Nerves to **pelvis/lower limbs**

Spinal Nerves & Segmentation:

- **31 pairs** of spinal nerves (segmented into cervical, thoracic, lumbar, sacral regions)
- **Cauda equina** (horse's tail):
 - Bundle of nerve roots (L2–S5) below the spinal cord
 - Innervates **pelvic organs/lower limbs**



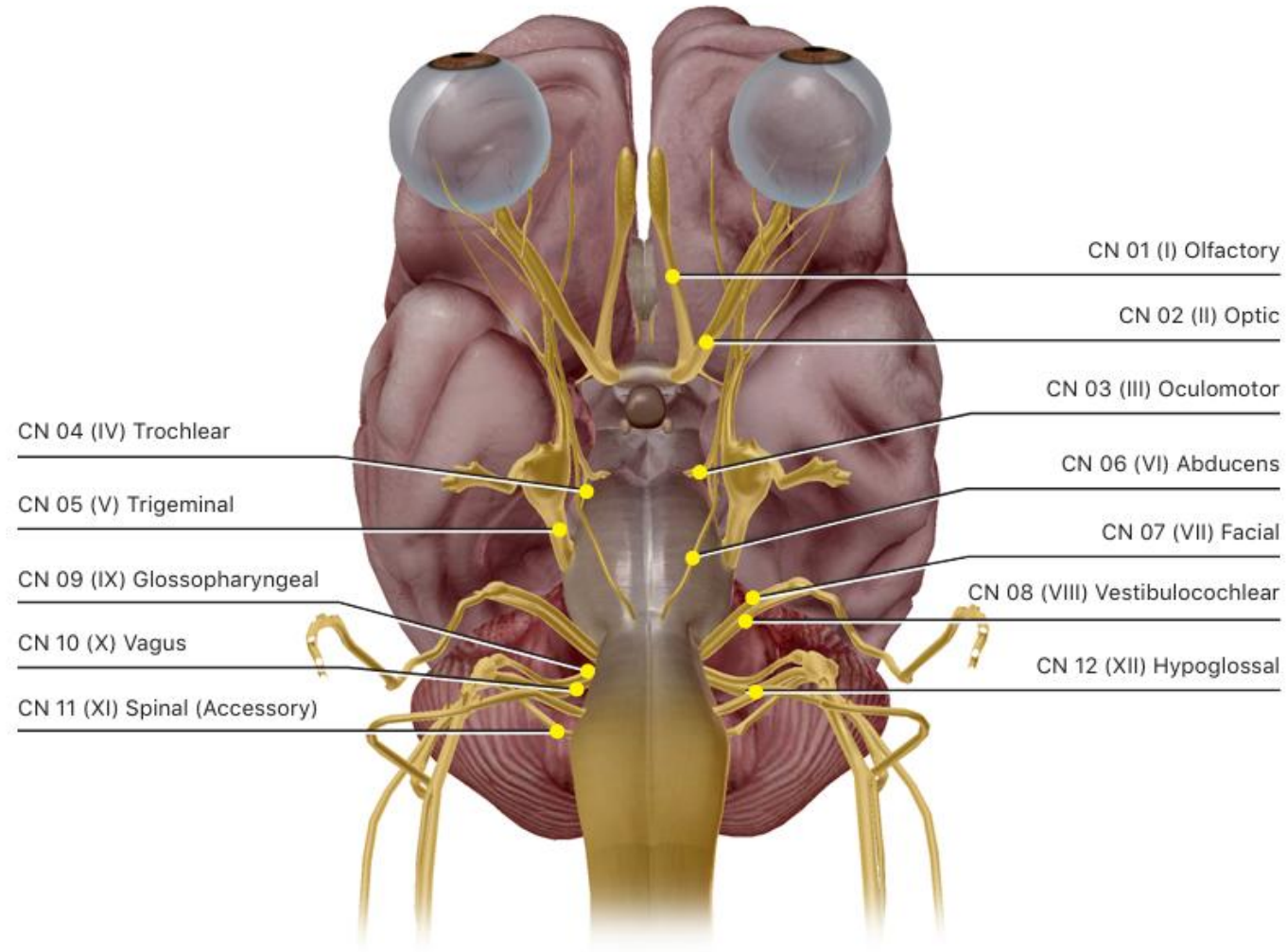


SPINAL NERVES

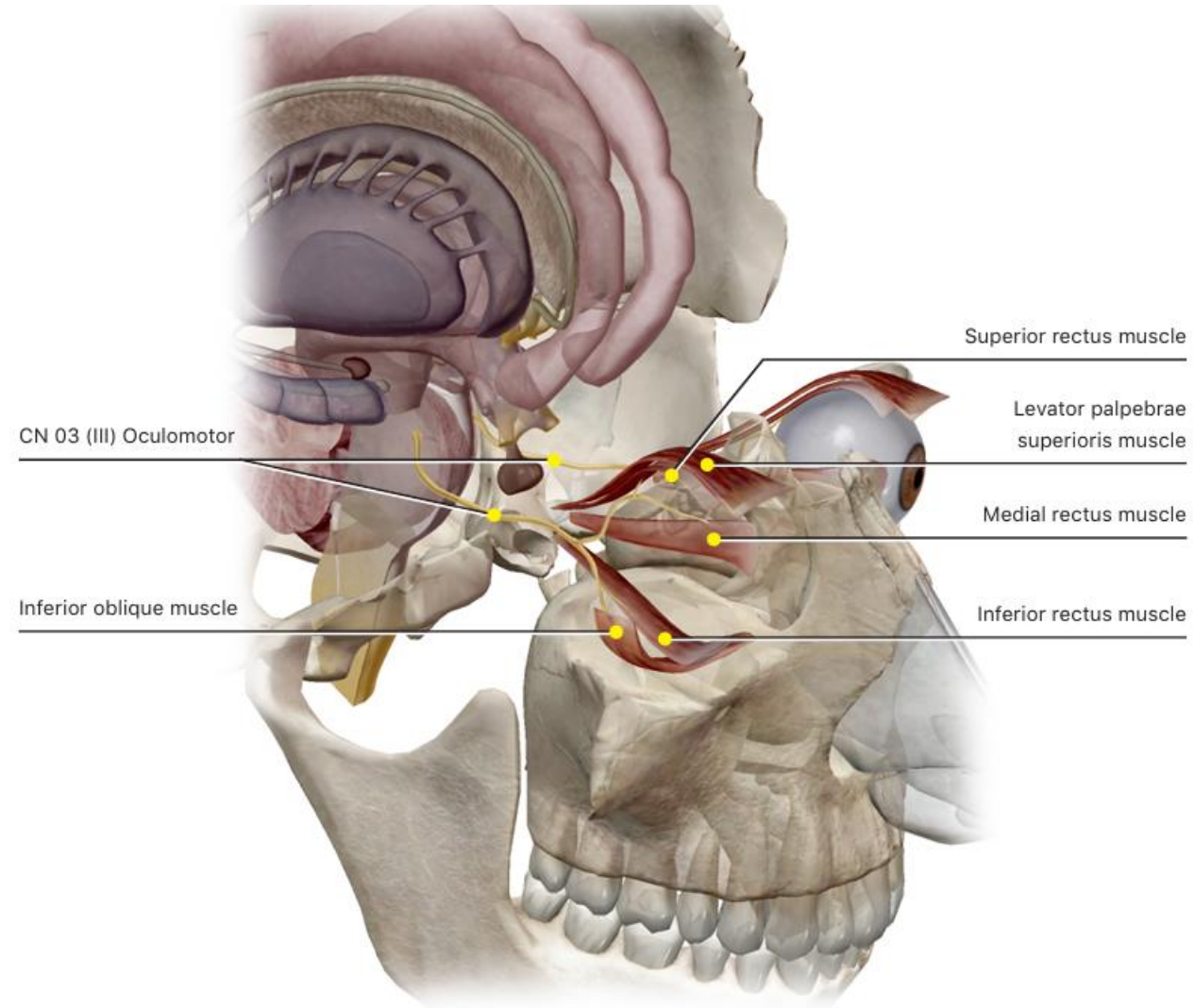
- The human body contains **31 pairs of spinal nerves** that connect to the spinal cord. Each pair is named and numbered according to its corresponding vertebral level

Nerve Distribution by Region:

- **Cervical:** 8 pairs (C1-C8)
- **Thoracic:** 12 pairs (T1-T12)
- **Lumbar:** 5 pairs (L1-L5)
- **Sacral:** 5 pairs (S1-S5)
- **Coccygeal:** 1 pair (Co1)



CRANIAL NERVES



PERIPHERAL NERVOUS SYSTEM (PNS)

- PNS can be divided into 2 subcategories:

1. Afferent (Sensory) Pathway

- Transmits sensory input *from* skin/organs → spinal cord → brain
- Includes receptors for touch, pain, temperature, and proprioception

2. Efferent (Motor) Pathway

- Carries motor commands *from* CNS → muscles/glands
- Divided into:
 - Somatic (voluntary muscle control)
 - Autonomic (involuntary functions)

■ Mixed Nerves (spinal nerves)

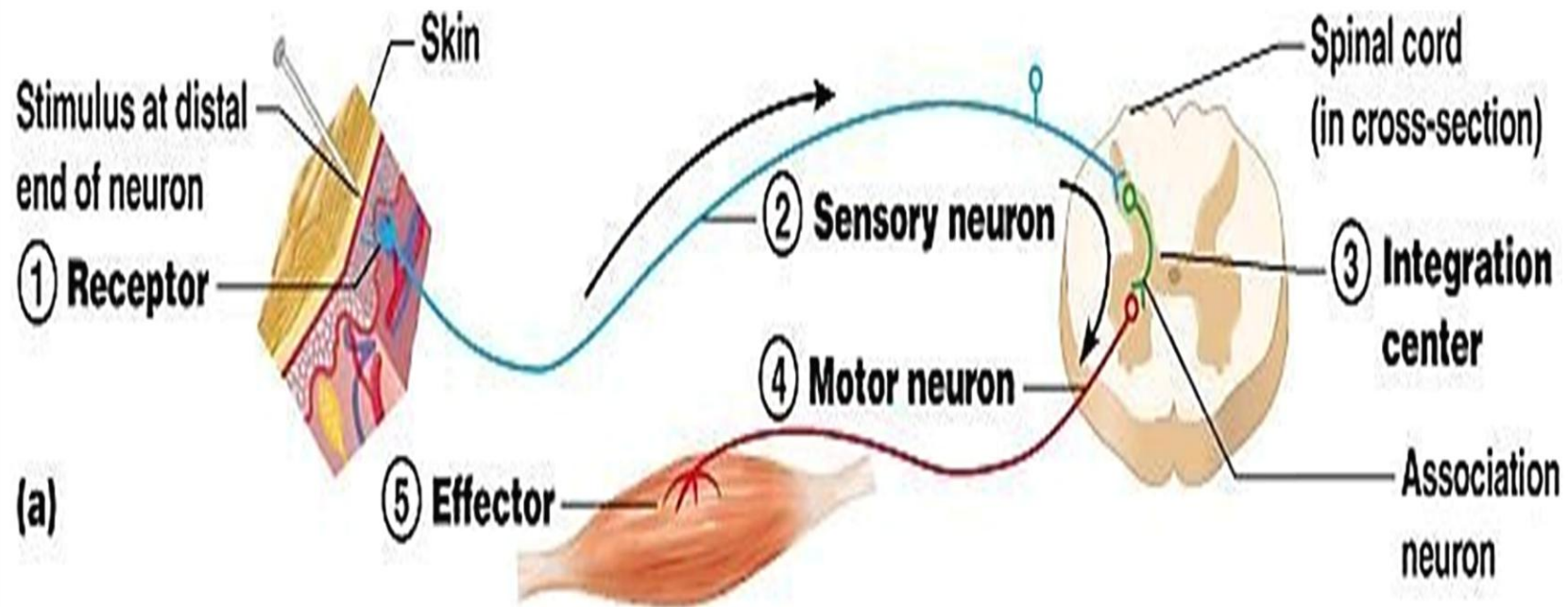
- Contain *both* sensory + motor fibers
- Found specially in spinal nerve of spinal cord

Remember:

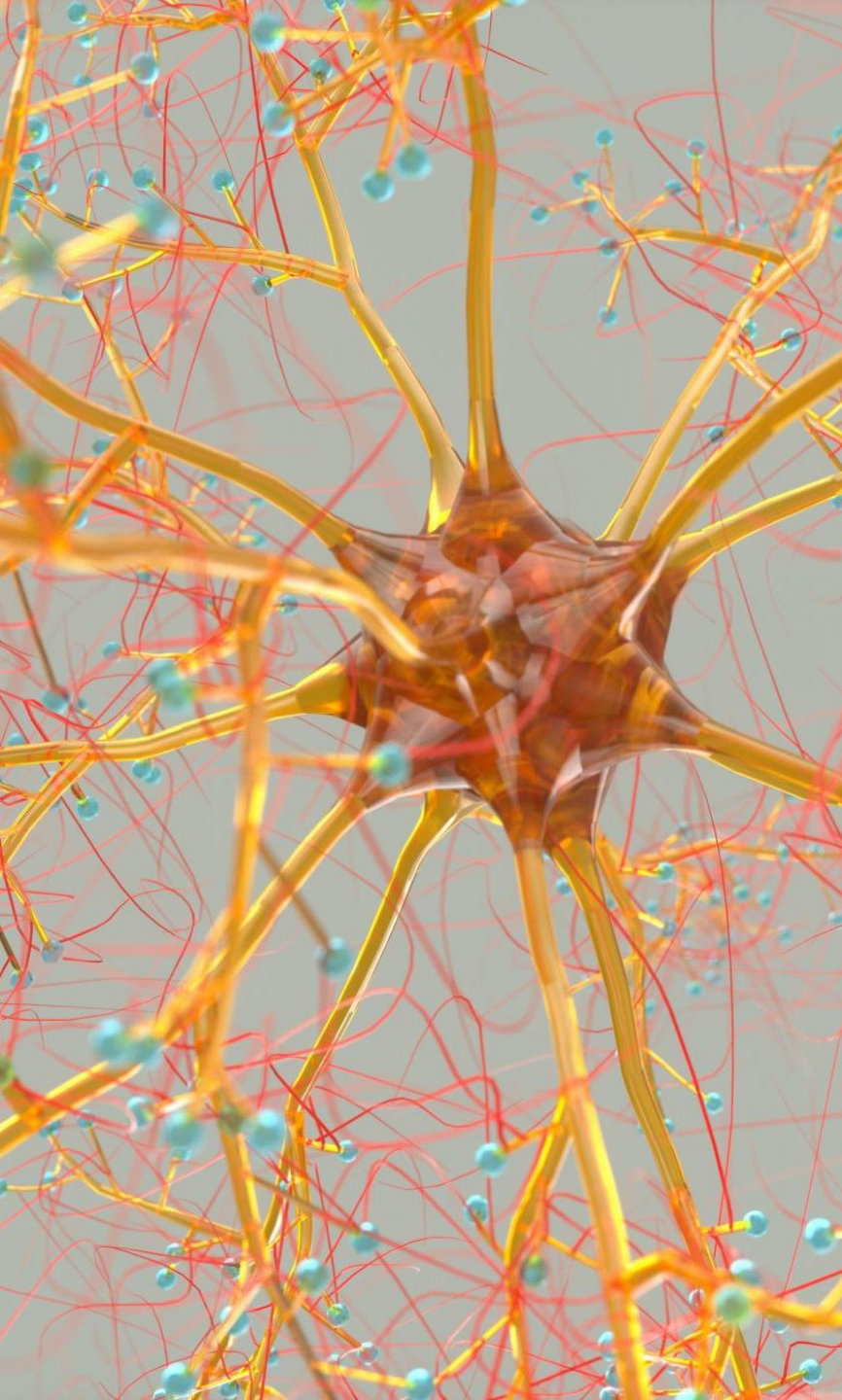
PNS

├── Sensory (Afferent)
└── Motor (Efferent)

├── Somatic
└── Autonomic (Sympathetic/Parasympathetic)



(a)



AUTONOMIC NERVOUS SYSTEM (ANS)

- Major role in maintains **homeostasis** by controlling **involuntary bodily functions**:
 - Heart rate, digestion, respiration, glandular secretion, etc...

Two Complementary Divisions:

1. Sympathetic Nervous System
2. Parasympathetic Nervous System

Shared Characteristics:

- ✓ **Dual innervation**: Most organs receive input from **both** divisions
- ✓ **Two-neuron pathway**:
 - *Preganglionic neuron* (CNS → ganglion)
 - *Postganglionic neuron* (ganglion → target organ)
- ✓ **Automatic operation**: Functions unconsciously

SYMPATHETIC DIVISION

- Originating from the thoracic (T1-T12) and upper lumbar (L1-L2) spinal segments, the sympathetic division is anatomically **termed the thoracolumbar division**
- This system activates during stress responses, rapidly assuming control over visceral organs to prepare the body for "**fight or flight**" situations
 - Increased heart rate, bronchodilation, and blood flow redistribution to optimize performance under threatening conditions

PARASYMPATHETIC NERVOUS SYSTEM

- The parasympathetic division originates from cranial nerves (III, VII, IX, and X) and sacral spinal segments (S2–S4), earning its designation as the **craniosacral division**
- This division dominates during rest, coordinating "**rest and digest**" functions
 - Such as slowing heart rate, stimulating digestion, constricting pupils, and promoting nutrient absorption
- Its effects are often localized and antagonistic to sympathetic responses, maintaining homeostasis through acetylcholine-mediated signaling
- Clinically, parasympathetic pathways are targeted in treatments for conditions like glaucoma (cholinergic agonists) while anticholinergic drugs (e.g., atropine) inhibit its activity to manage overdoses or certain autonomic disorders



THANK YOU

