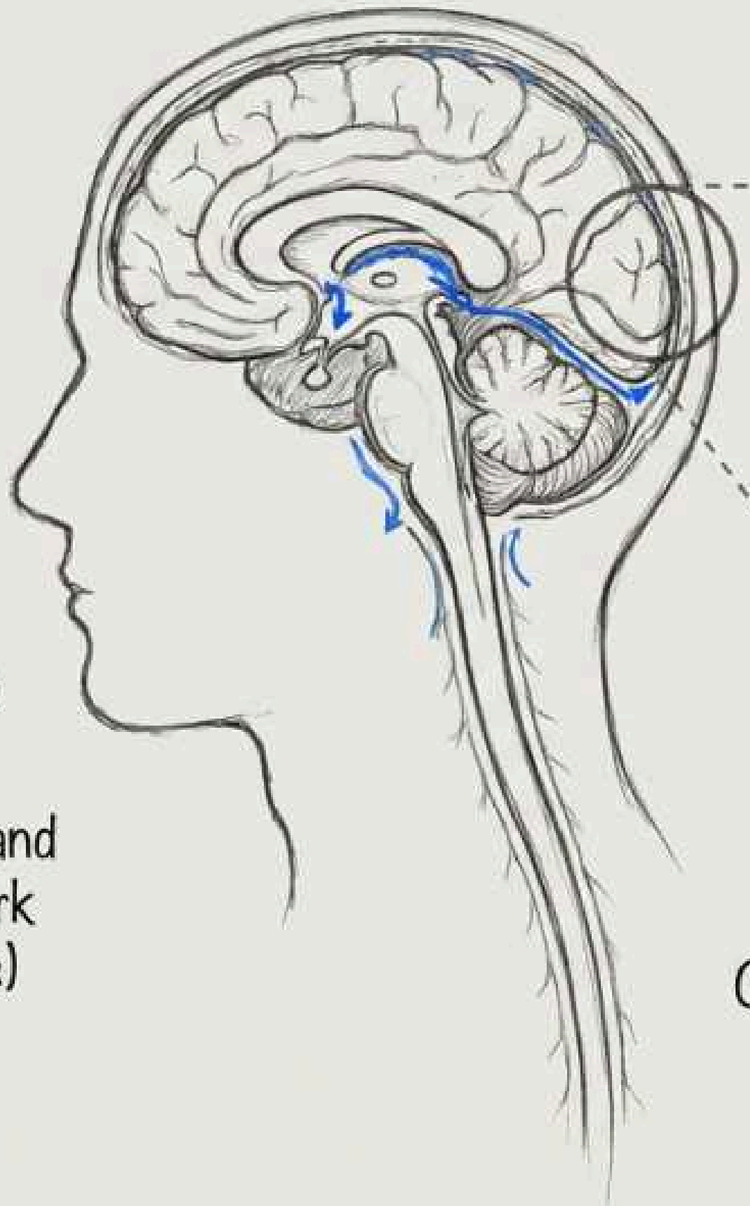
MED 513 B: Maps of the Nervous System (Lecture 3) — Boundaries & Wrappings

Central Nervous System (CNS)

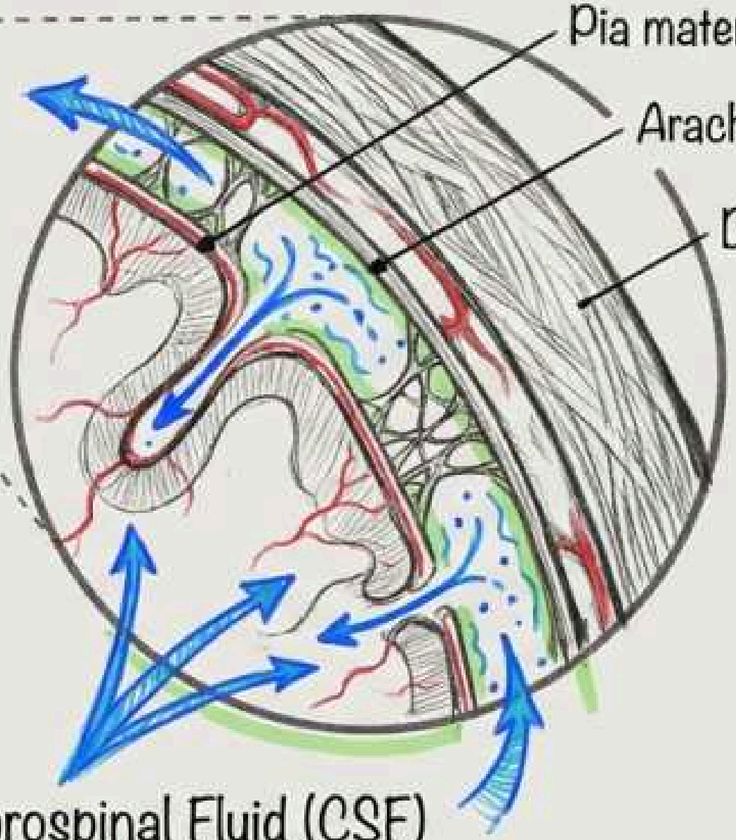
- Brain & Spinal Cord

Peripheral Nervous System (PNS)

- Nerves, Ganglia, and Autonomic network (governing organs)



The Meninges: Three distinct membranes covering the brain and cord.



Cerebrospinal Fluid (CSF)

Supports, protects, and regulates the chemical environment.

The Spinal Cord: Cable & Computer

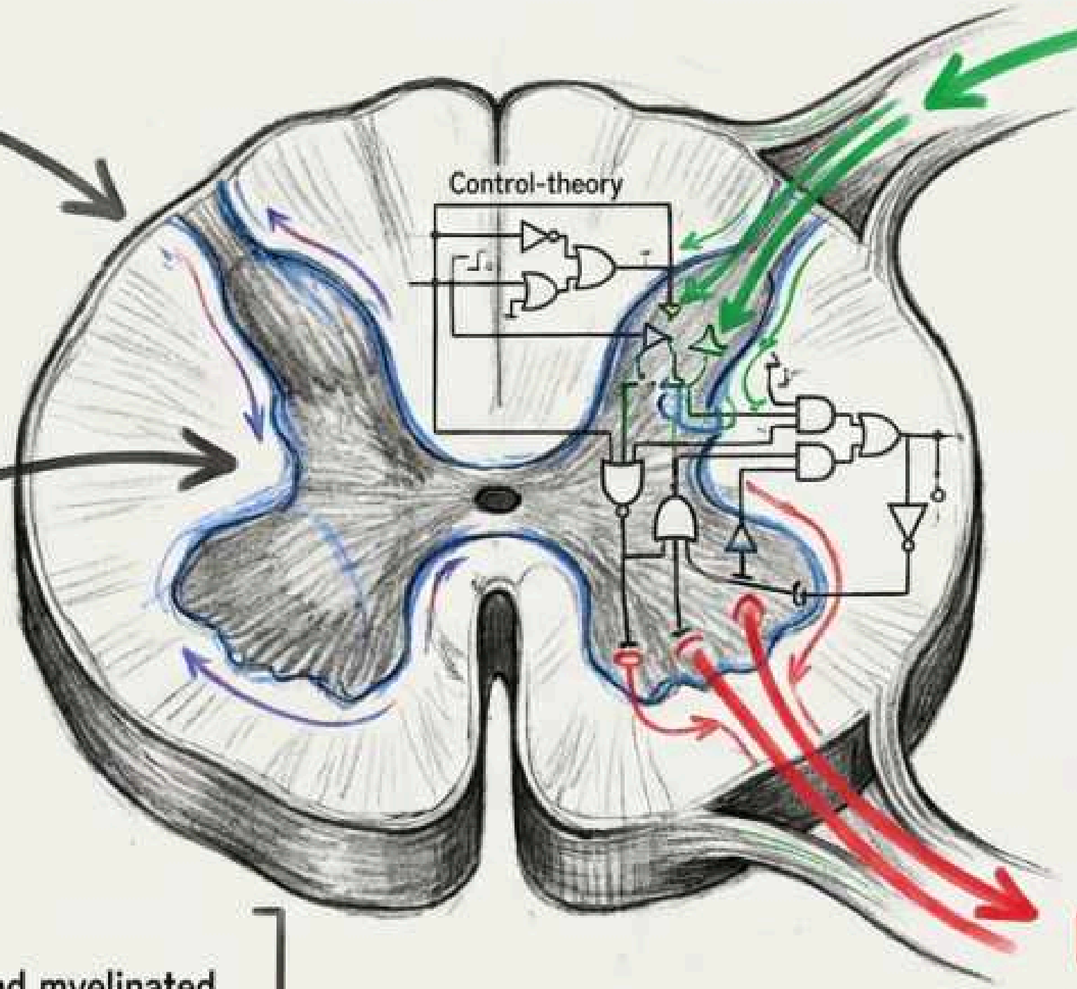
¶ 3.2

White Matter: Outer tracts (the highway)

Myelinated axons transmitting signals over long distances

Grey Matter: Inner butterfly (the local computer / cell bodies)

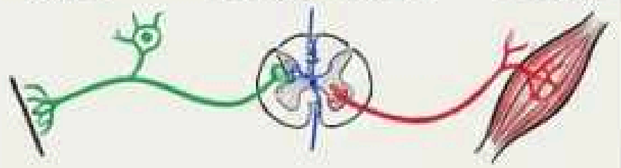
Contains neuronal cell bodies, synapses, and interneurons for processing.



Sensory fibers

Afferent signals (e.g., pain, touch) enter dorsal root

The Reflex Arc



Organizes reflexes without waiting for cortical processing.

Motor fibers

Efferent signals (e.g., muscle movement) exit ventral root.

Clinical / Structural Notes:

- Peripheral nerves are built of axons and myelinated by Schwann cells (targets of common neuropathies).
- The cord is physically segmented, creating a consistent map relating cord levels to body regions.

Brainstem & Cranial Nerves: The Vital Core

¶ 3.3

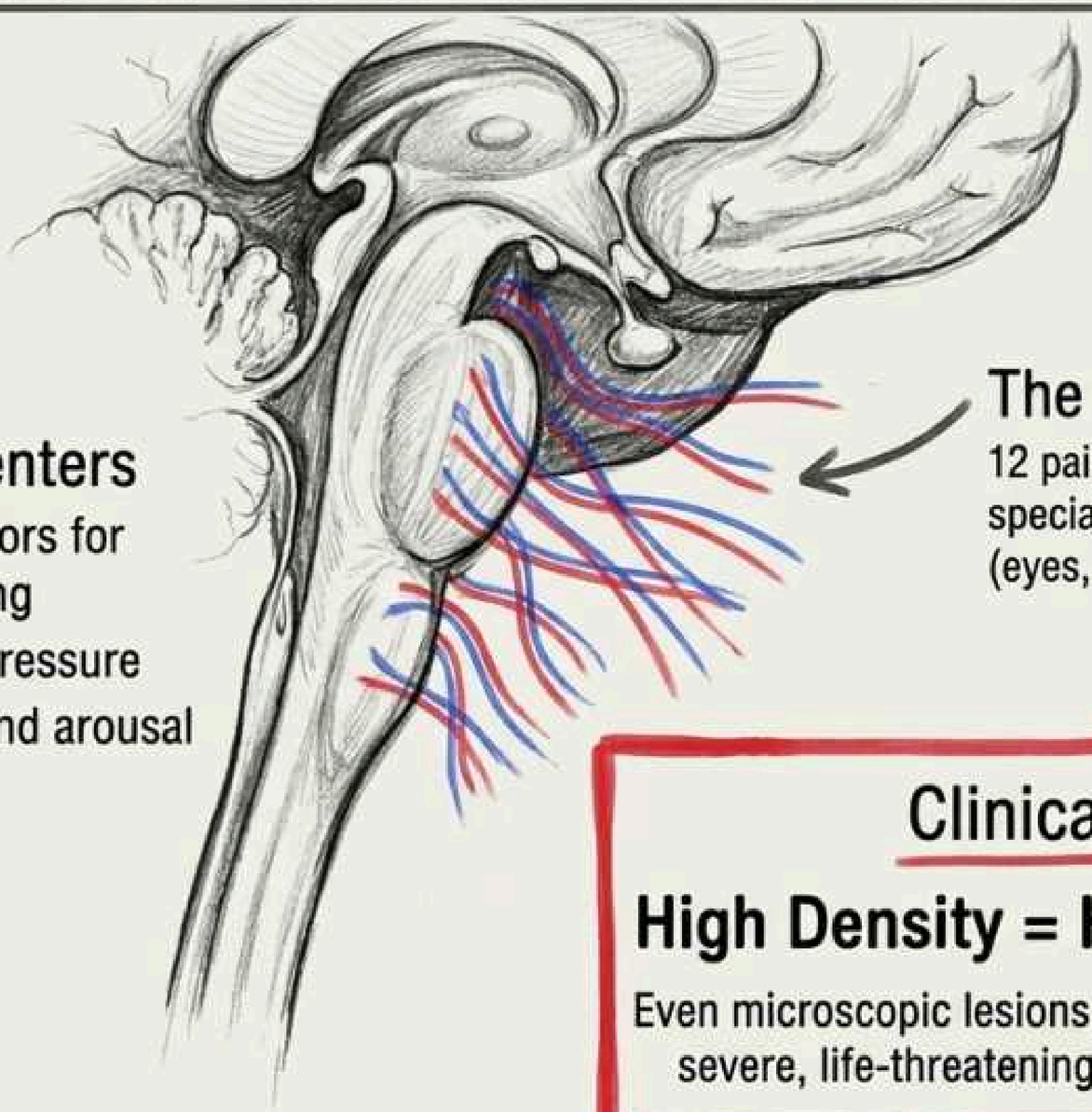
Midbrain

Pons

Medulla

Vital Centers

- Regulators for breathing
- Blood pressure
- Sleep and arousal



The Cranial Nerves:

12 pairs carrying sensation (face, special senses) and motor commands (eyes, face, jaw, throat, neck).

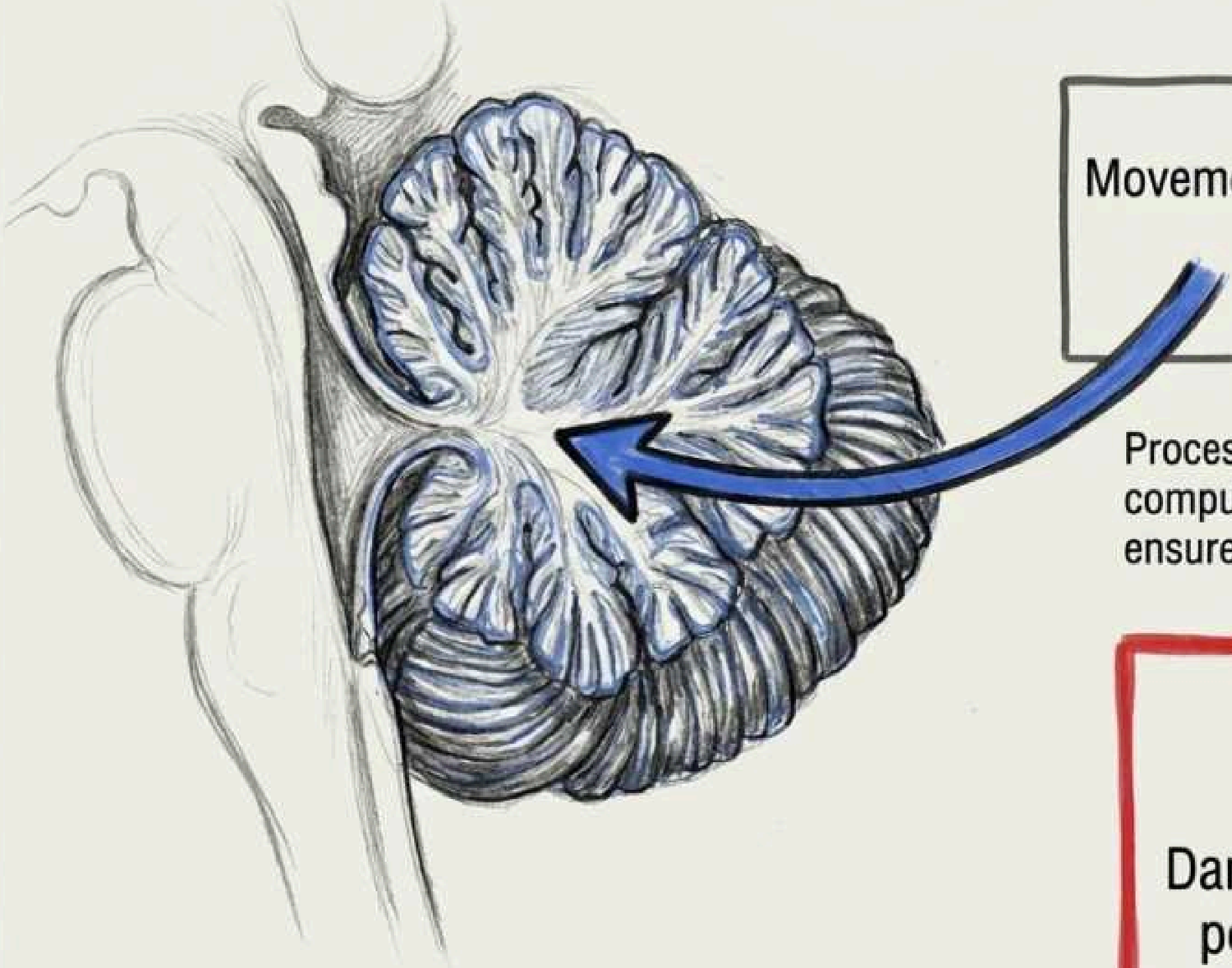
Clinical Axiom

High Density = High Vulnerability

Even microscopic lesions in this compact space have severe, life-threatening systemic consequences.

The Cerebellum: Movement, Timing, and Learning

¶ 3.4



$$\text{Movement}_{\text{intended}} - \text{Movement}_{\text{actual}} = \text{Error } (\Delta)$$

If $\Delta \neq 0 \rightarrow$ Issue Correction

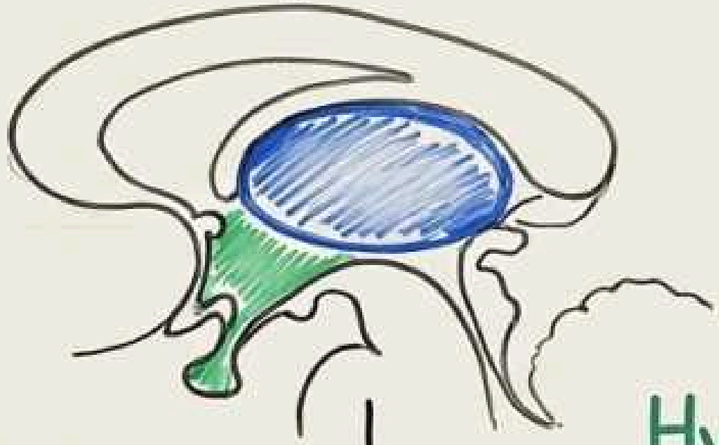
Process Flow: Deep cerebellar nuclei send these computational corrections back to the brain to ensure smooth, accurate, well-timed actions.

Diagnostic Callout

Damage ≠ Weakness.

Damage = Clumsiness, unsteady gait, poor rapid alternating movements.

The Diencephalon Gatekeepers: Thalamus vs. Hypothalamus

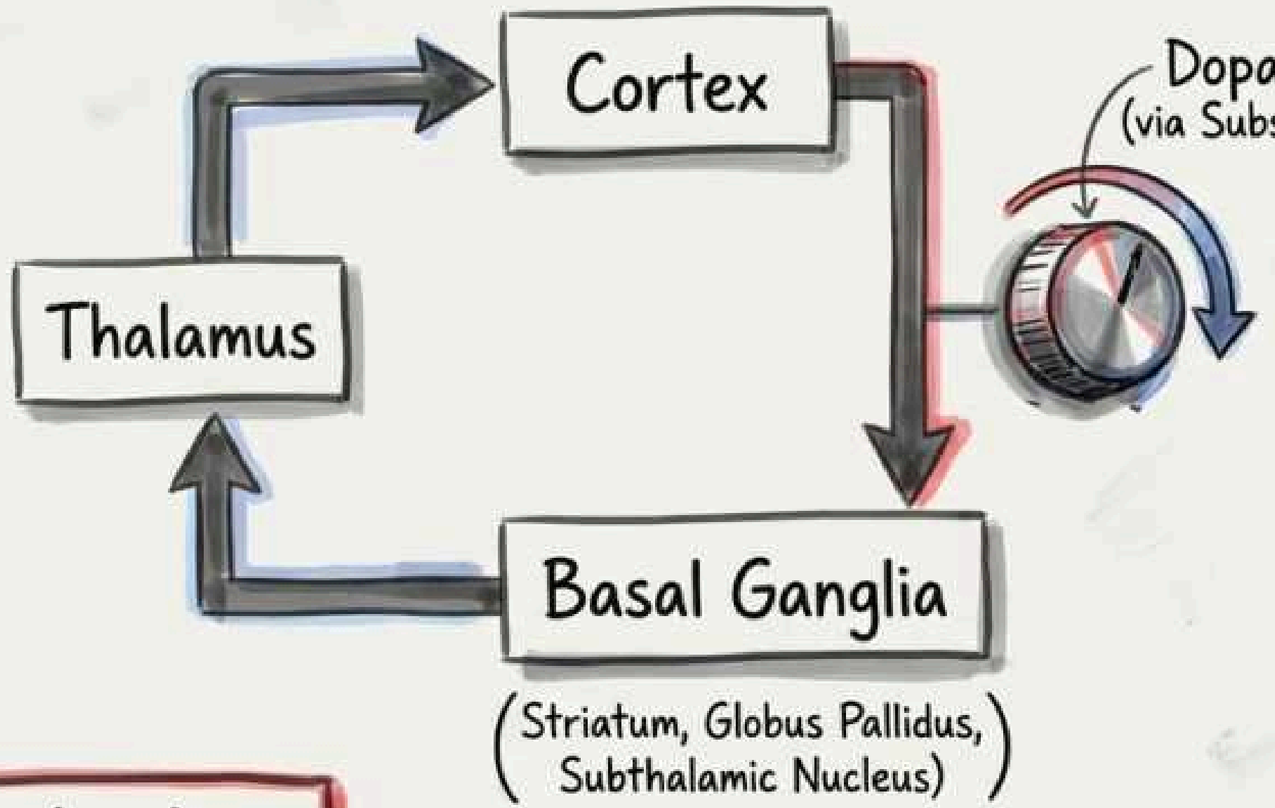


Thalamus	Hypothalamus
Role: Major Relay & Gate.	Role: Internal Organizer.
Function: Routes almost all sensory info (except olfaction) to the cortex.	Function: Maintains internal balance (hunger, thirst, temperature, sleep-wake timing).
Network: Manages essential cortico-subcortical loops.	Network: Controls the pituitary gland, serving as the master switch for the body's hormone/endocrine system.

Synthesis Statement: The space between brainstem and cortex is not an empty corridor—it is an active set of nuclei filtering inputs and keeping the body's internal state within livable bounds.

The Action Selectors: Basal Ganglia & Cortical Loops

¶ 3.6



Dopamine
(via Substantia Nigra in midbrain)

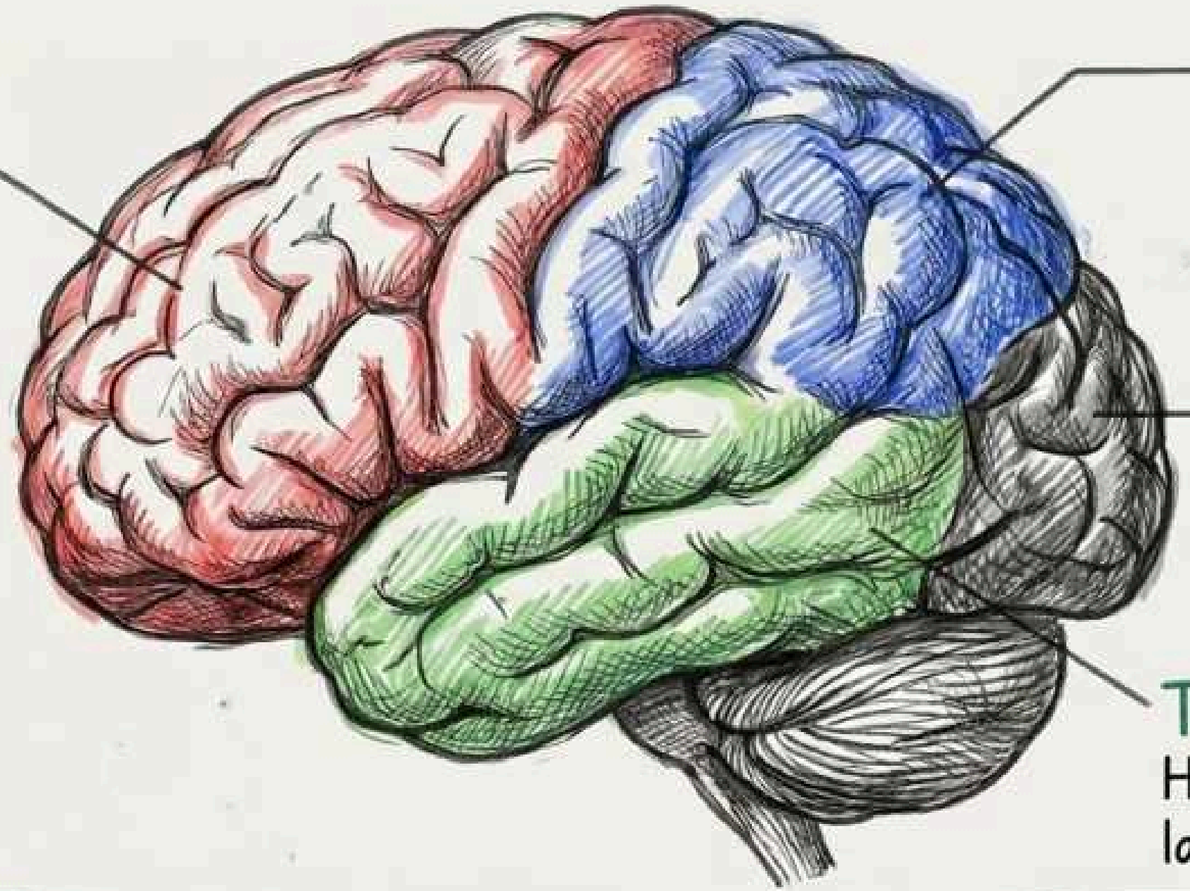
Chemistry of this loop turns the "gain" of movement up or down (Parkinson's disease pathology).

Key Distinction:

The basal ganglia are selectors and initiators of action, habits, and motivation—they are <u>not</u> the final motor pathway to the muscle.

The Cortical Mantle: Hemispheres & Lobes

¶ 3.7



Frontal:
Action, planning, voluntary movement, language production.

Parietal:
Space, attention, sensation.

Occipital:
Vision.

Temporal:
Hearing, aspects of memory, language comprehension.

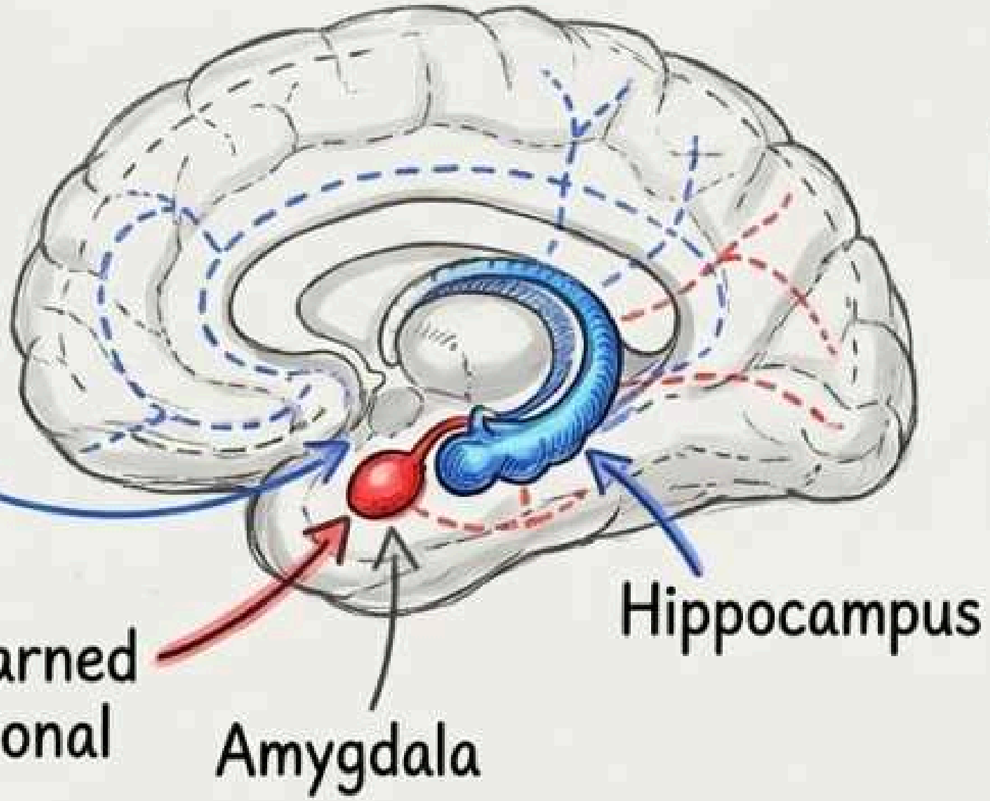
Network Note: These are characteristic emphases, not exclusive territories. Modern neuroscience treats human capacities as distributed across networks, not locked in single boxes.

The Limbic Network: Emotion & Memory

Network Nodes

Hippocampus: Essential for forming new factual and event memories.

Amygdala: Crucial for learned fear and assigning emotional value to stimuli.



Conceptual Shift

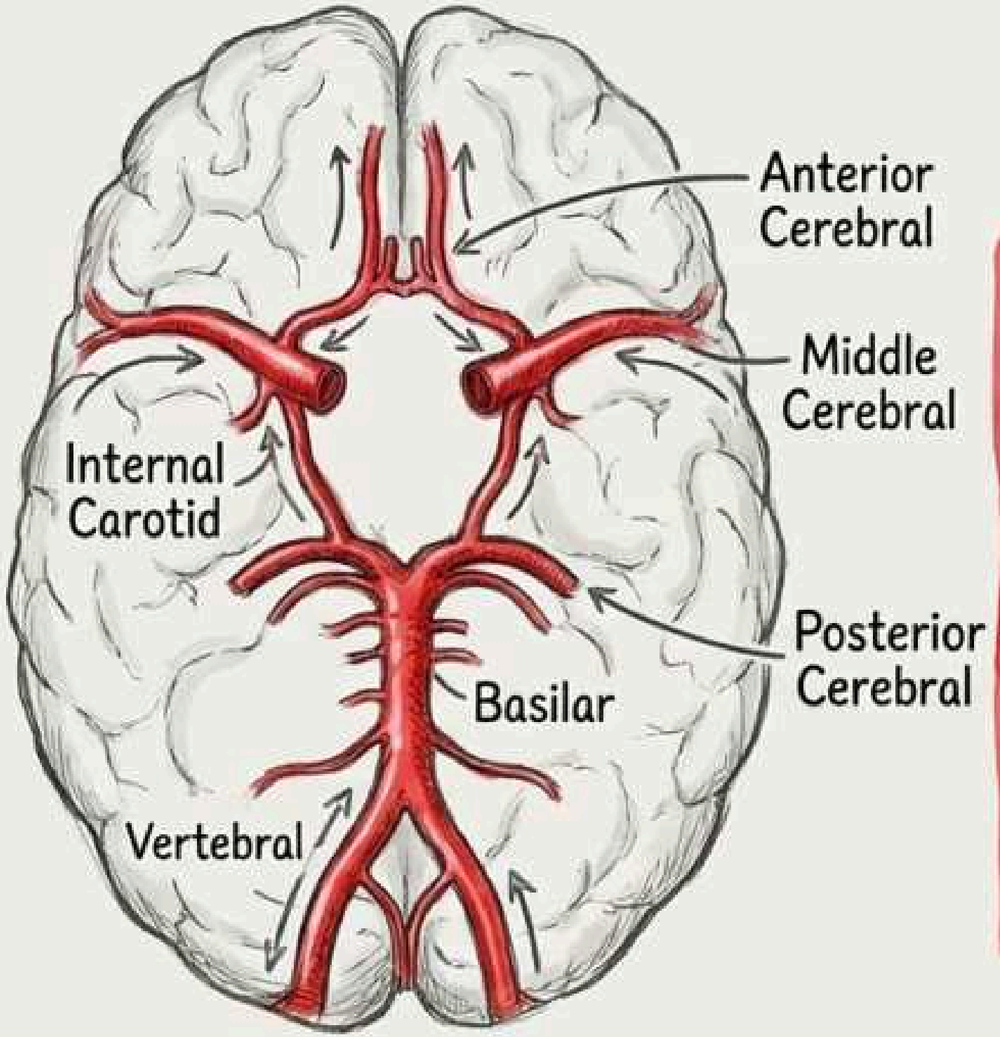
Older Teaching: A tidy, closed circuit constituting the whole organ of emotion.

Contemporary Science: Nodes within wider, distributed networks.

Integration Note: These structures interact constantly with the prefrontal cortex, hypothalamus, and diencephalon chemical systems.

The Vascular Feed & Stroke

¶ 3.9



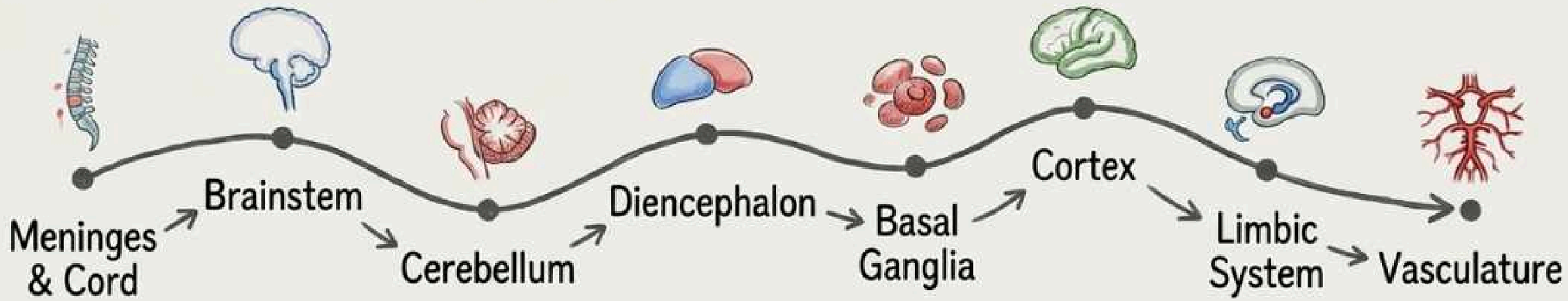
Blocked or Burst Vessel → Tissue Damage = STROKE

- ☐ Sudden weakness (especially unilateral)
- ☐ Sudden trouble speaking or seeing
- ☐ Sudden loss of balance
- ☐ Sudden severe headache

Call emergency services at once.

Note: CT/MRI technologies allow visualization of living structure and activity without opening the skull.

Mapping Complete: Next Steps



Resources:

Grokipedia articles serve as open starting points for all anatomical regions covered (Spinal cord, brainstem, cerebellum, thalamus, hypothalamus, basal ganglia, cortex, limbic system, hippocampus, and stroke).

Looking to Lecture 4:

Transitioning from this structural map to Sensation—the transduction of light, chemicals, touch, sound, and head motion into perception.

Concluding Ethos:

Our aim is a clear structural organization of the system, not a set of procedures for clinical examination or vascular intervention.