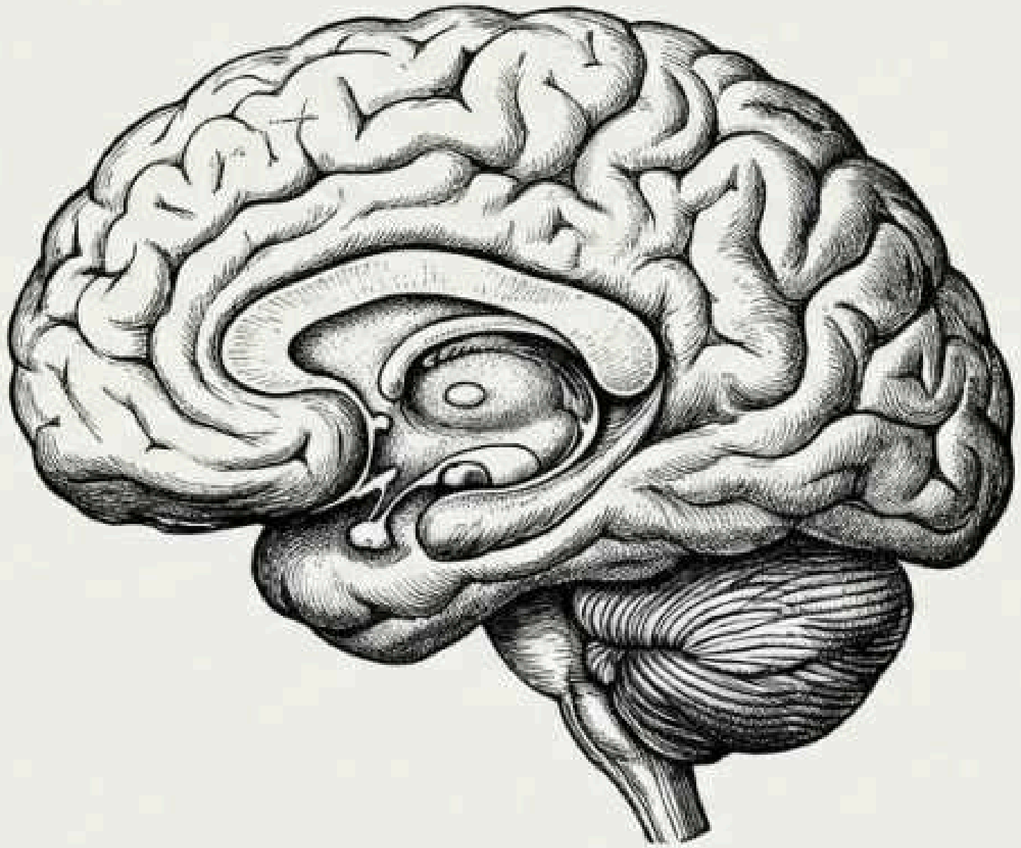
¶ 1.1

NEUR 101 B: Lecture 1

Neurons and the Architecture of the Nervous System.



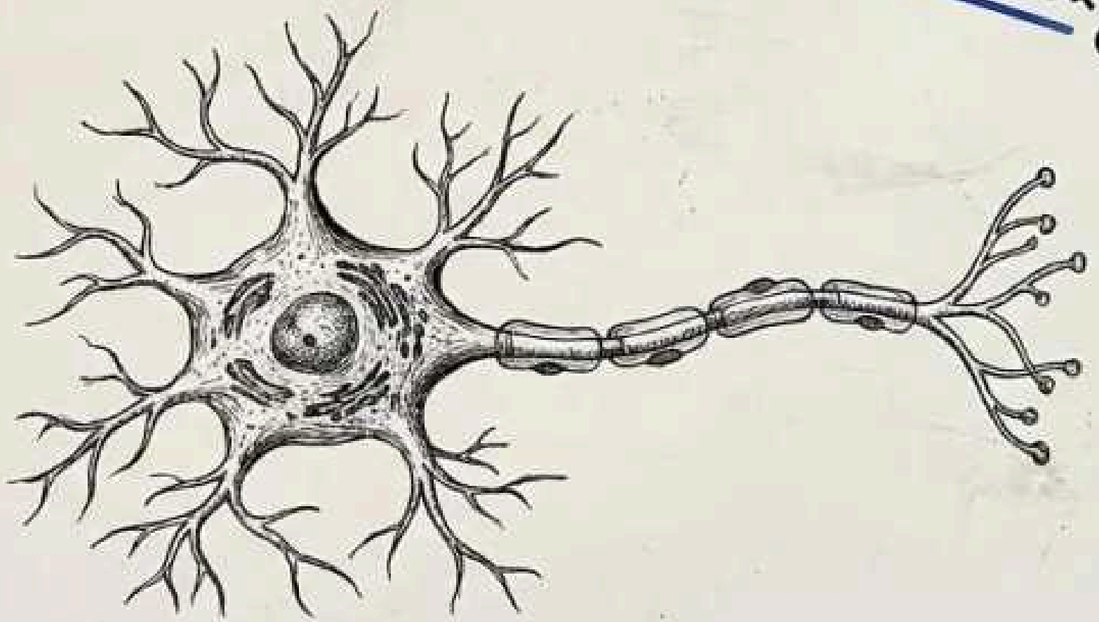
Gemini Notebook

The Lecture Roadmap

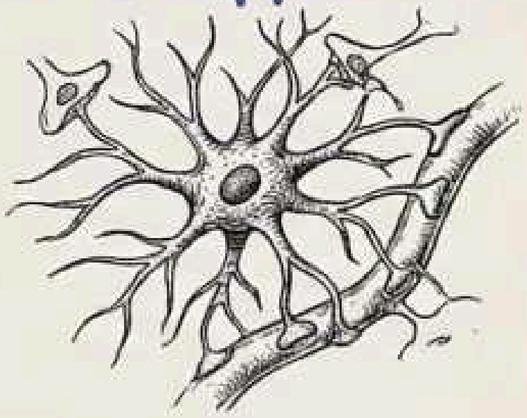
¶ 1.2

Everything in the course grows from these ideas.

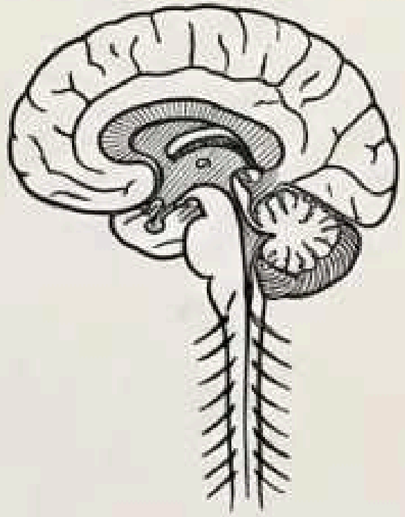
The Signal Carrier



The Supporters



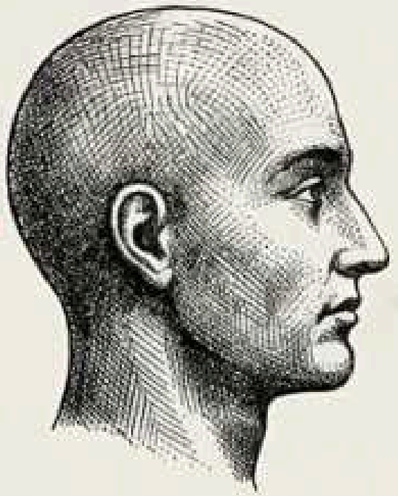
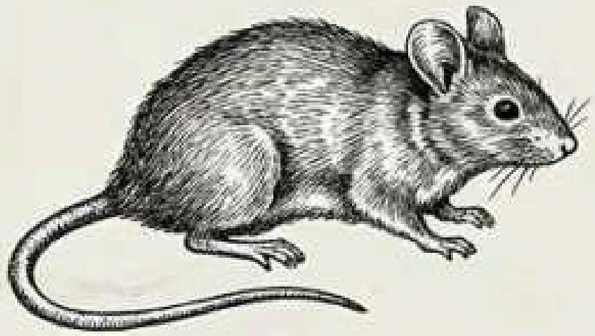
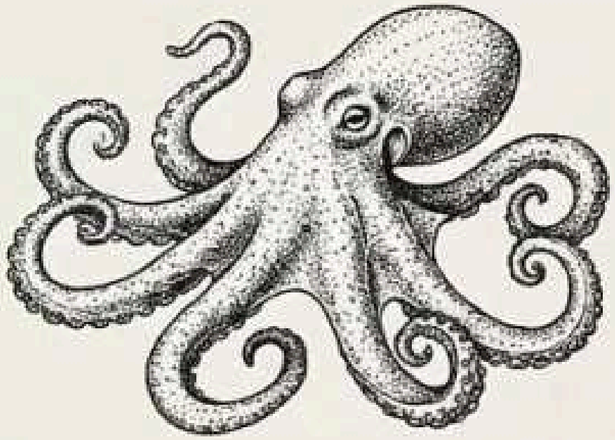
The Architecture



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The Brain by the Numbers

¶1.3

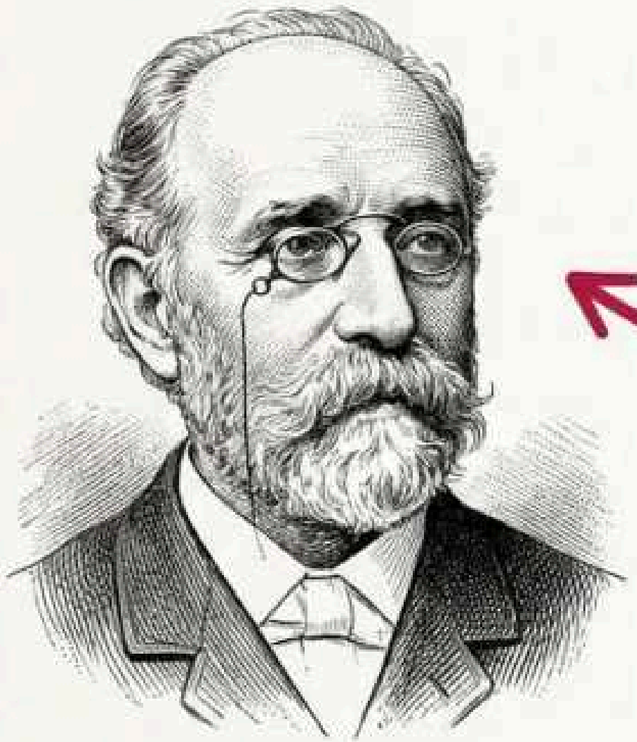
Human	Mouse	Octopus
		
1.5 kg (2% body weight) 86 Billion Neurons	70 Million Neurons	500 Million Neurons

69 Billion in Cerebellum /
16 Billion in Cerebral Cortex.

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¶ 1.4

The Pioneers of Neuroscience



1906

Shared Nobel Prize



Camillo Golgi

1873 Stain: Darkens isolated cells completely.

?

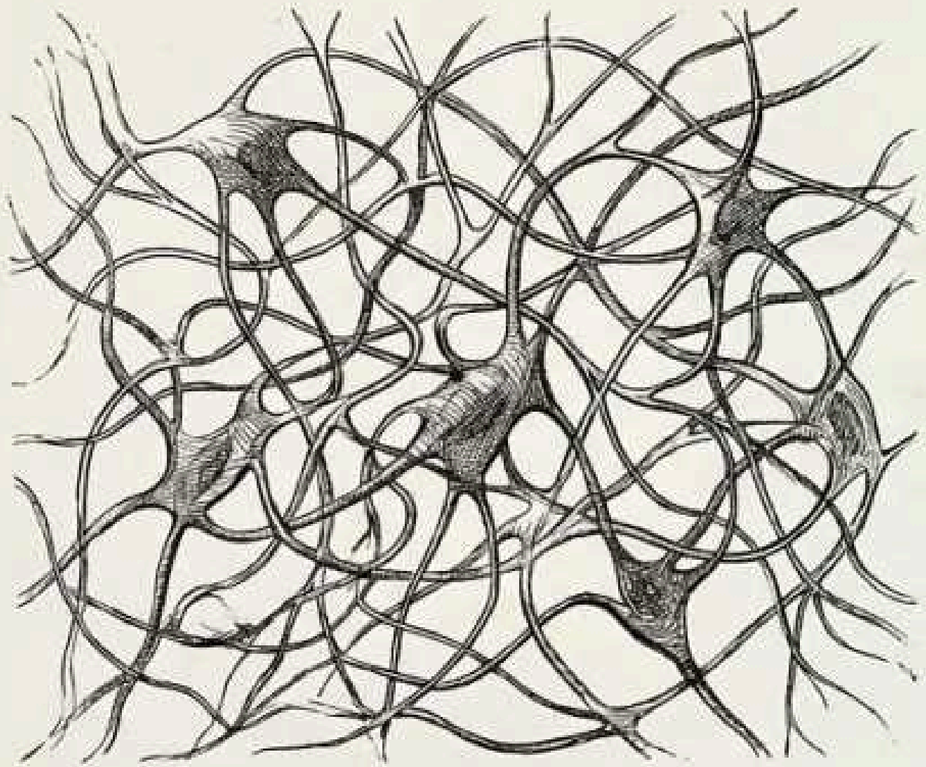
Santiago Ramón y Cajal

Used the stain to draw cells in exquisite detail.

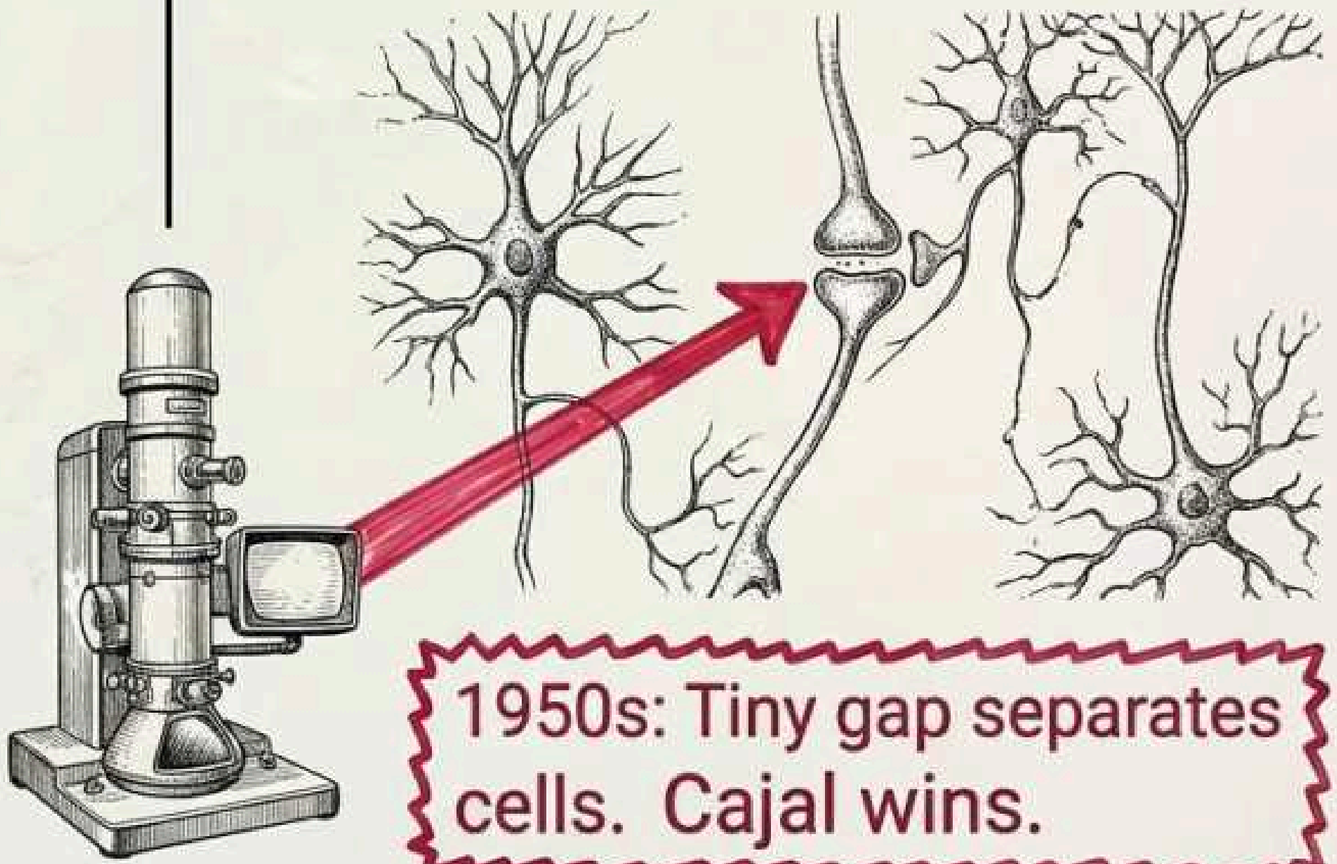
Gemini Notebook

The Neuron Doctrine vs. The Continuous Web ¶ 1.5

The Continuous Web
Golgi's View



The Neuron Doctrine
Cajal's View

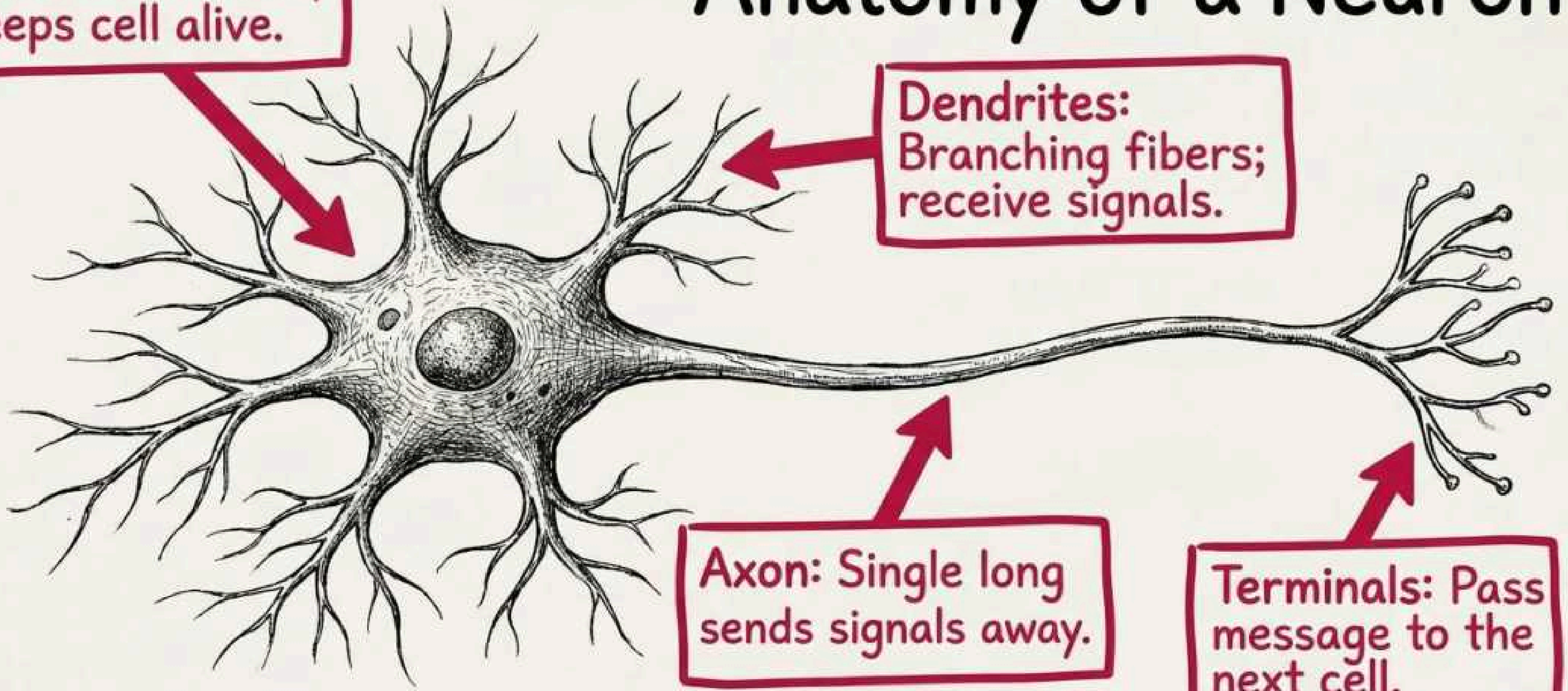


1950s: Tiny gap separates cells. Cajal wins.

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¶ 1.6

Anatomy of a Neuron



Soma (Cell Body): Holds the nucleus, keeps cell alive.

Dendrites: Branching fibers; receive signals.

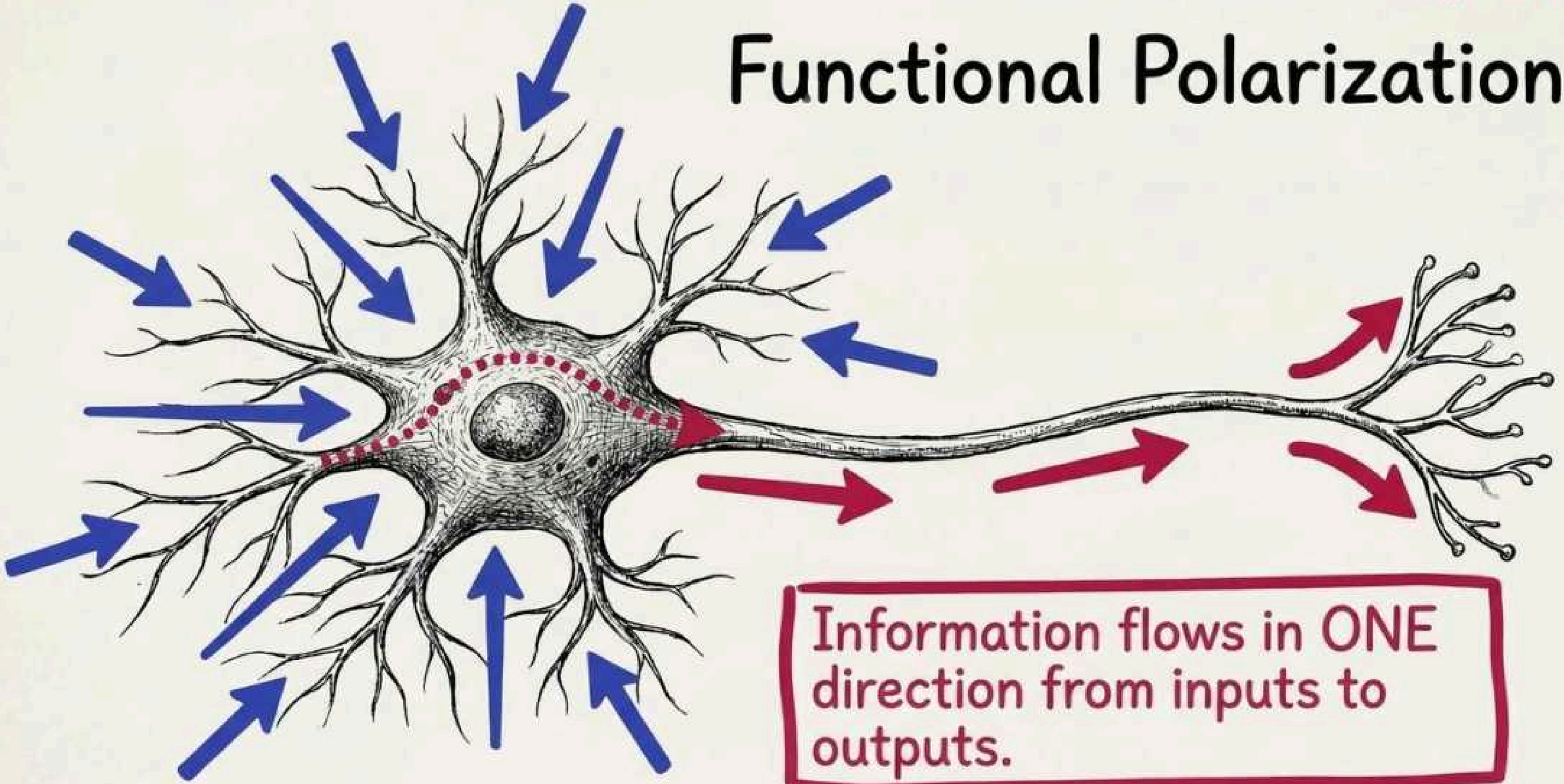
Axon: Single long sends signals away.

Terminals: Pass message to the next cell.

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¶ 1.7

Functional Polarization

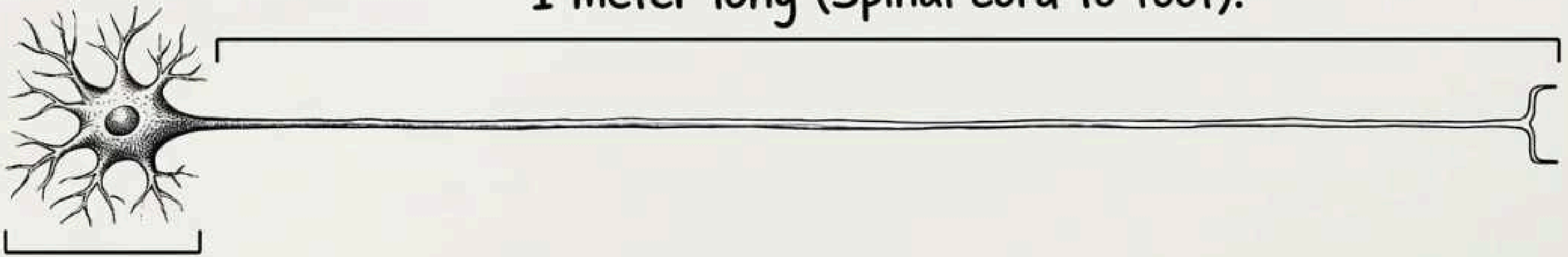


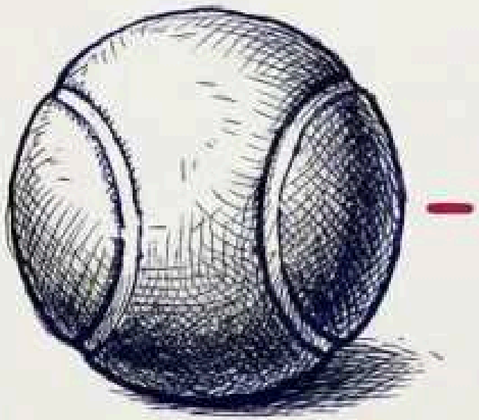
Information flows in ONE direction from inputs to outputs.

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The Extremes of Scale

¶ 1.8





3 Kilometers

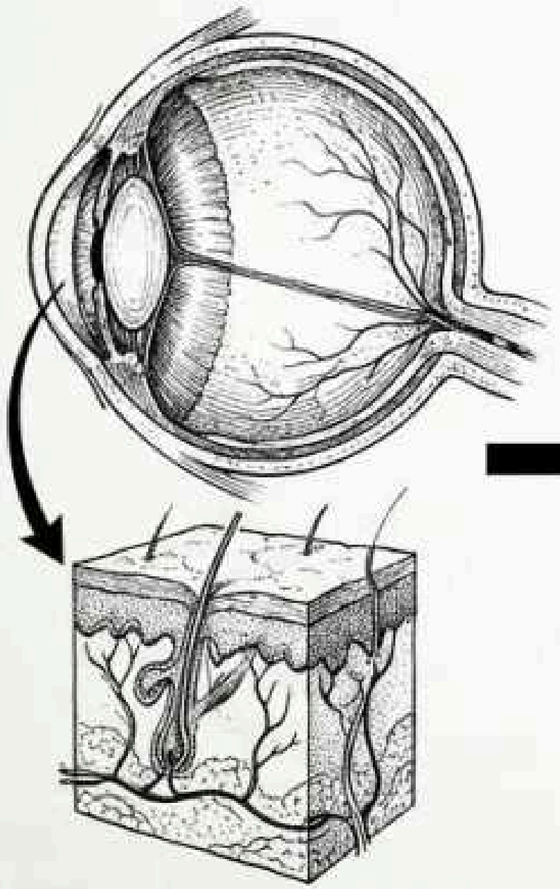


Gemini Notebook

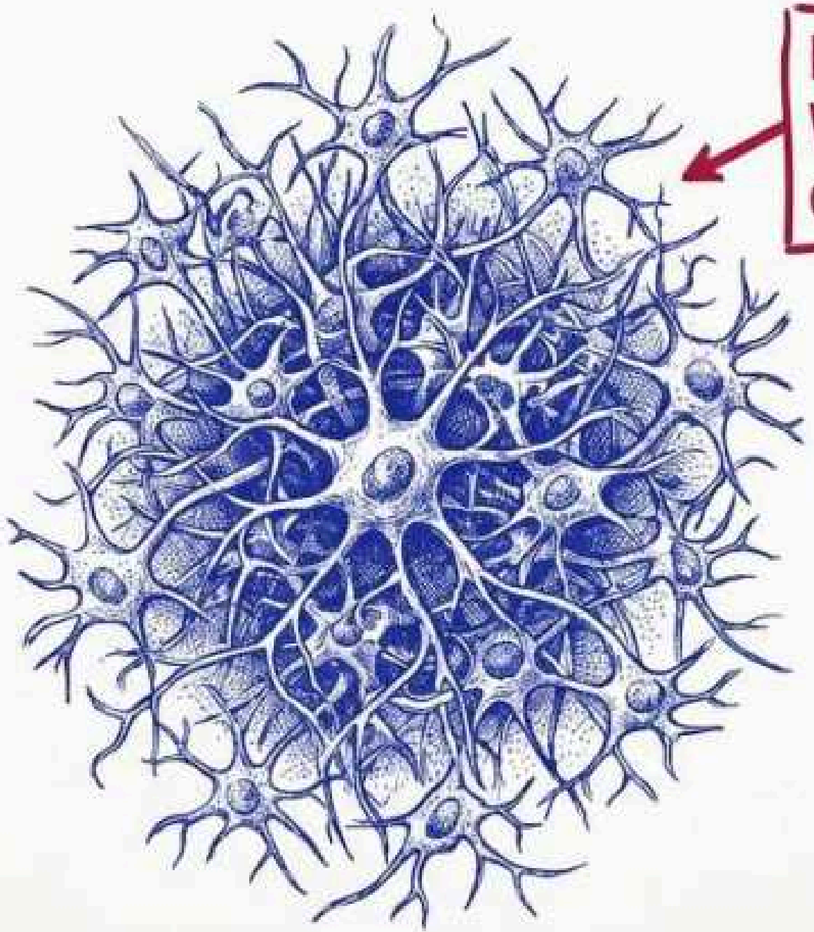
¶ 1.9

Neurons by Job (The Circuit)

Sensory Neurons

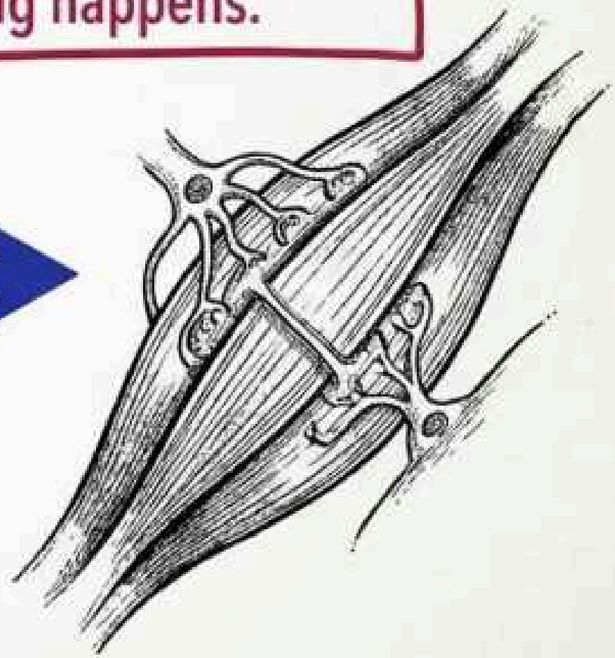


Interneurons



By far the most numerous. Where the brain's computing happens.

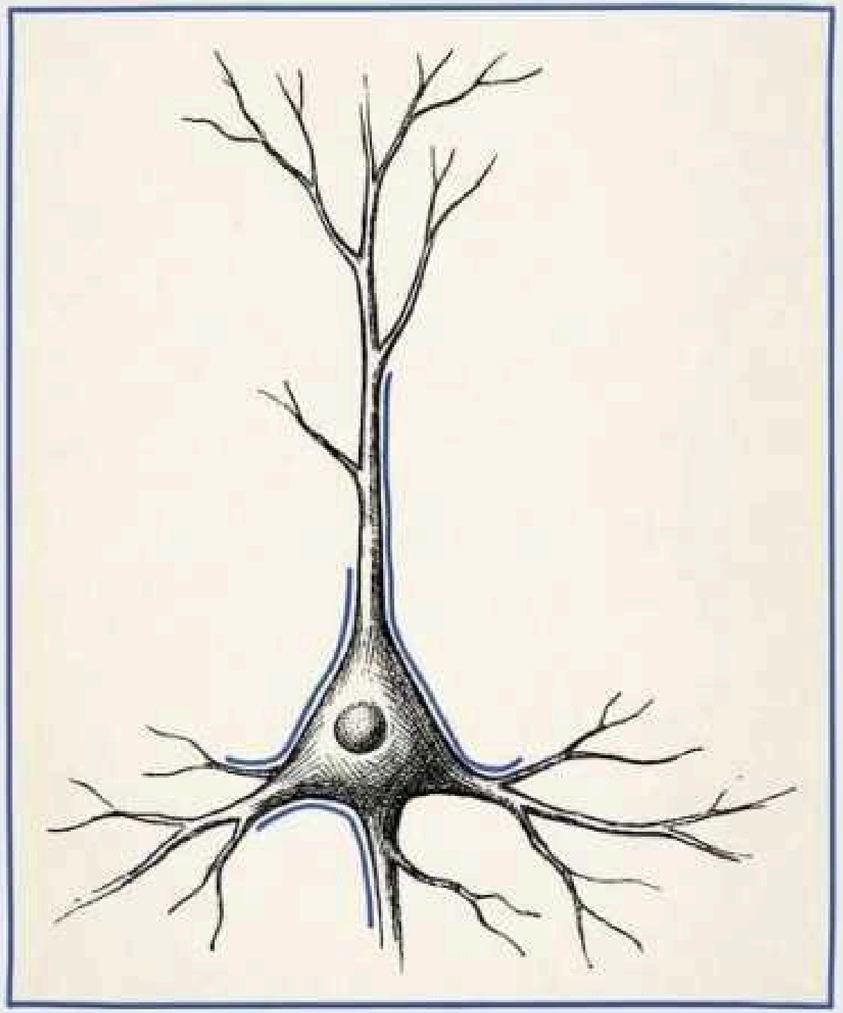
Motor Neurons



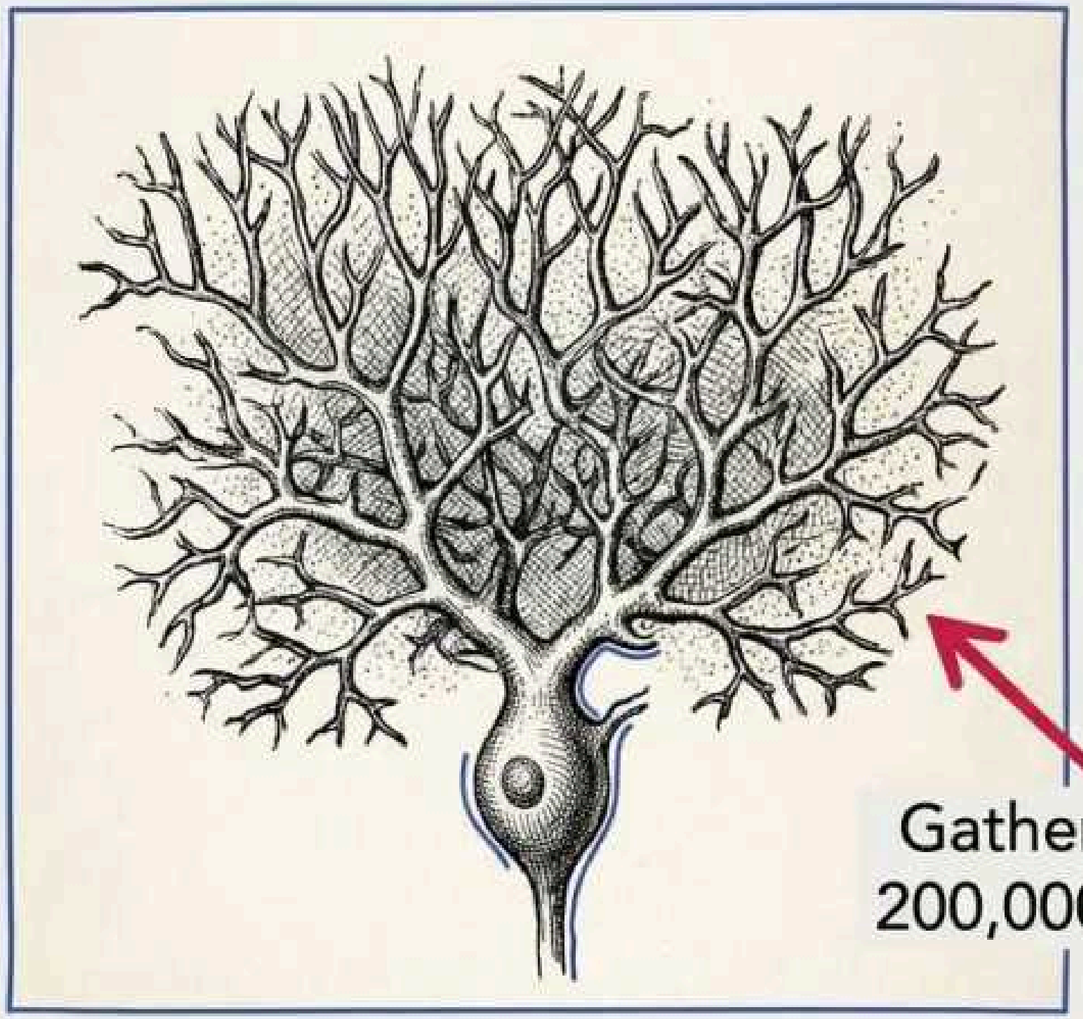
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Shape Follows Function

¶ 1.10



Pyramidal Cell
(Dominates Cortex).



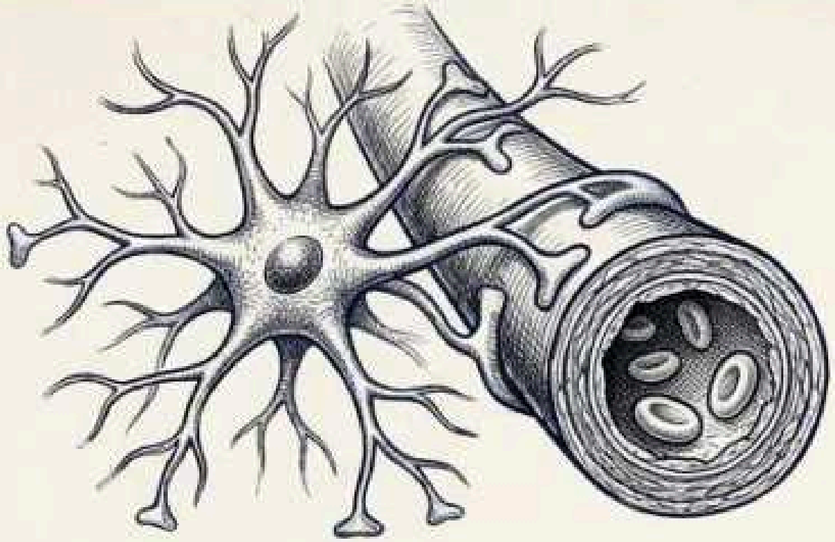
Purkinje Cell
(Cerebellum).

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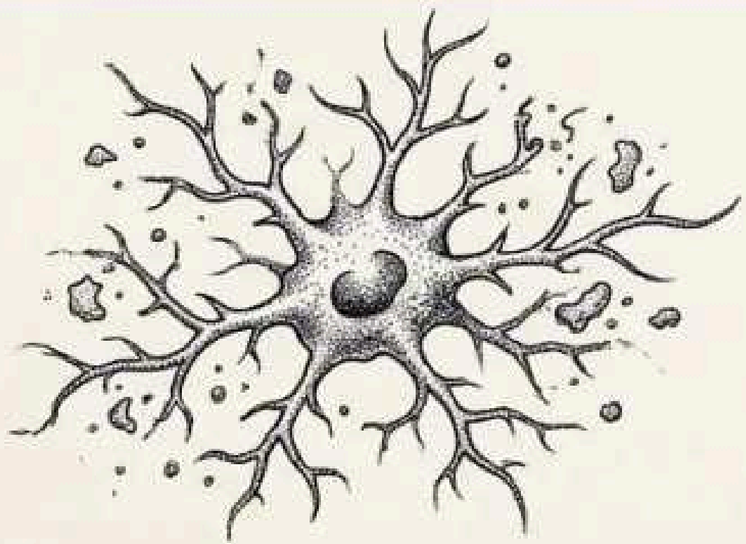
¶ 1.11

The Supporting Cast (Glia)

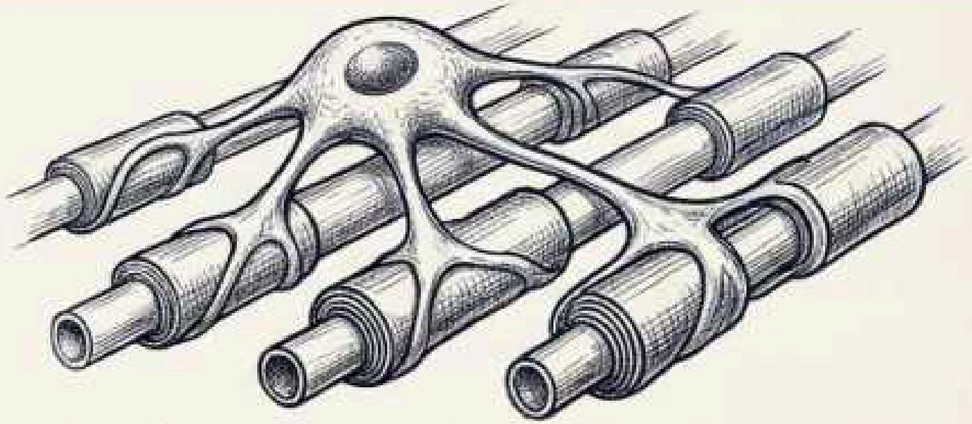
Much more than "mere glue".



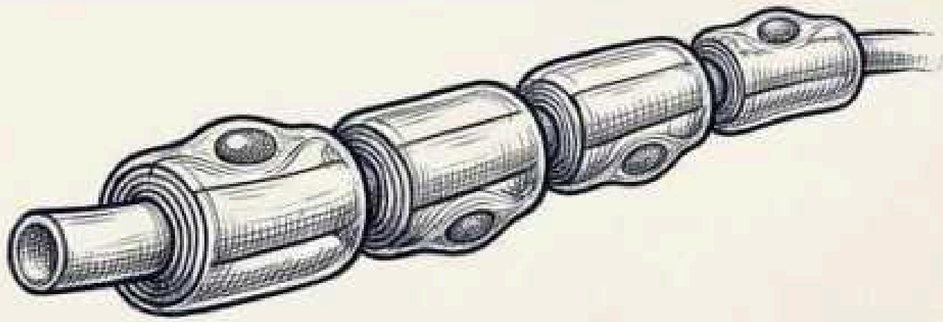
Astrocytes: Regulate chemistry & feed neurons.



Microglia: Brain's immune cells & debris clearers.



Oligodendrocytes: Insulating myelin wrap (CNS).



Schwann Cells: Provide myelin (PNS).

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Calculating the Network

86,000,000,000 Neurons

× 7,000 Connections Each

~ 600,000,000,000,000 Synapses

[Published estimates safely range from 100 to 1,000 Trillion synapses].

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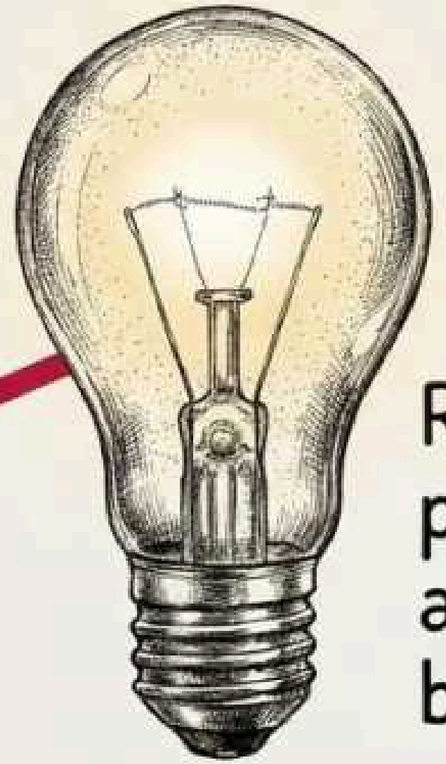
¶ 1.13

The Energy Cost

2000 kcal/day → 97 Watts Total

Brain = 2% of Body Weight,
but 20% of Resting Energy.

97W x 0.20 = **19 Watts**



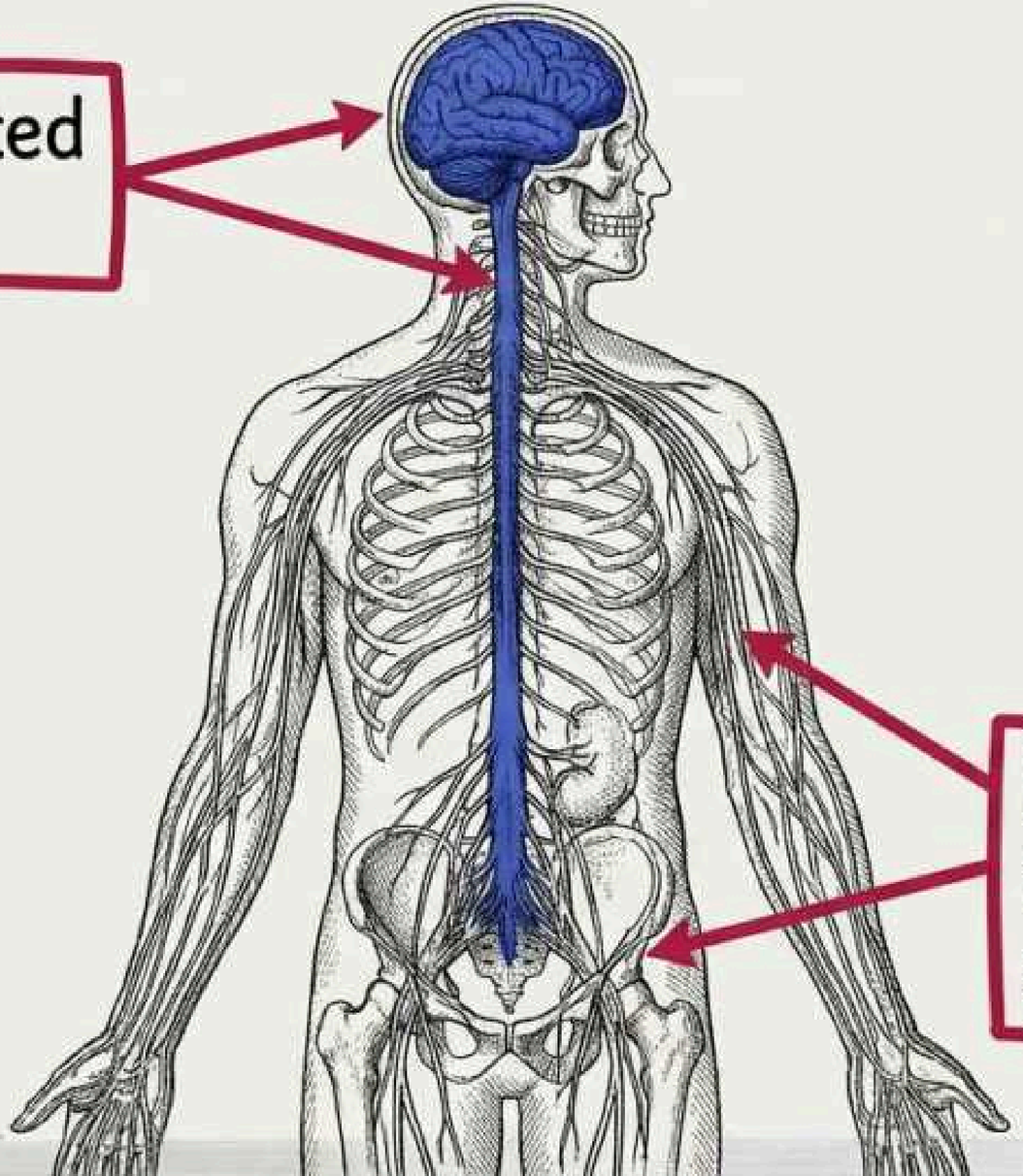
Runs on less power than a dim light bulb.

Gemini Notebook

Macro-Architecture: CNS vs. PNS

¶ 1.14

CNS: Protected by bone.



PNS: Links center to skin, muscles, and organs.

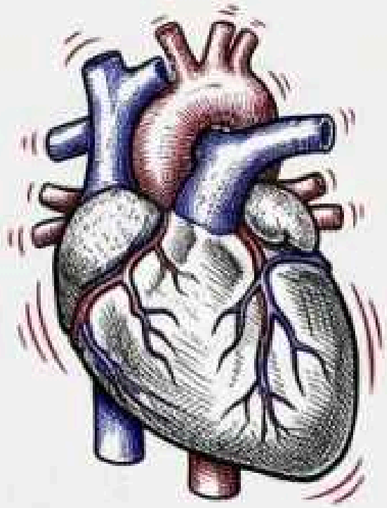
Gemini Notebook

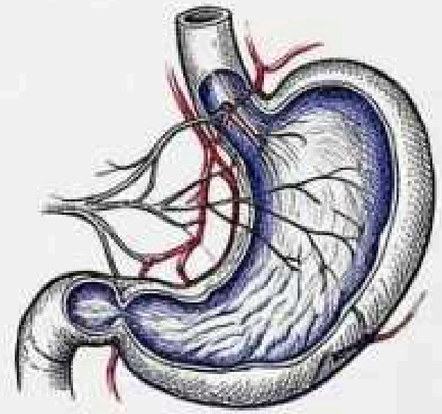
Branches of the Peripheral System

¶ 1.15

Peripheral Nervous System (PNS)

- **Somatic Branch**
  - Sensory info & Voluntary muscles
- **Autonomic Branch**
  - Runs organs without conscious effort
  - Working in balance.
  - **Sympathetic**
    - Action (Raises heart rate)
  - **Parasympathetic**
    - Rest & Digest

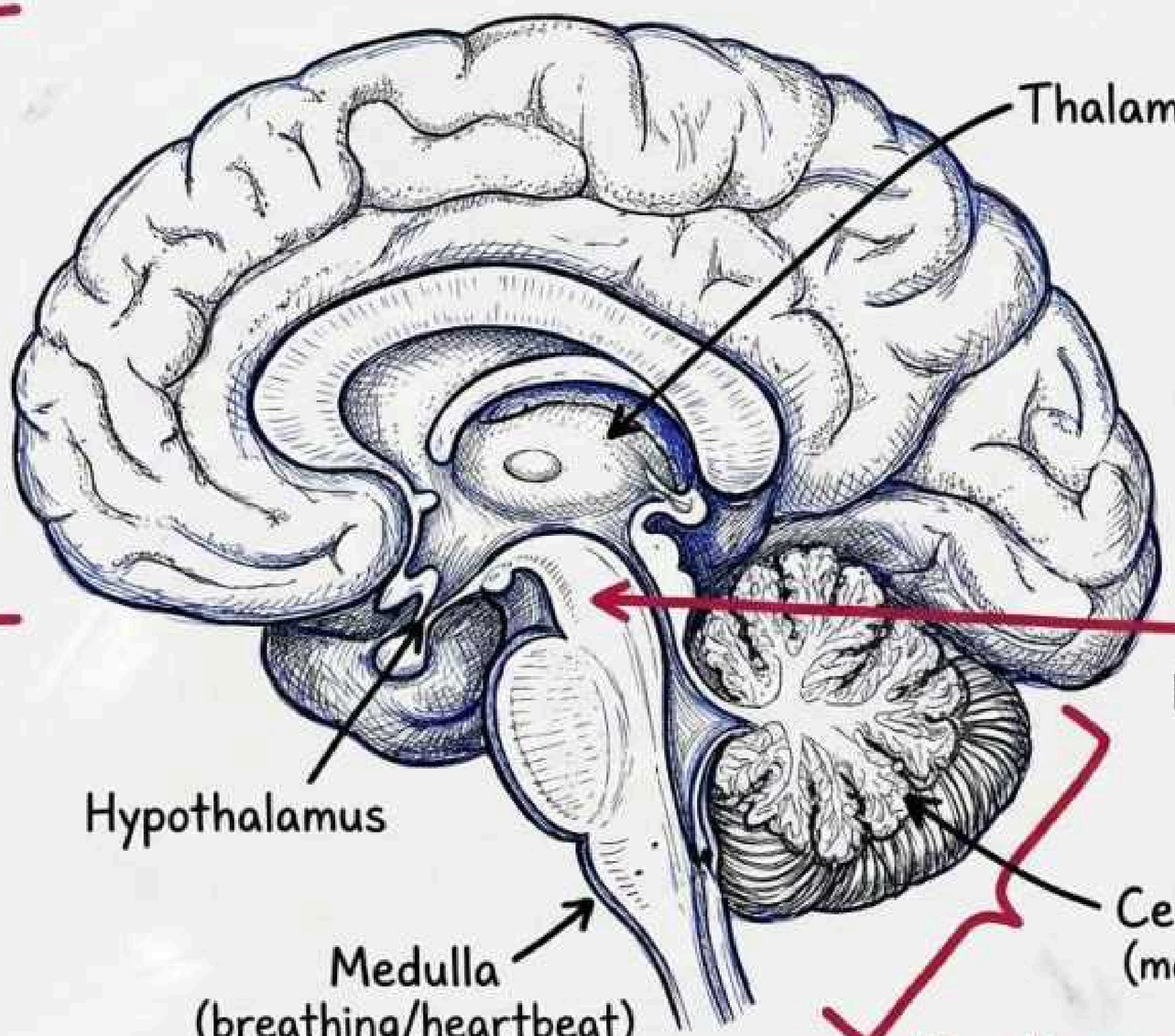




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Major Divisions of the Brain

¶ 1.16

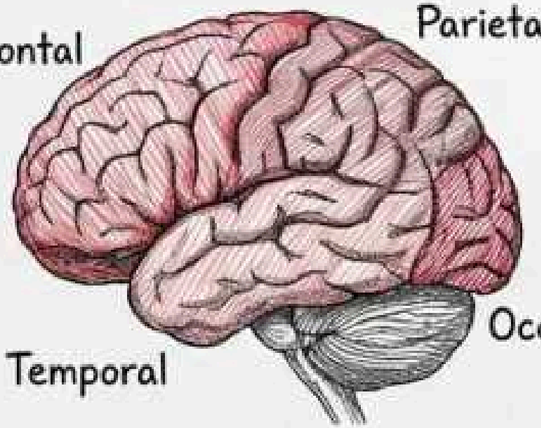


Forebrain

Midbrain
Relays visual/auditory info.

Hindbrain

Cerebral Hemisphere Lobes

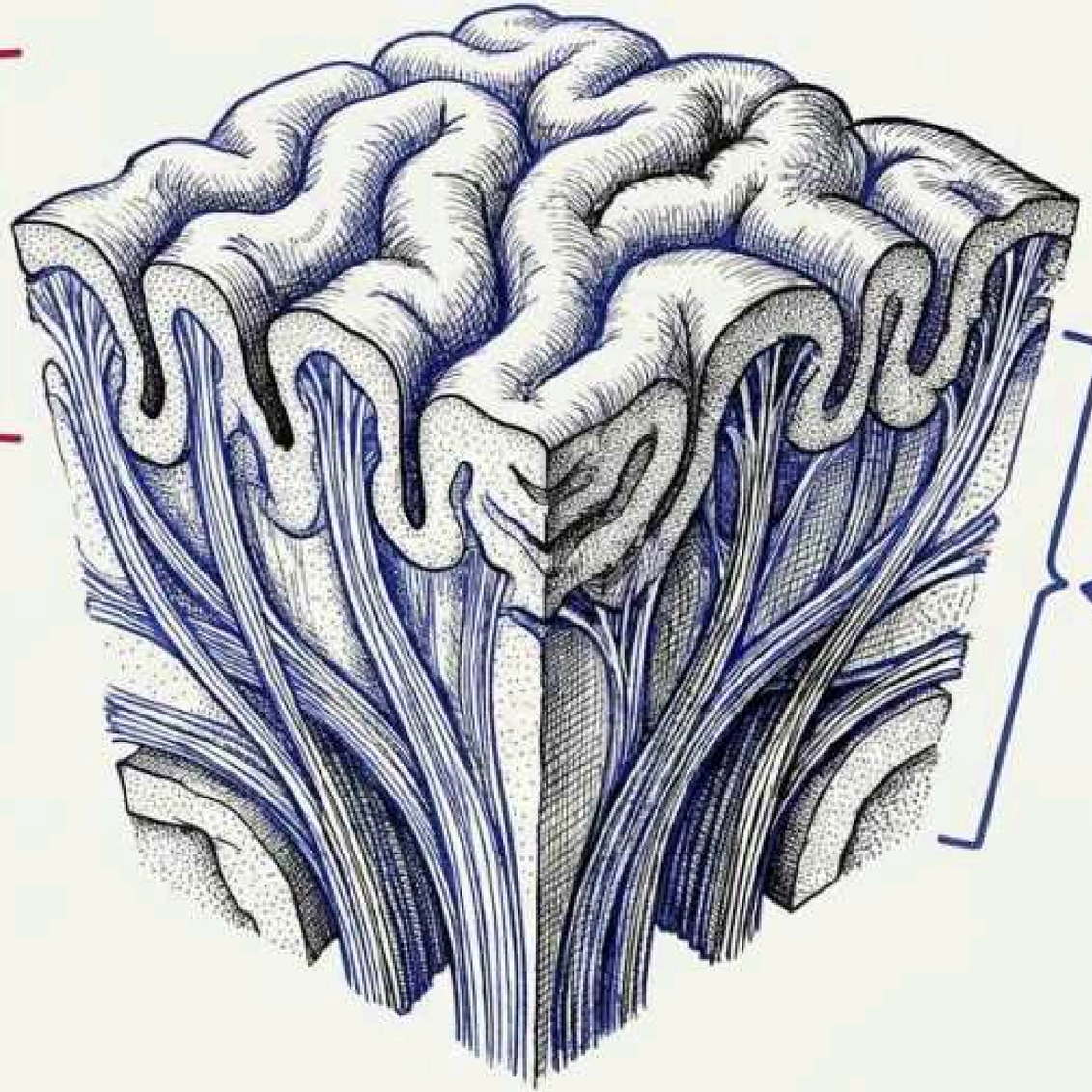


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The Cerebral Cortex

¶ 1.17

Gray Matter:
Only 2–4mm thick.
Folding packs
2,000 sq cm
of surface area
into the skull.



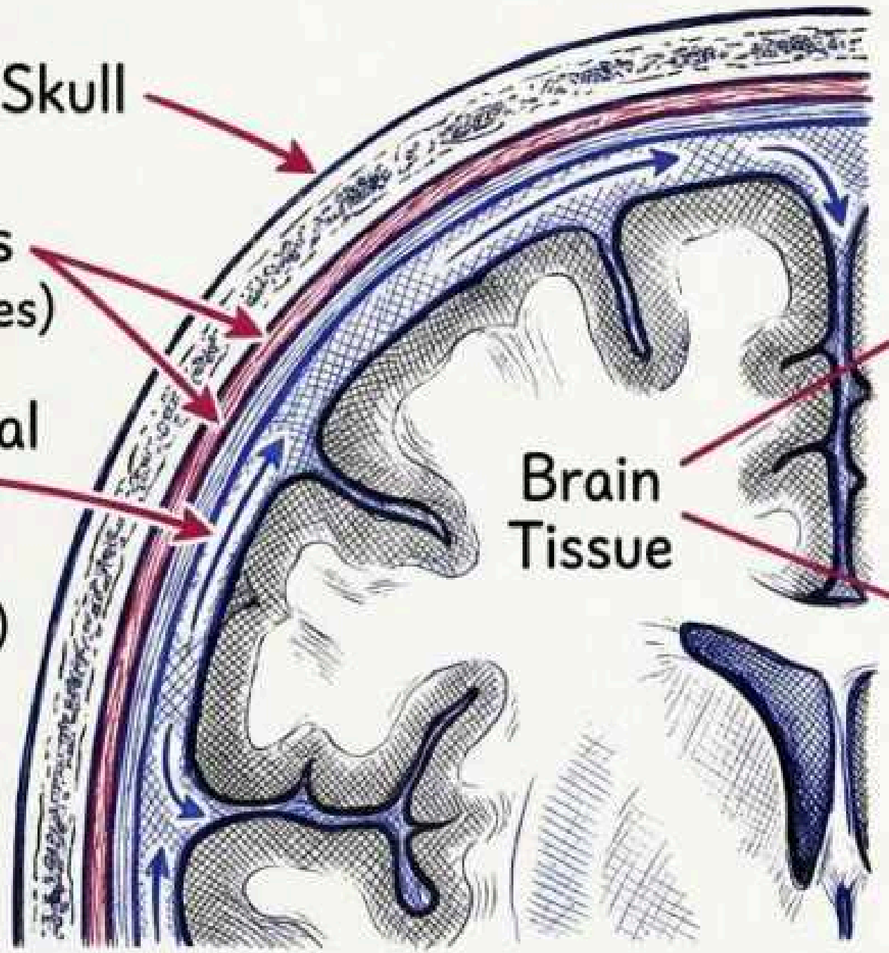
White Matter: Bundles
of myelinated axons
linking regions.

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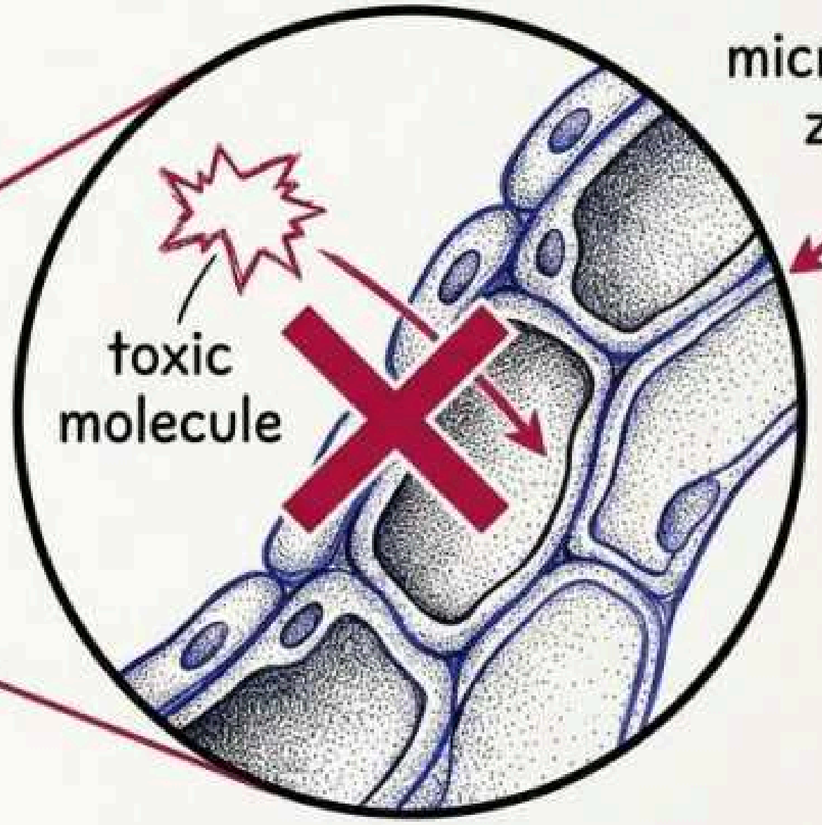
Brain Protection Systems

¶ 1.18

Macro Scale



Micro Scale

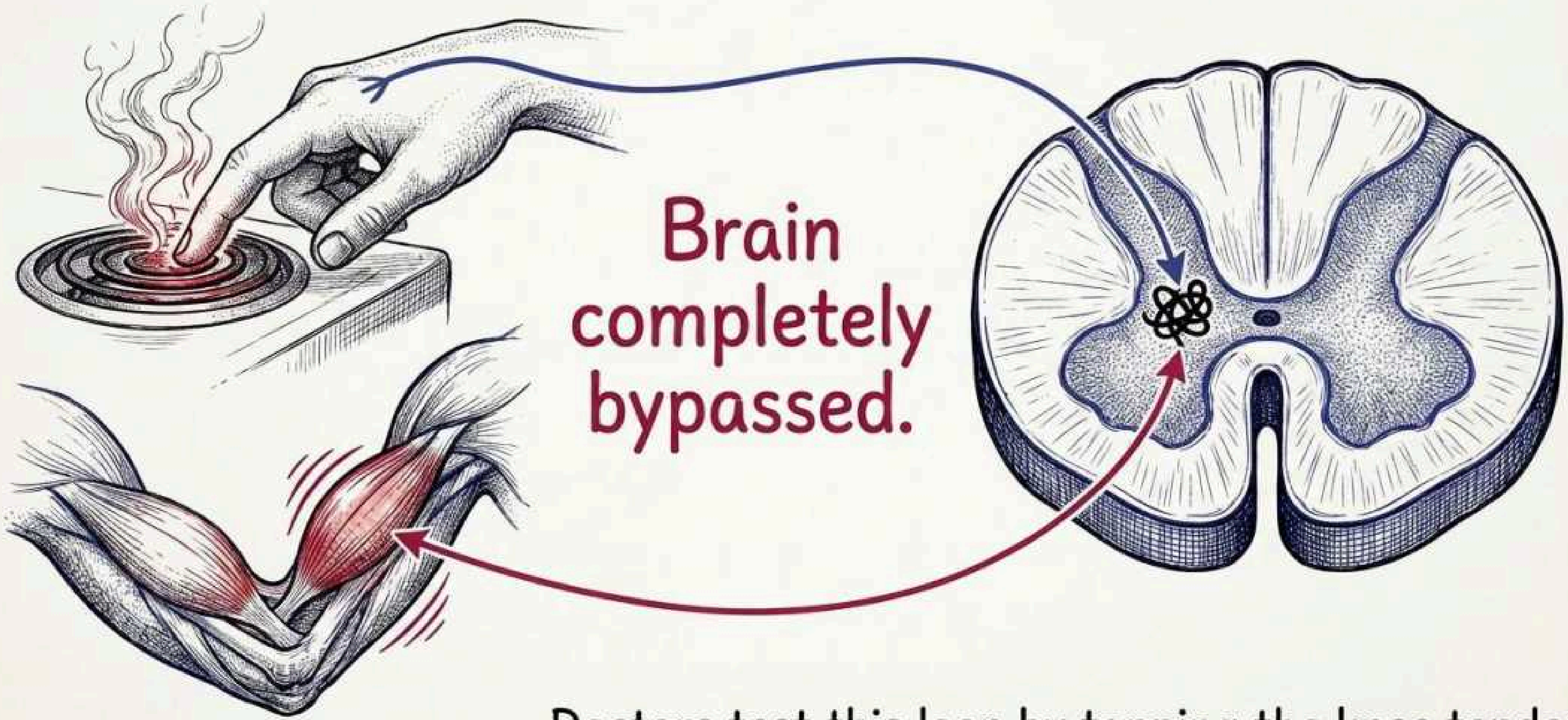


Blood-Brain Barrier:
Highly selective tight joints.
(Keeps out toxins, but also blocks many medicines).

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The Spinal Cord & Reflex Arc

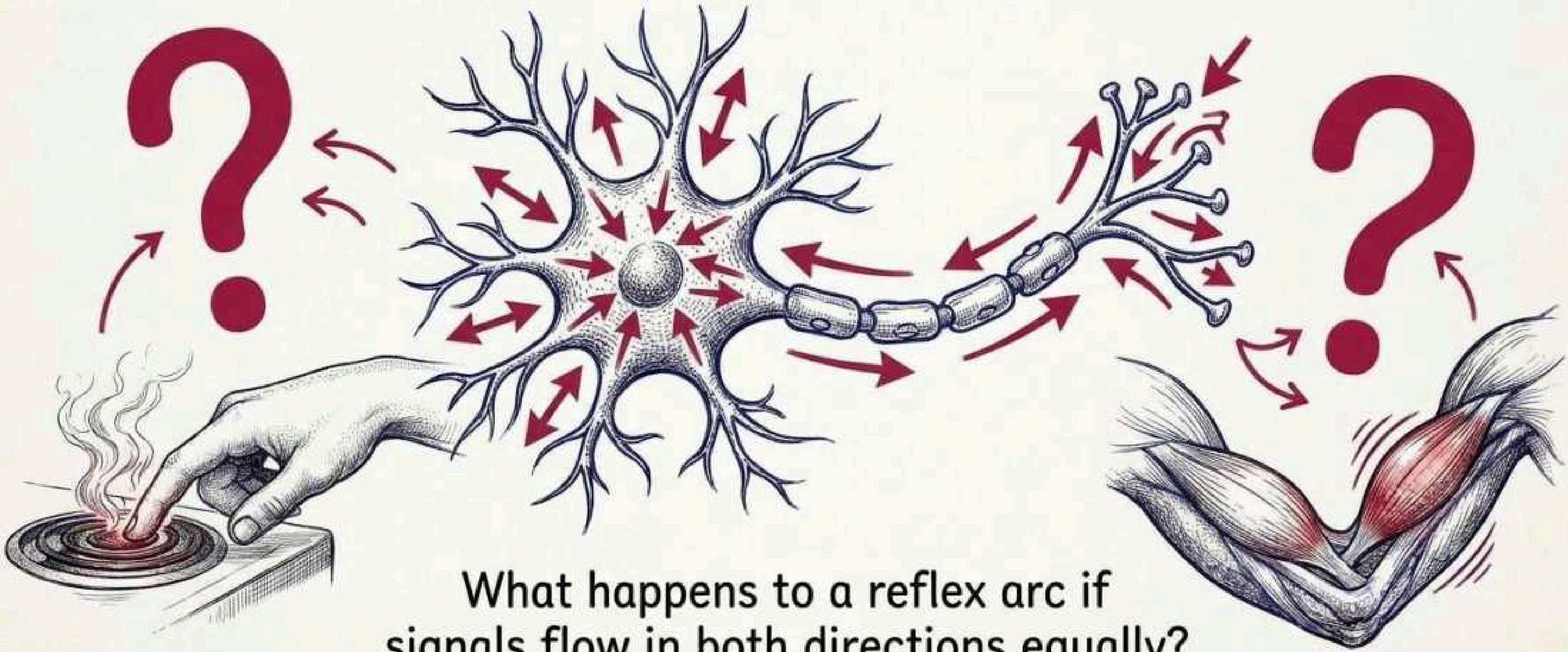
¶ 1.19



Doctors test this loop by tapping the knee tendon.

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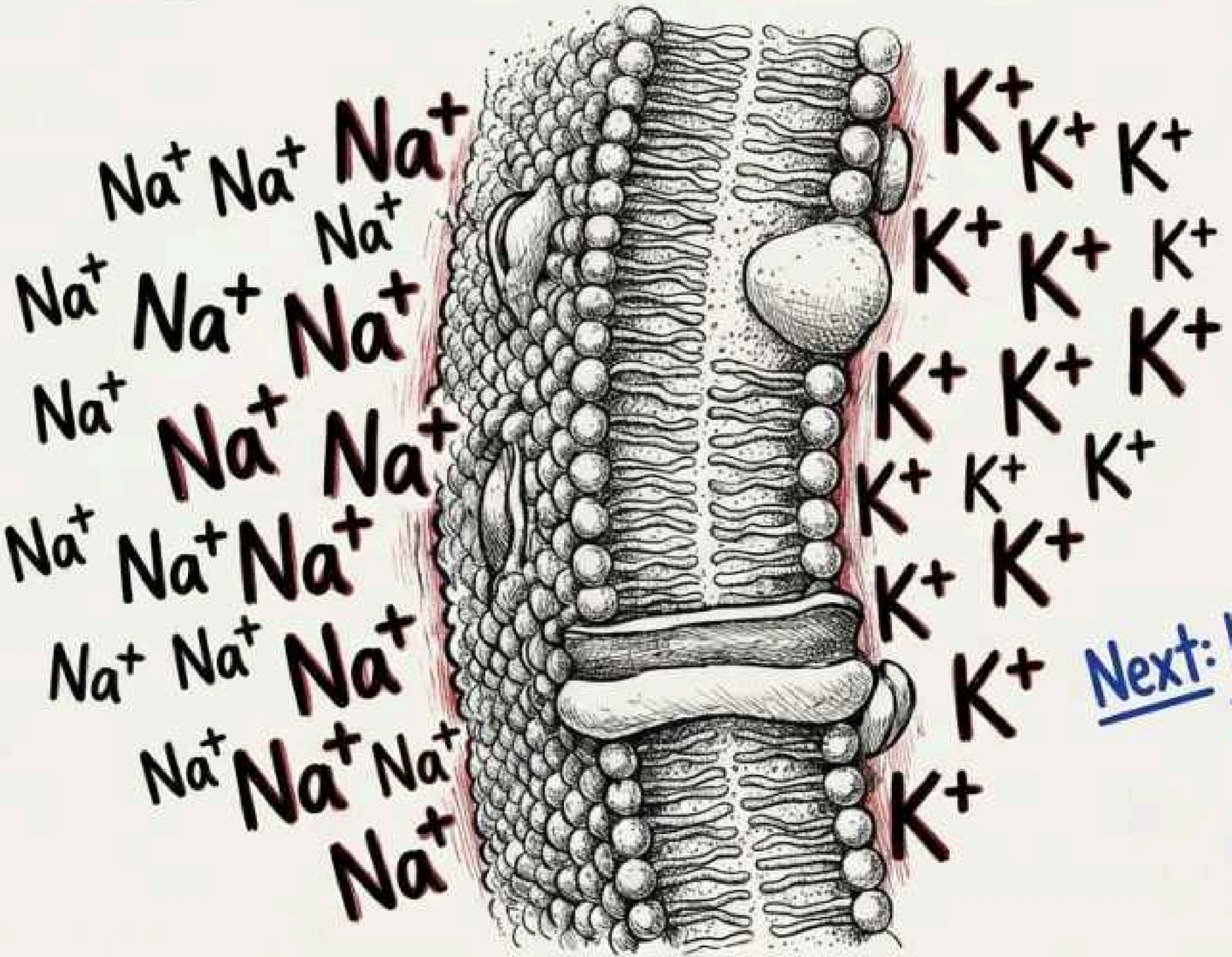
Thought Experiment: A Broken Circuit ¶ 1.20



What happens to a reflex arc if signals flow in both directions equally? (Why reliability demands polarization).

Gemini Notebook

Looking Ahead to Lecture 2



Next: How the cell actually fires. The Membrane, the Ions, Ions, and Action Potential. Potential.

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