The Hierarchy of Movement

¶ 5.1

Brainstem & Motor Cortex

Goal specified, Path chosen

Cerebellum

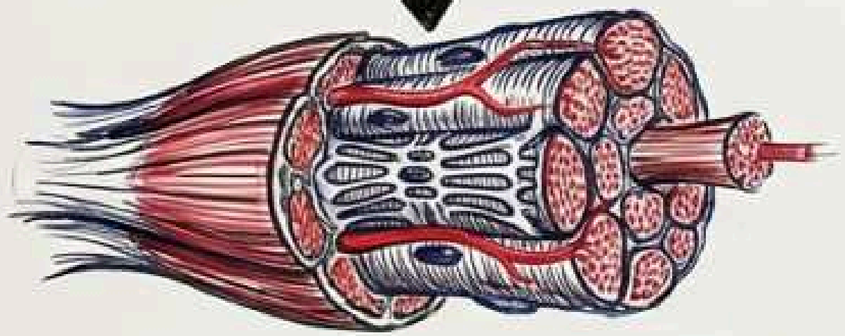
Adjusting coordination, selection, and scale

Basal Ganglia

$$\text{Action} = f(\text{Goal}, \text{Path}, \sum \text{Corrections})$$

Spinal Circuits & Motor Neurons

Final command delivered

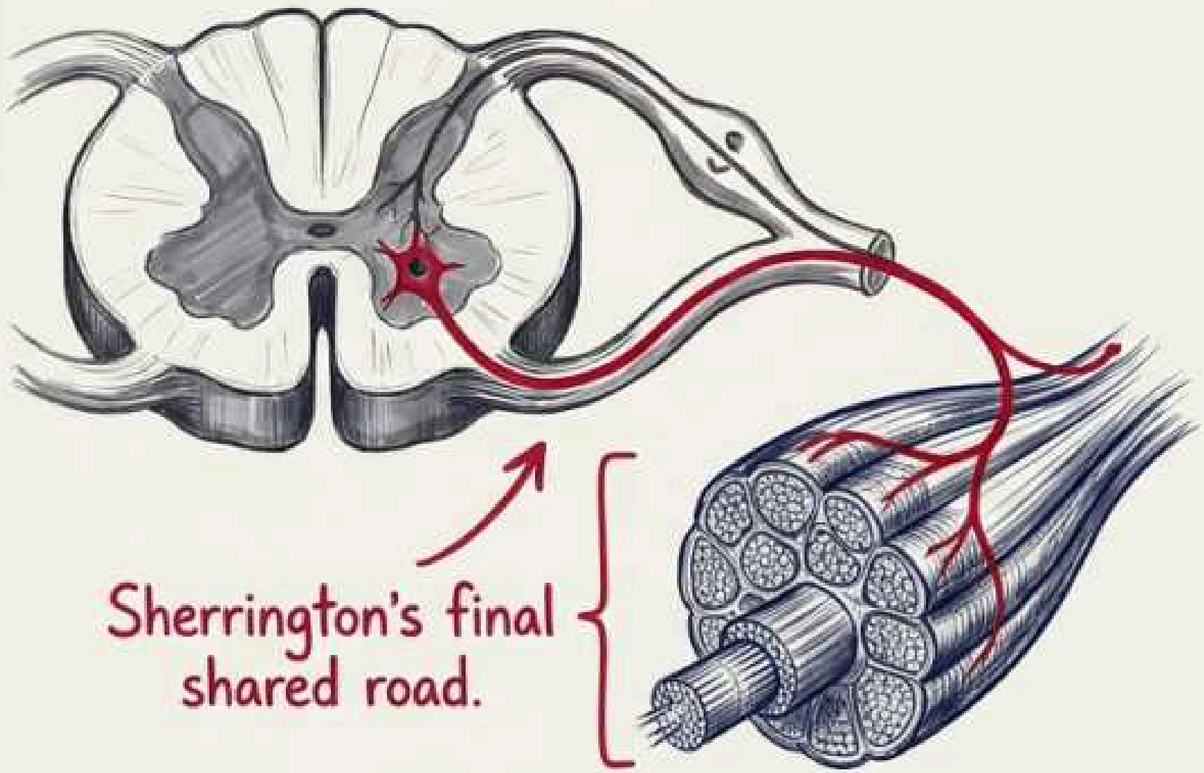


A voluntary reach is a negotiated act. Intention trickles down a highly organized hierarchy, modified at every level before hitting the muscle.

The Final Common Path

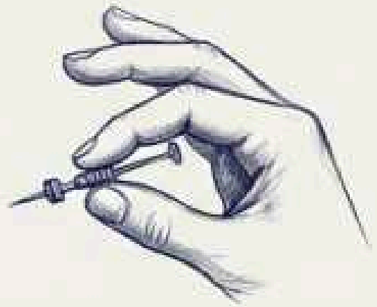
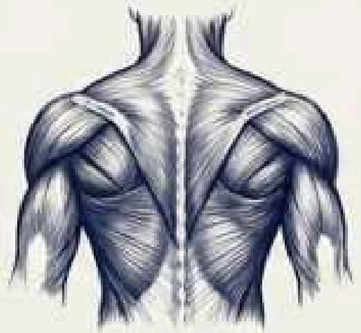
¶ 5.2

Anatomical Pindrop



Sherrington's final shared road.

Motor Units

Fine Motor		**Fine Motor Units:** Small units = Precision.
Gross Motor		**Gross Motor Units:** Large units = Power.

Motor Unit = 1 Motor Neuron + [n × Muscle Fibres]

(where n is small for fine muscles, large for postural)

- Brain speaks to body by addressing motor neurons.

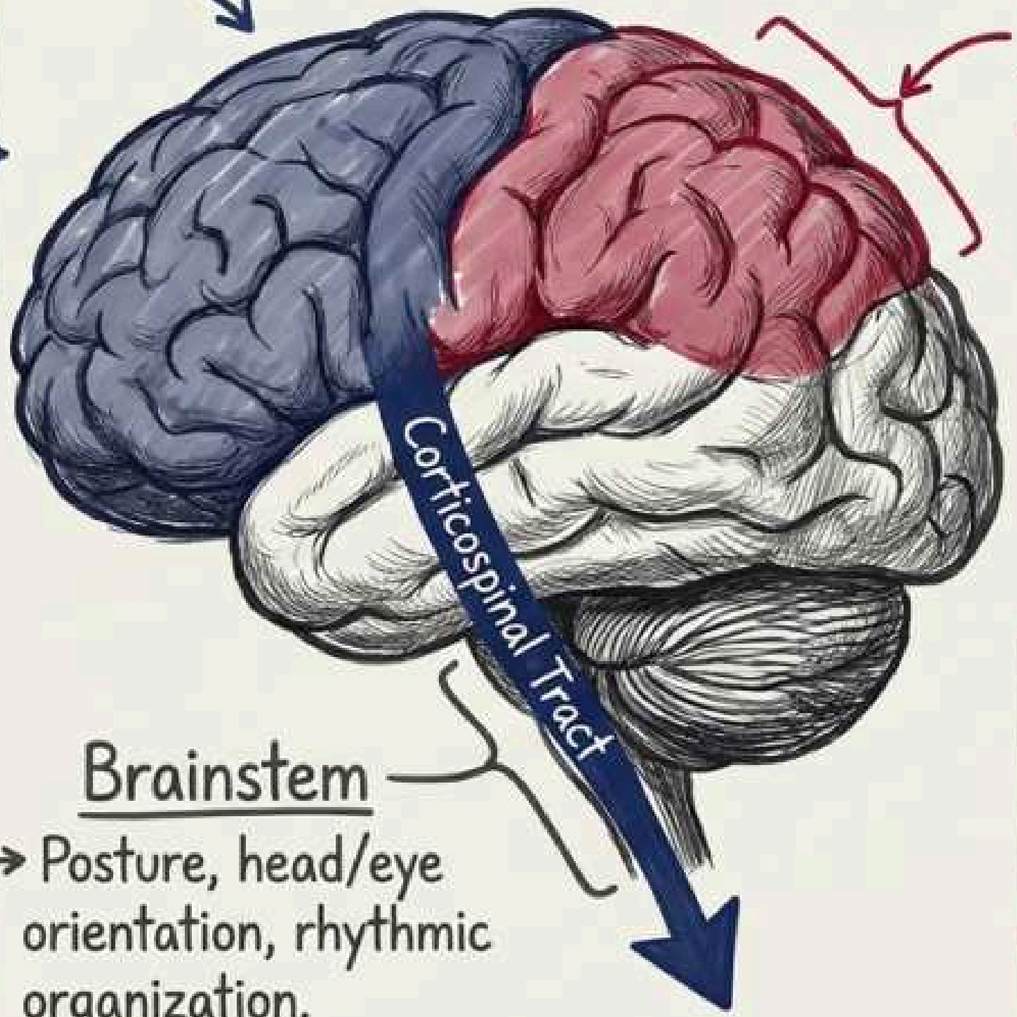
↳ Spinal reflex circuits can act (e.g., stretch, noxious withdrawal) without waiting for cortical input.

Assembling Intention: Cortex & Brainstem

¶ 5.3

Frontal Lobe

Primary motor, premotor, and supplementary areas
→ Execution & preparation of action.



Parietal Cortex

→ Representing spatial theater of action.

> "Intention does not leap from a wish to a muscle; it is assembled."

Brainstem

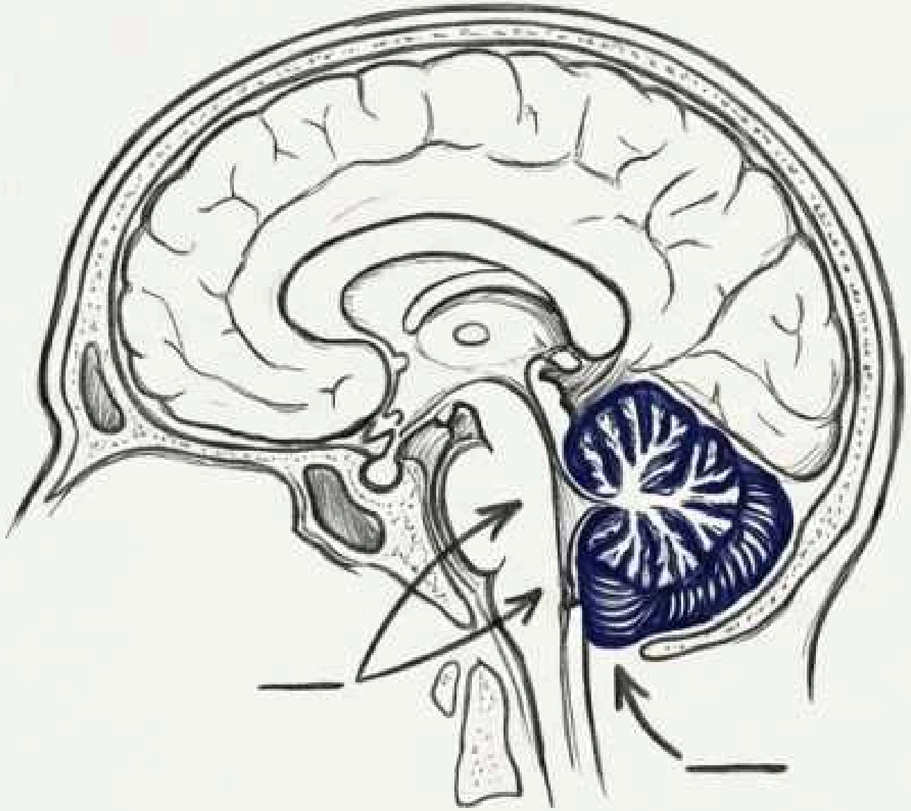
→ Posture, head/eye orientation, rhythmic organization.

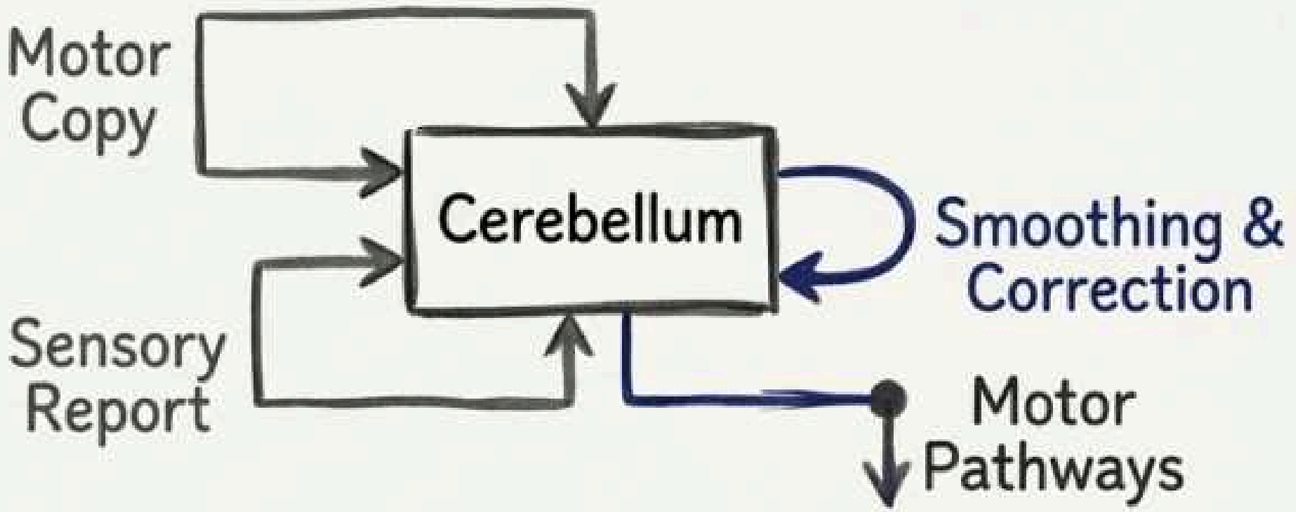
CLINICAL NOTE:

Large injuries to the primary motor path classically produce contralateral (opposite side) weakness.

The Cerebellum: Coach & Comparator

¶ 5.4





ΔE = Target – Actual

Outputs issued to minimize ΔE (preventing overshoot, stabilizing gait).

Function

- Coordinates timing and skilled movement learning (e.g., vestibulo-ocular reflex).

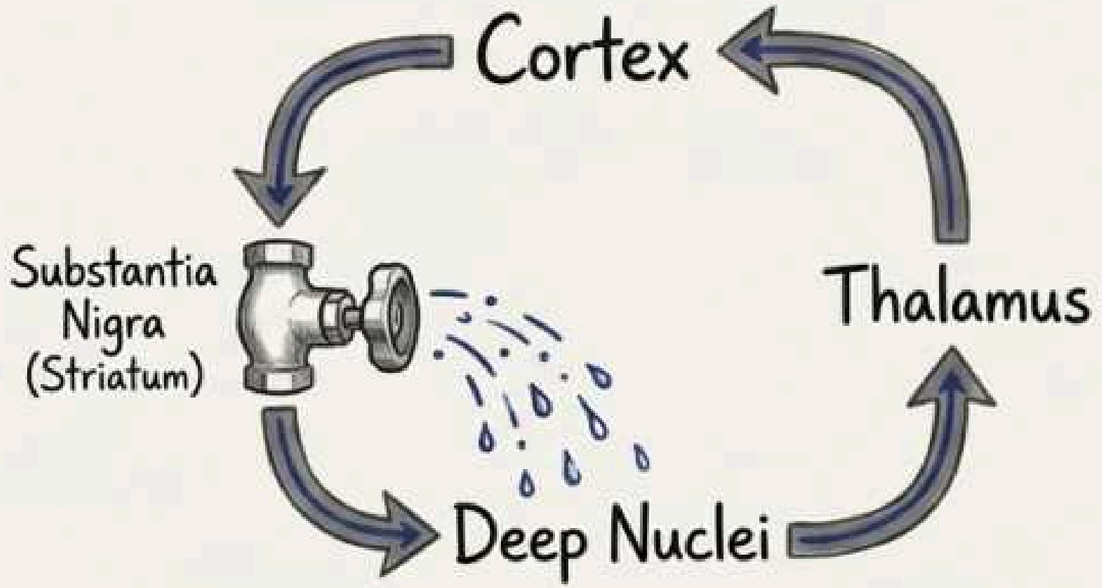
Damage Profile

- Retained strength, but clumsy, wide unsteady stance, poor rapid timing.

Basal Ganglia: Gate & Gain Control

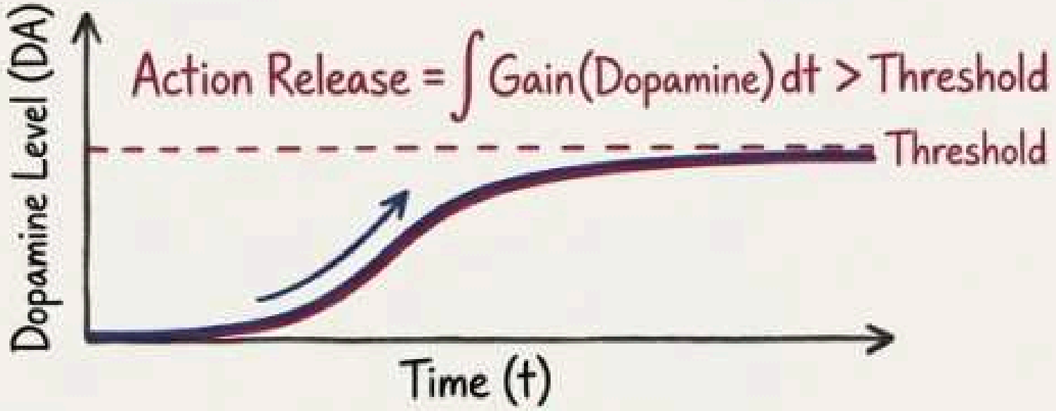
¶ 5.5

- Sits deep in the forebrain (not a second surface motor cortex).
- Selects actions, sets scale/ease of movement.
- Crucial role in habit learning and valuation.





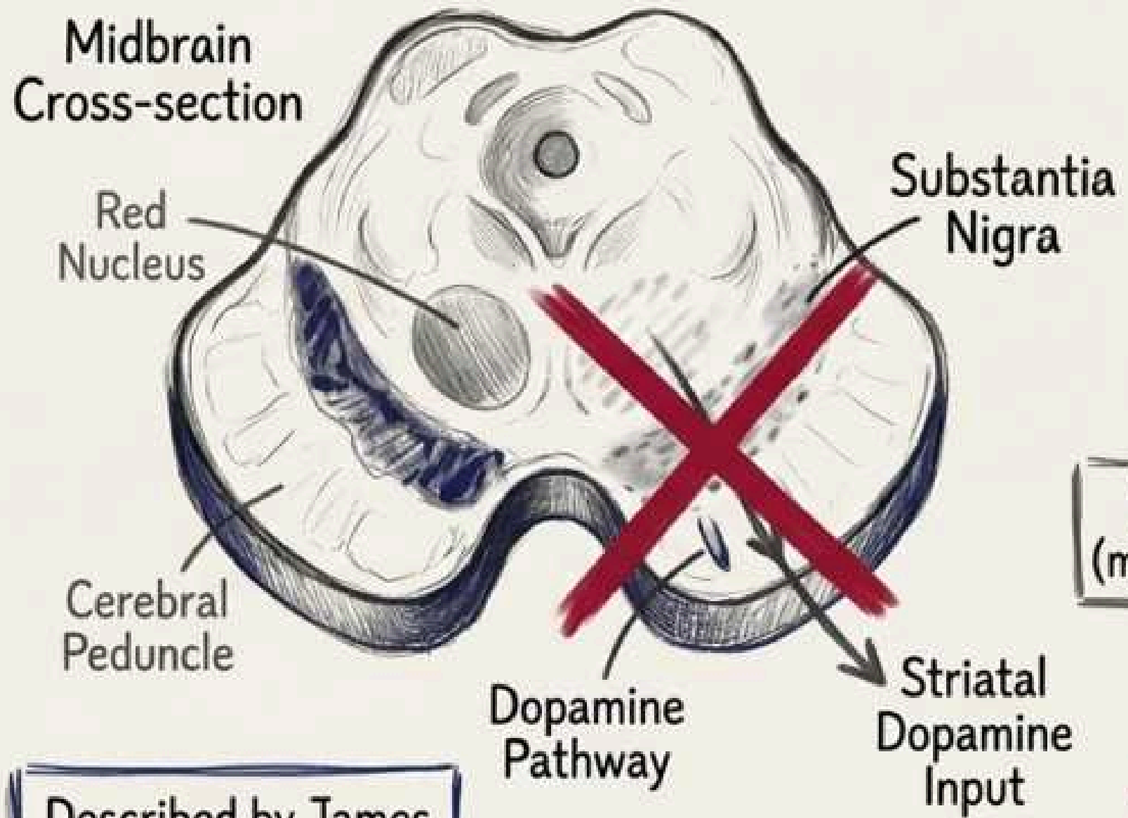




(Too little DA = Hard to start/scale; Excess DA = Poorly controlled movement)

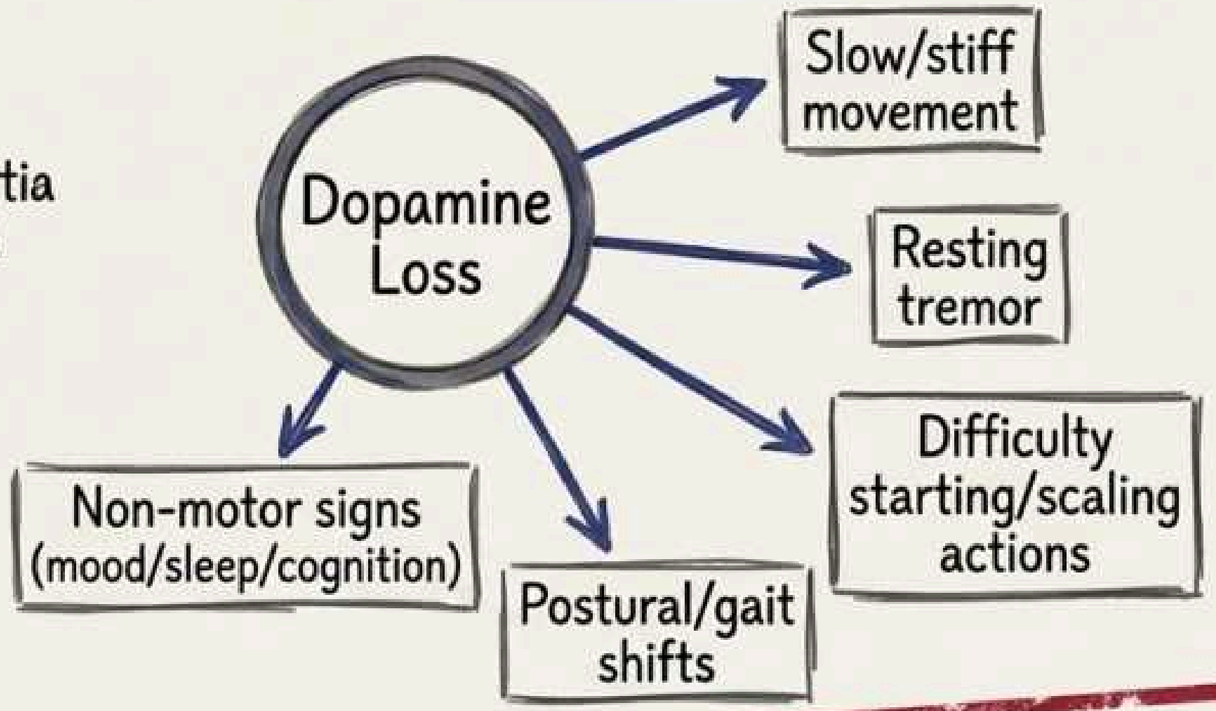
Window on the Hierarchy: Parkinson's Disease

Anatomical Failure Point



Described by James Parkinson, 1817.

Symptom Web

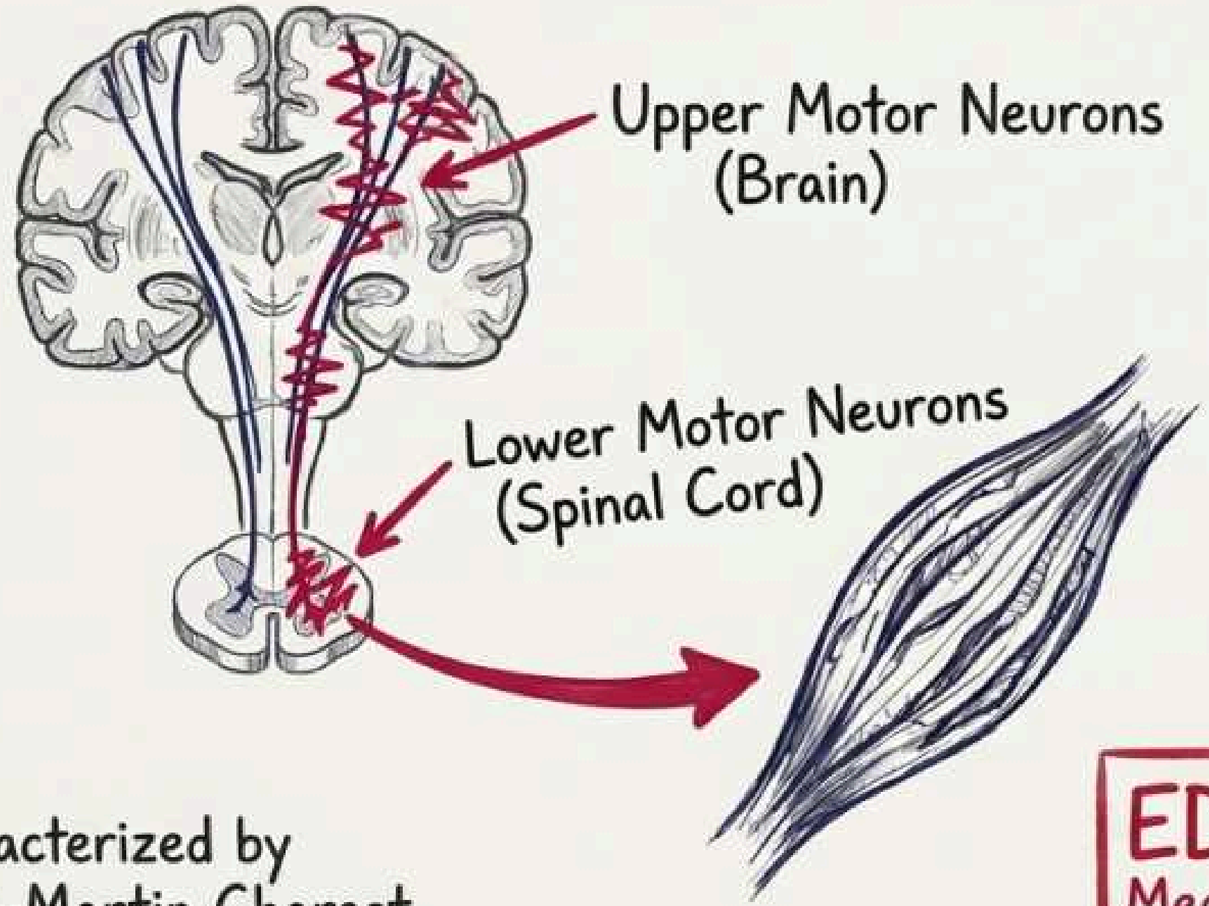


EDUCATIONAL ONLY. No dosages, no treatment advice. Progressive symptoms require qualified clinical consultation, not textbook self-matching.

Window on the Final Path: ALS

¶ 5.7

Anatomical Failure Point



Spared Systems

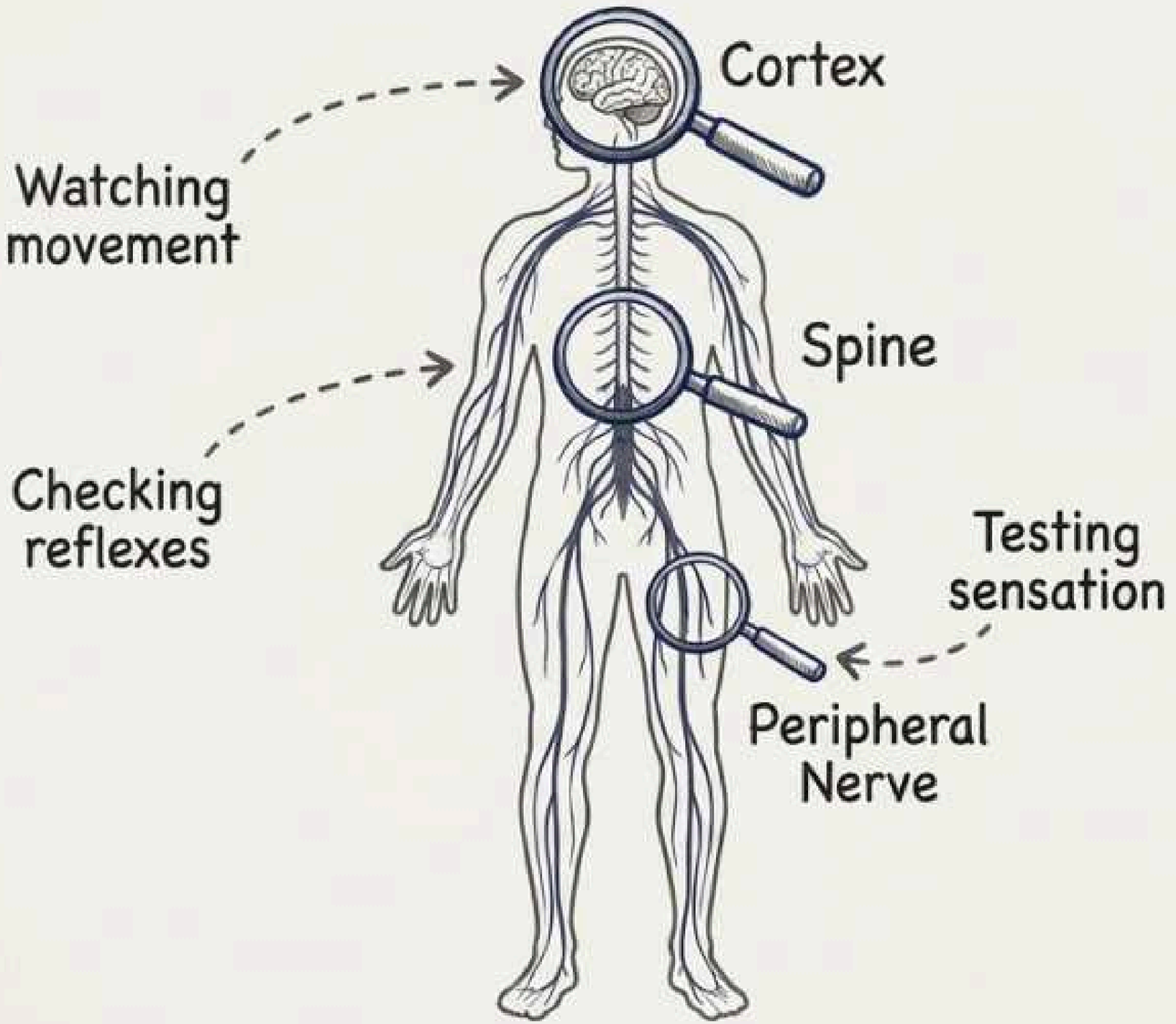
- ✓ Sensation
- ✓ Memory/Language (usually)

Characterized by Jean-Martin Charcot (19th C.); associated with Lou Gehrig (USA).

EDUCATIONAL ONLY.
Mechanism as a window on the final common path.
Care, diagnosis, and support belong to clinicians.

The Neurological Examination

¶ 5.8



The Principle

Different parts of the map, when injured, disturb movement and sensation in recognizable patterns.

The Goal

To ask where in the nervous system a problem lies.

Constraint

Turning patterns into a conclusion is the work of a trained clinician, not an hour's reading. This course teaches the reason for the exam, not the skill to perform it.

The Practical Edge: Time & Triage

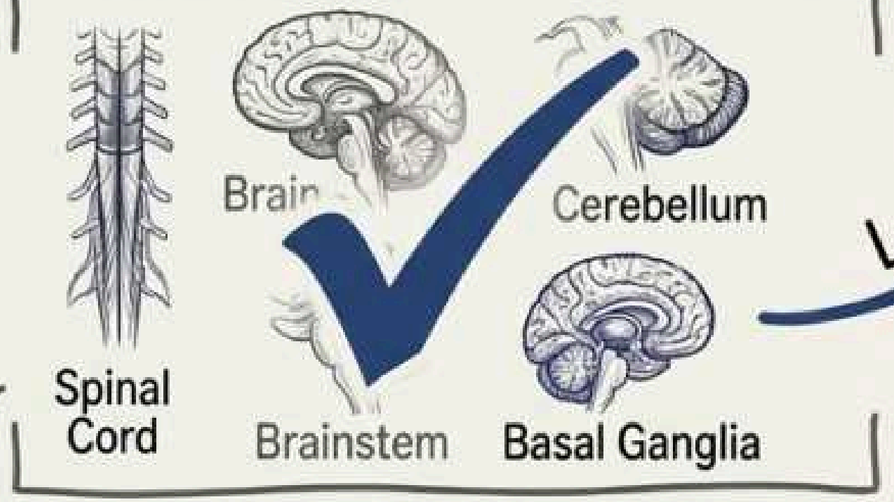
The Emergency	The Progressive
• **Signs:** Sudden weakness (esp. one-sided), sudden trouble walking, sudden loss of coordination.	• **Signs:** Slowly progressive tremor, stiffness, unexplained muscle wasting.
• **Meaning:** Warning sign of stroke.	• **Meaning:** Hierarchical system degradation (e.g., PD, ALS).
• **Action:** Call emergency services AT ONCE (Ref: ¶ 0.3).	• **Action:** Seek timely clinical advice; do not wait on a book.

Synthesis Note:

The hierarchy of movement is a hierarchy of places where things can go wrong. Seek help in the world, not from these pages.

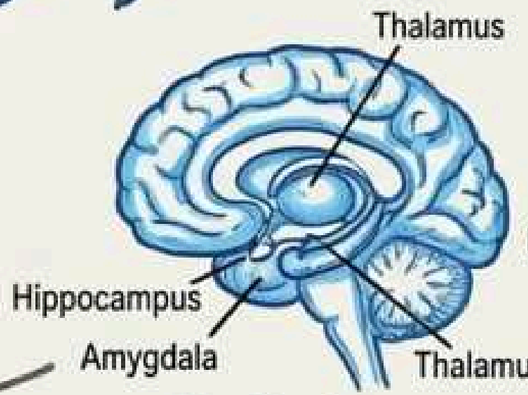
Curriculum Horizon: Beyond Movement

The Motor Block

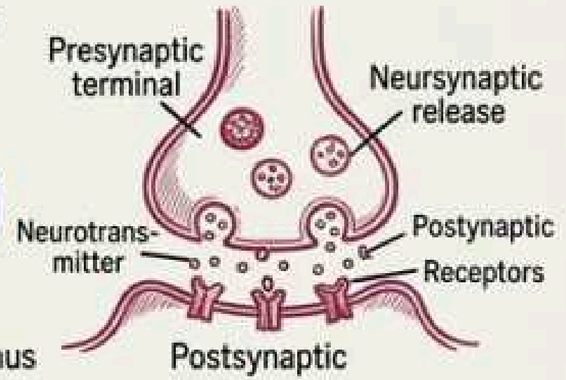


Lecture 6 Horizon

Limbic System



Limbic System



Synaptic Cleft

1. Open Starting Points (Suggested Reading):

Grokipedia articles on Basal Ganglia, Motor Neurons, Parkinson's, ALS.

2. Looking Ahead (Lecture 6):

Transitioning from the mature, moving body to system assembly/injury, memory organization, and how fear, mood, and addiction share this underlying limbic map and chemistry.

Note: Crisis lines will be provided when addiction/mood topics appear.