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Platinum Neuro Integration I

Foundations: How the Nervous System Signals and Adapts

NEW ZEALAND COLLEGE of CHIROPRACTIC

TE KĀRETI KAIKOROHITI o AOTEAROA

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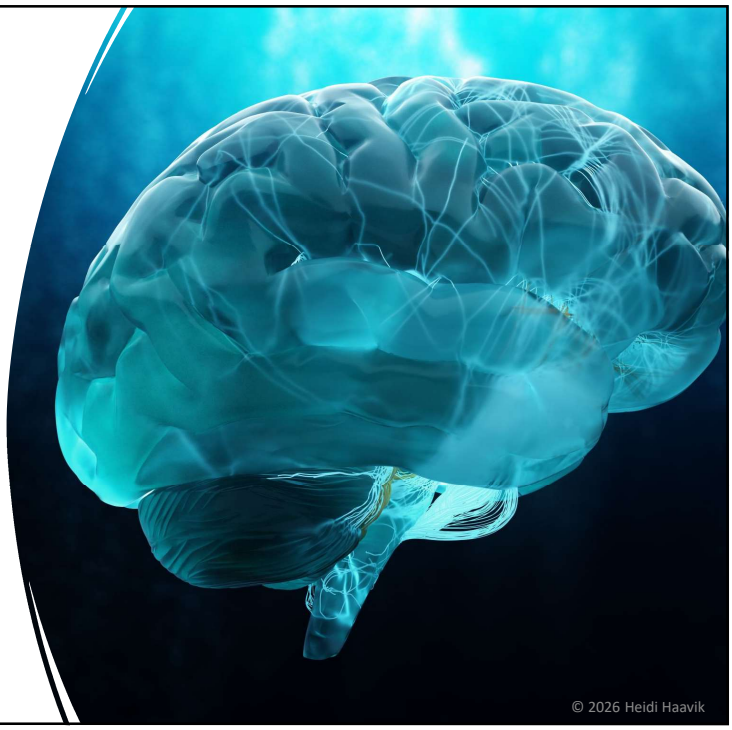
Purpose

Understand the basic “rules” of neural signalling so clinical responses start to make sense.



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Outline of today

Highlight	Review	Check on	Discuss
Highlight superstars	Quick review of each of four classes	Check on your understanding	Discuss relevance of neurointegration in practice

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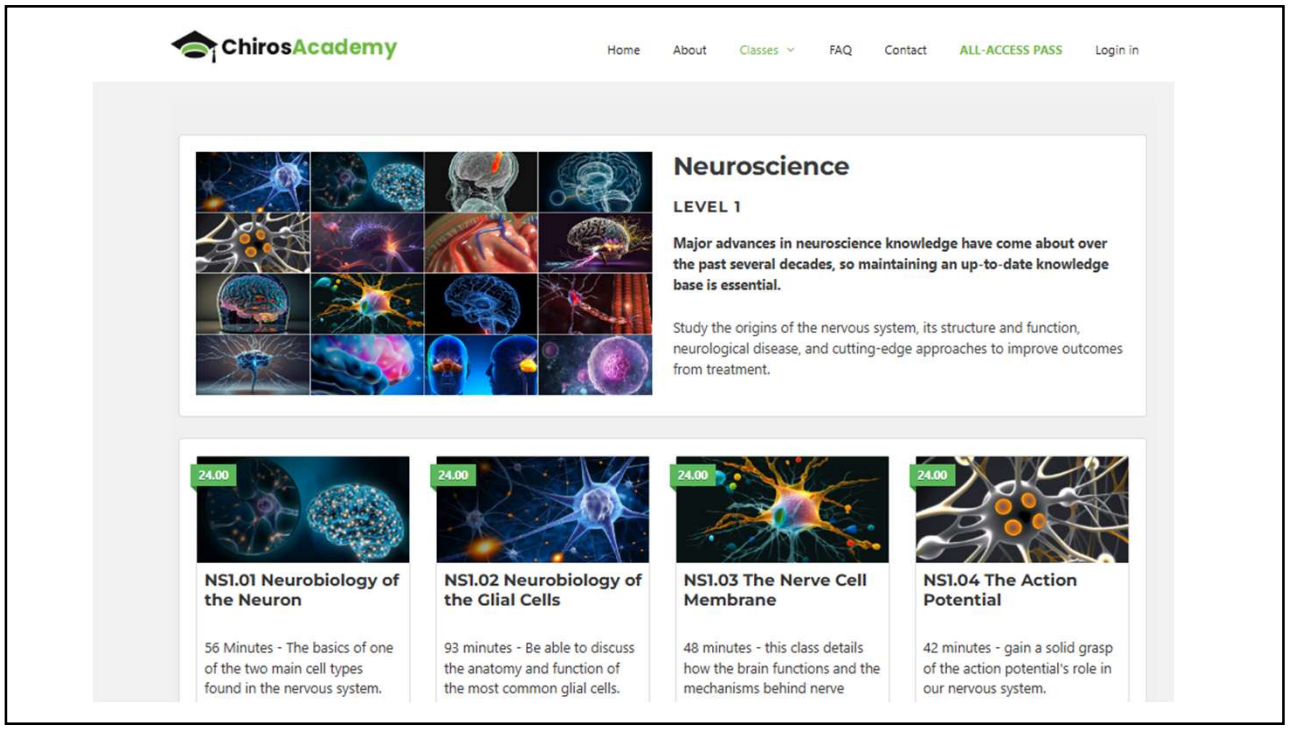

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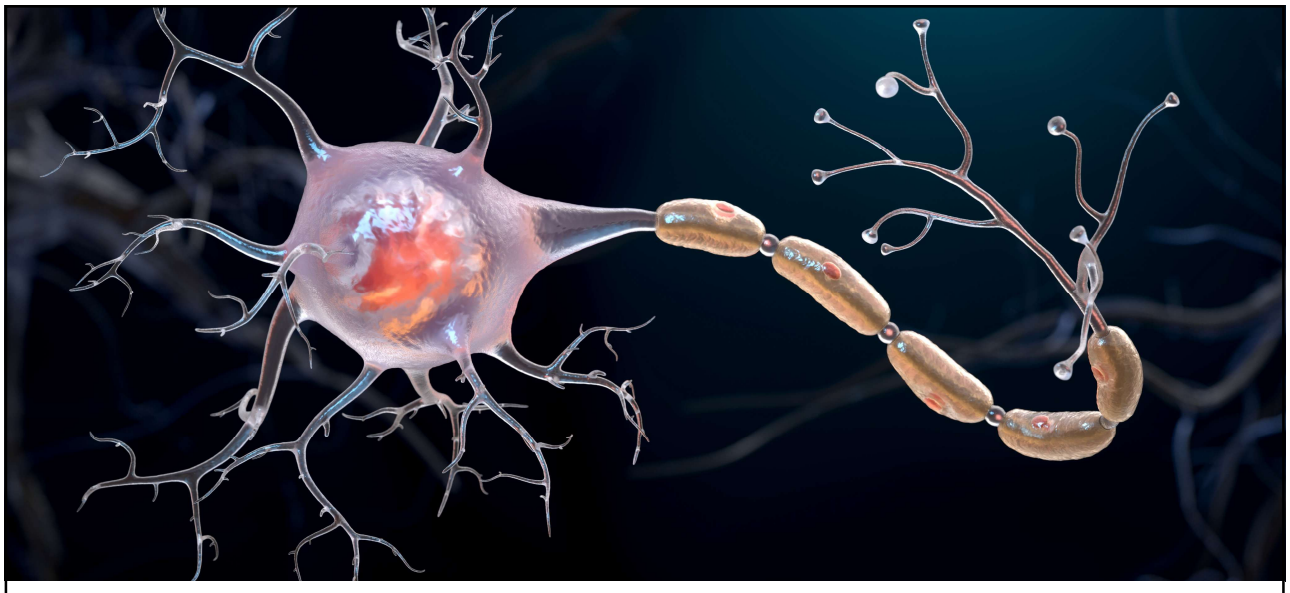

NS1.01 The Neurobiology of the Neuron

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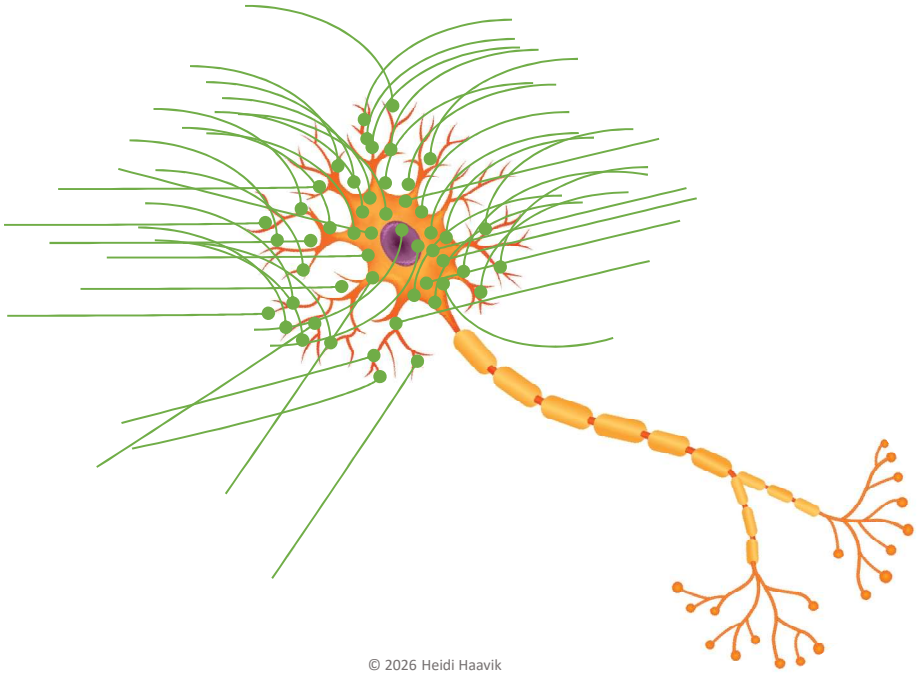

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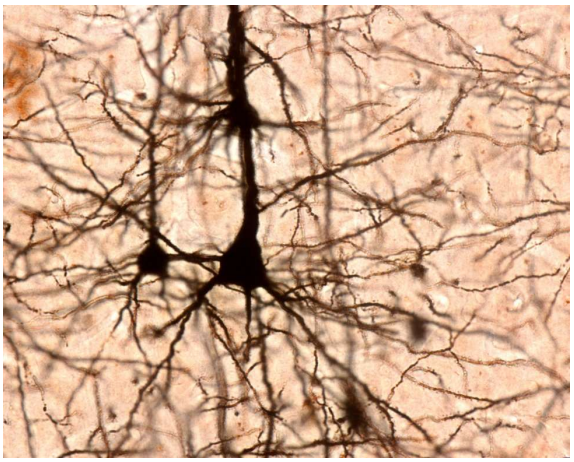
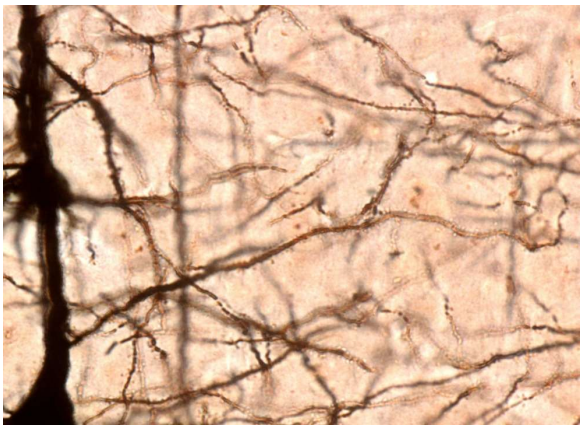
Dendritic spines





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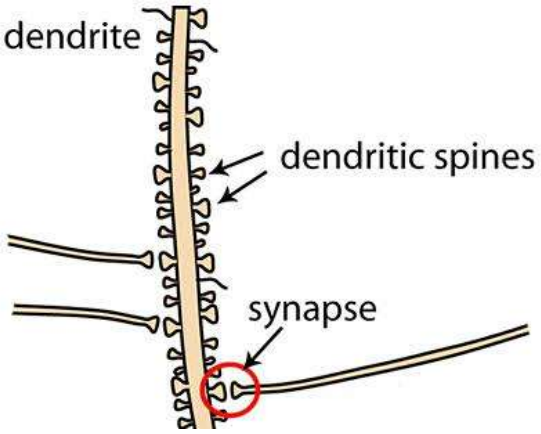
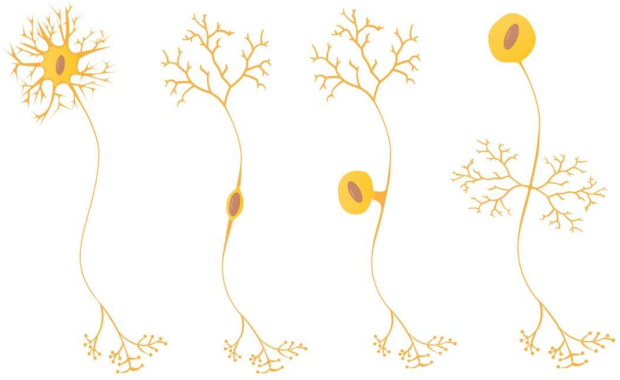
Dendritic spines

- Increased dendrite surface area also allows for more synapses
- Isolates reactions occurring at that synapse
- The amount of dendritic spines can changes (neuroplasticity) depending on use/environment and pathology

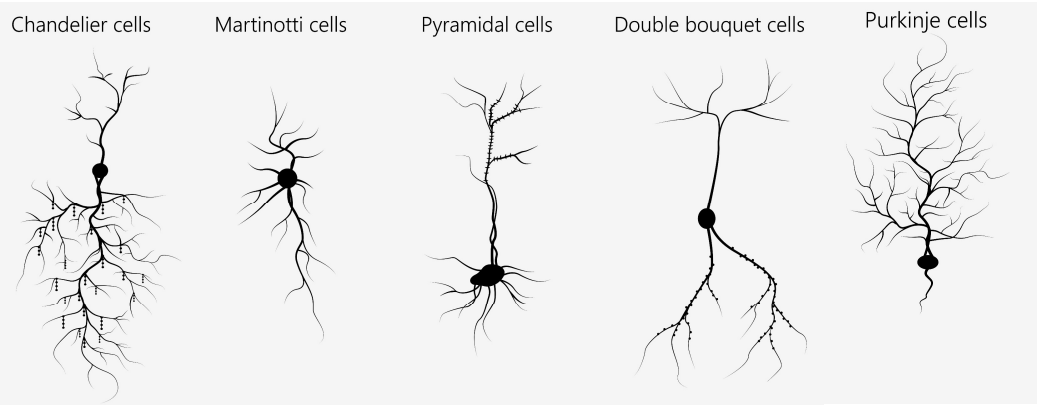


Variation in Neuronal Structure – based on neurites

- **Multipolar neuron**
  - most common
  - many dendrites/one axon
- **Bipolar neuron**
  - one dendrite/one axon
  - olfactory, retina, ear
- **Unipolar neuron**
  - sensory from skin & organs to spinal cord
- **Anaxonic neuron**
  - many dendrites/no axon
  - help in visual processes

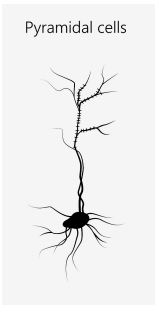


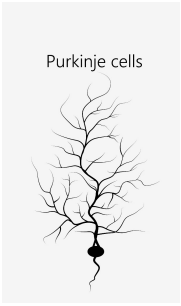
Variation in Neuronal Classification
e.g. based on dendrites or cell body



- Spiny or aspinous – depending on whether the dendrites have spines or not

According to size or length of axon





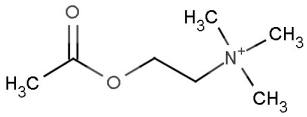
Golgi type 1 neurons have long axons

- Pyramidal cells of the cerebral cortex
- Purkinje cells of the cerebellar cortex
- Motor cells of the spinal cord

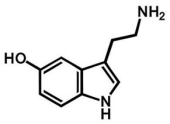
Golgi type II neurons have short axons

- Cerebral and cerebellar cortex have lots of Golgi type II neurons

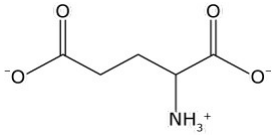
According to chemistry (neurotransmitter)



- **Cholinergic** – voluntary alpha motor neurons release acetylcholine as their neurotransmitter



- **Serotonergic** – cells that release serotonin



- **Glutaminergic** – cells that release glutamate

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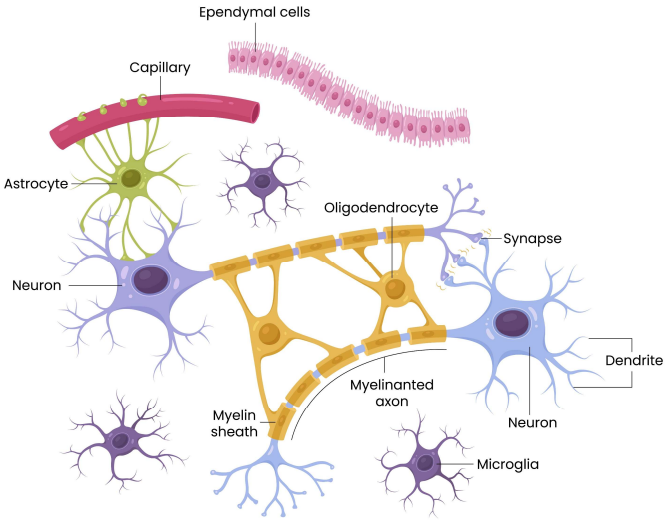
NS1.02 The Neurobiology of Glial Cells



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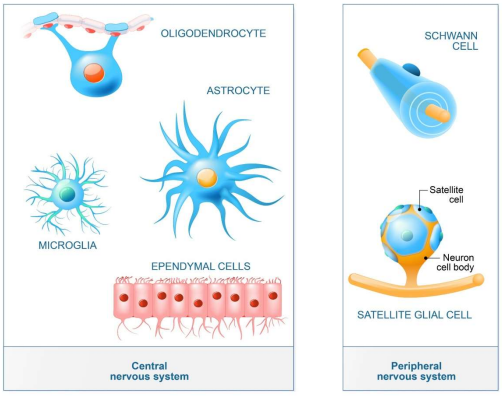
Glial Cells



- ***Regulators*** of nervous system function and homeostasis
- Structural support for neurons and neural networks
- Myelination of axons to increase conduction speed
- Regulation of extracellular ions and neurotransmitters
- Neurotransmitter uptake and recycling
- Modulation of synaptic activity and plasticity
- Metabolic and energy support for neurons
- Maintenance of the blood–brain barrier
- Immune defence and neuroinflammatory responses
- Synaptic pruning and neural circuit refinement
- Support of neurodevelopment and neuronal migration
- Involvement in learning, memory, and neuroplasticity
- Regulation of cerebral blood flow and homeostasis

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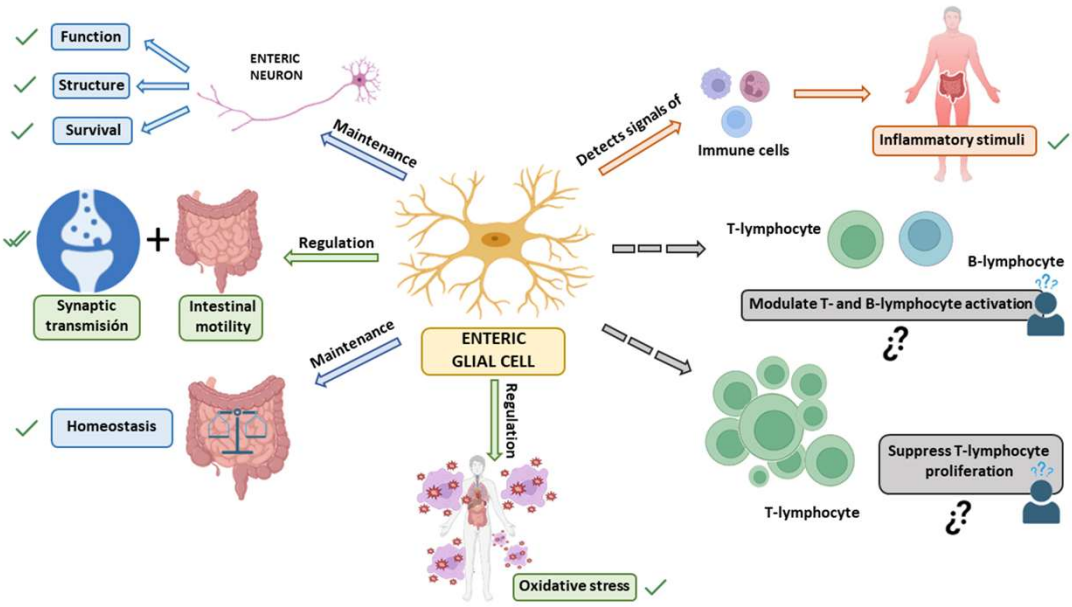

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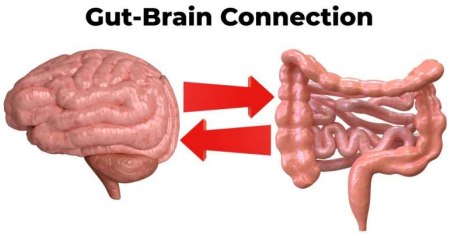
Glial cell dysfunction is known to lead to:

- Schizophrenia
- Bipolar disorder
- Attention deficit hyperactivity disorder (ADHD)
- Anxiety disorders
- Dementia
- Major depressive disorder
- Parkinson's disease
- Autism spectrum disorder
- Amyotrophic lateral sclerosis
- Alzheimer's diseases
- Prion diseases
- Encephalopathies
- Creutzfeldt-Jakob disease
- Depression and/or Anxiety
- Behaviour, Mood and/or Cognition
- Stress & Fatigue
- Stroke



- Motility disorders
  - Constipation
  - diarrhoea
- Malabsorption syndromes
- Infectious gastroenteritis
- Inflammatory bowel disease
  - Chron's Disease
  - Ulcerative Colitis
  - Intestinal inflammation
  - Irritable bowel syndrome

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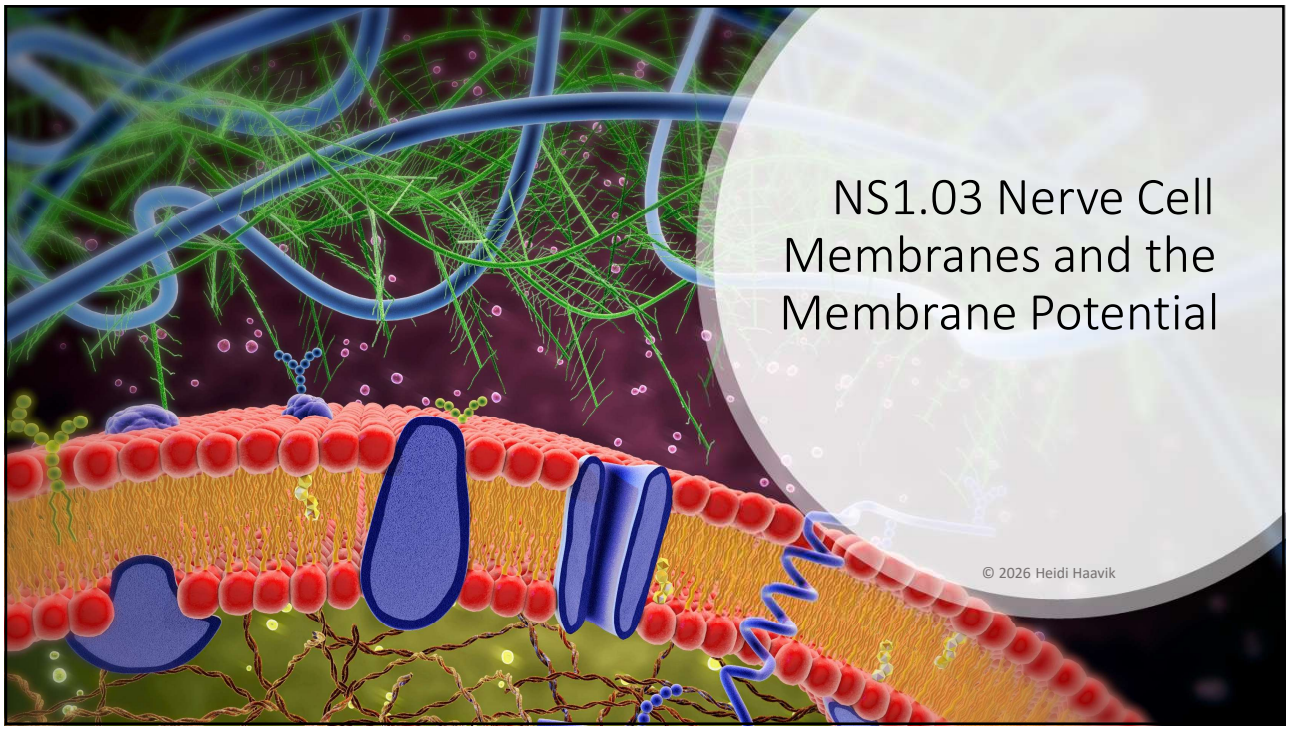

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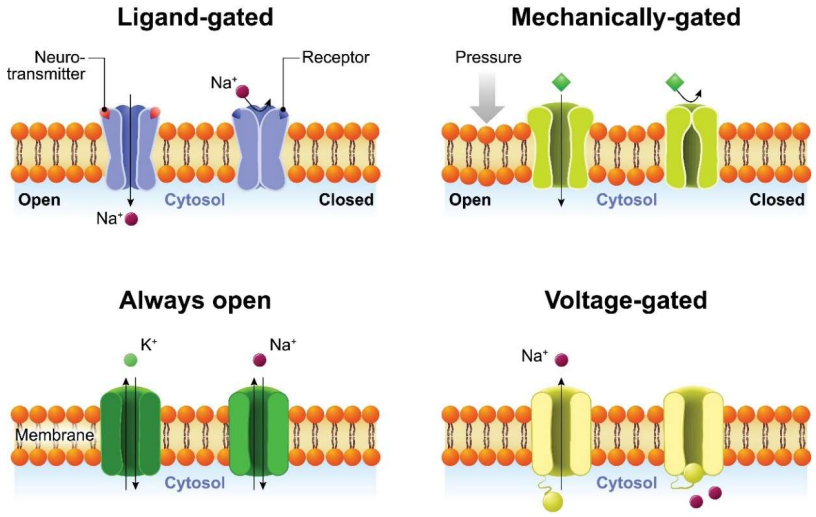

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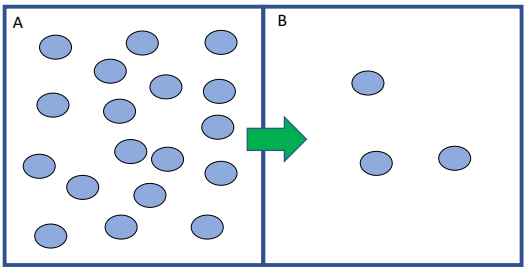
Two Forces Acting On Ions

1. The driving force of the **chemical concentration gradient** tends to move ions down this gradient (chemical potential).



2. On the other hand the **electrostatic force** due to the charge separation across the membrane tends to move ions in a direction determined by its particular charge.

- Opposites attract
- Same charge repels

- Cations (+ve)
- Anions (-ve)

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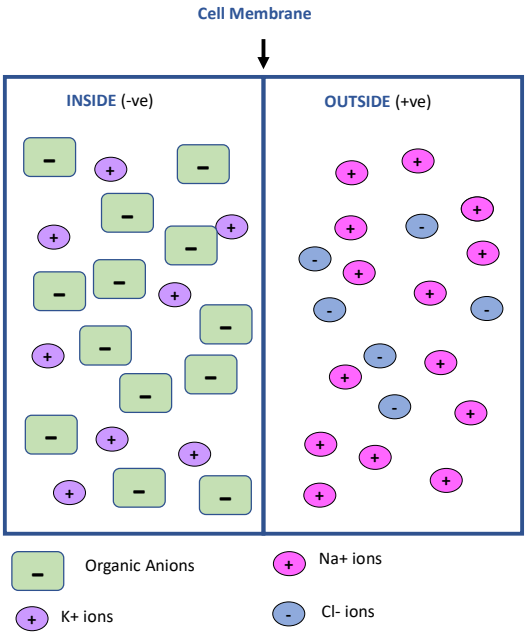
Charge Distribution

The relative excess of positive charges outside and negative charges inside the membrane of a nerve cell at rest is maintained because the lipid bilayer acts as a barrier to the diffusion of ions, and give rise to an electrical potential difference, which ranges from about 60 to 90mV.



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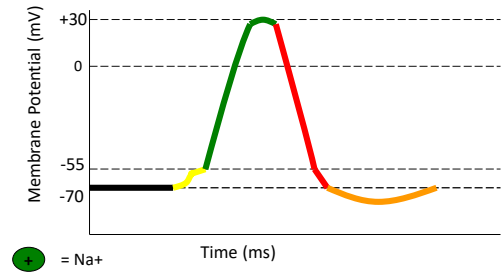
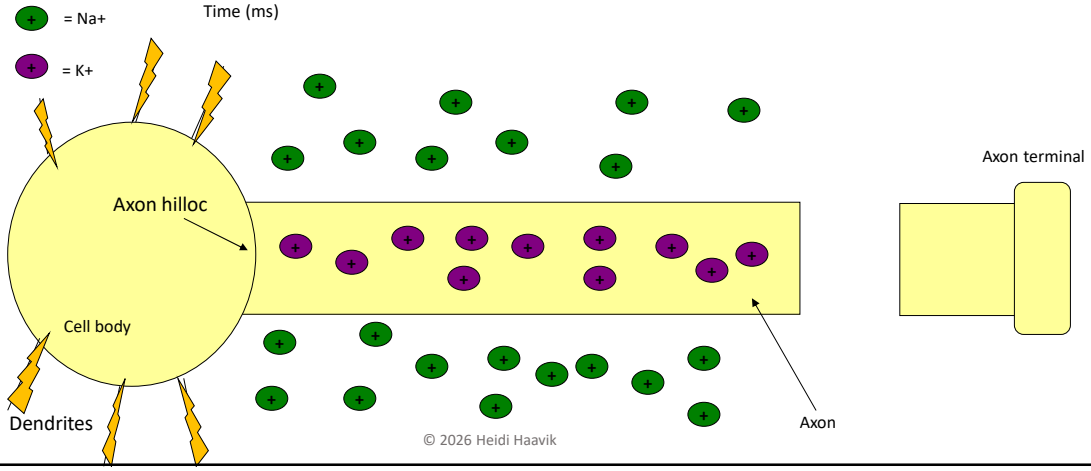
NS1.04 The Action Potential





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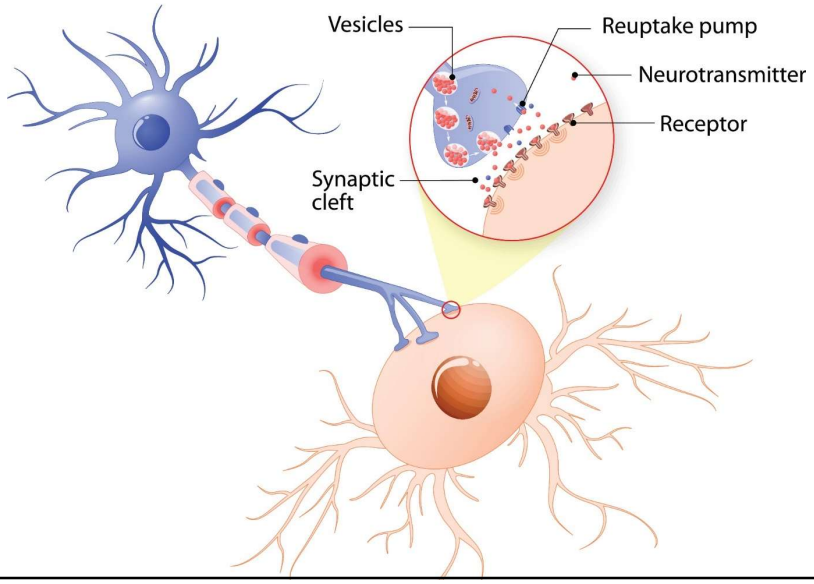
Three Types of Neuronal Information Transmission

1. Chemical signals are mainly involved in the transmission of information between neurons.
2. Transient electrical (electrochemical) signals are important for transferring information over long distances rapidly within the neuron (down the axon).
3. Intra-axonal transport of chemicals up and down the axon.



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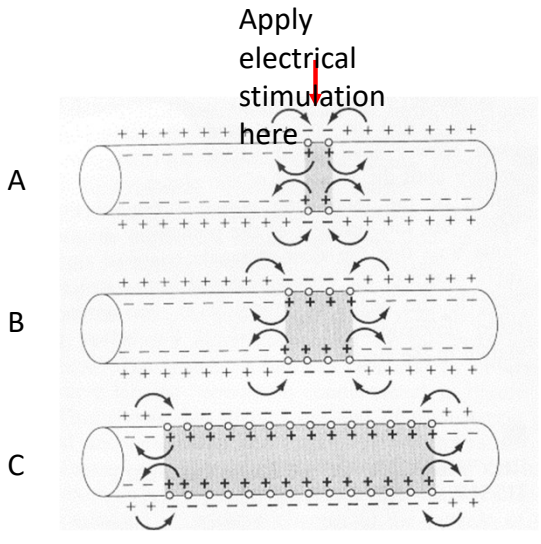

Action potential spreads in both directions from site of stimulation

Peripheral Nerve Stimulation

- In an experimental laboratory setting it is possible to apply electricity over a nerve or muscle through two electrodes (anode and cathode).
- This can initiate the action potential by opening the voltage-gated Na channels.
- This is called peripheral nerve stimulation.
- In this case, the action potential will spread in both directions.
- This does not occur under normal physiological conditions.

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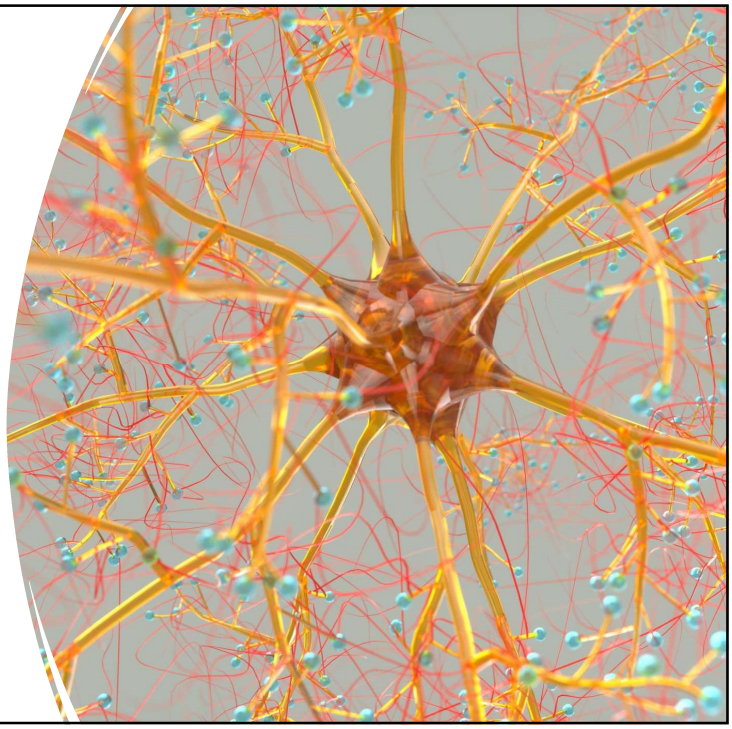
Key Take-Away Points from these classes

- Neurons = signaling units: The brain only knows what it is told through neural signaling
- The membrane = control of information flow; Every signal depends on ion gradients and membrane behavior. If this is off → signaling is off
- Action potentials = the language of the nervous system; All communication in the nervous system depends on threshold and firing. No threshold → no signal. Altered threshold → altered signaling
- Glial cells = regulators, not just support: The brain is not just neurons firing. It is a regulated, modulated system. Glia influence:
  - excitability
  - inflammation
  - efficiency
  - plasticity



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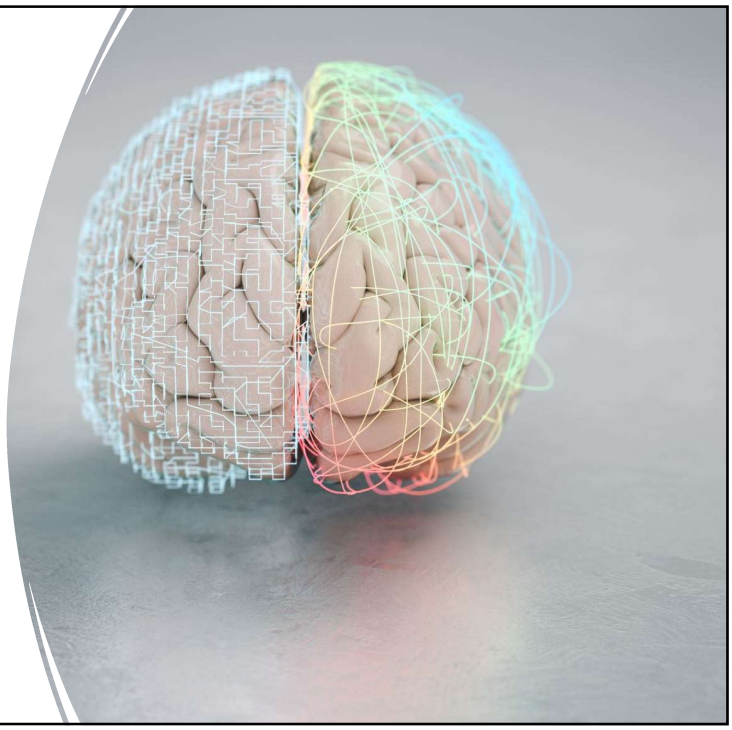
Everything the brain does depends on how well it can receive, regulate, and transmit signals

The nervous system is constantly:

- receiving input
- processing it
- predicting
- responding



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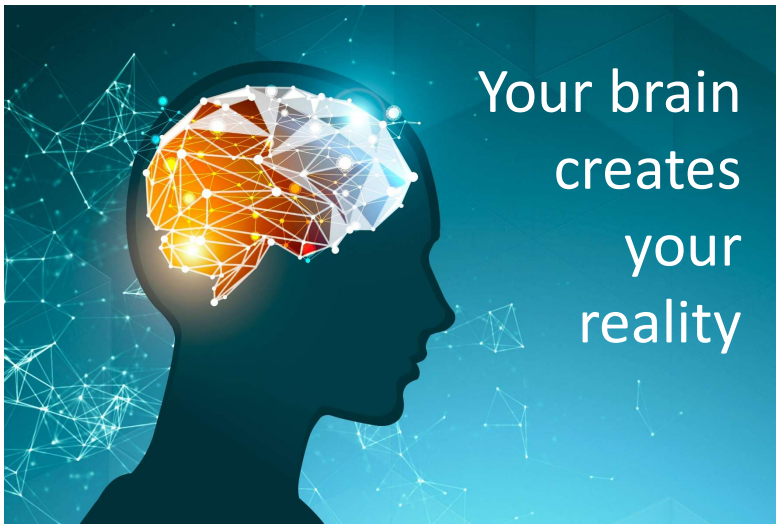

The predictive brain theory (or predictive processing) posits that the brain is an active prediction machine, not a passive receiver of sensory input.

It continuously generates top-down models of the world to anticipate sensory data and minimize "prediction errors" (differences between expectation and reality), driving perception, cognition, decision-making, action, and learning.

(Sprevak & Smith 2023 Top Cogn Sci; Millidge et al 2021 arXiv preprint arXiv:2107.12979*)*

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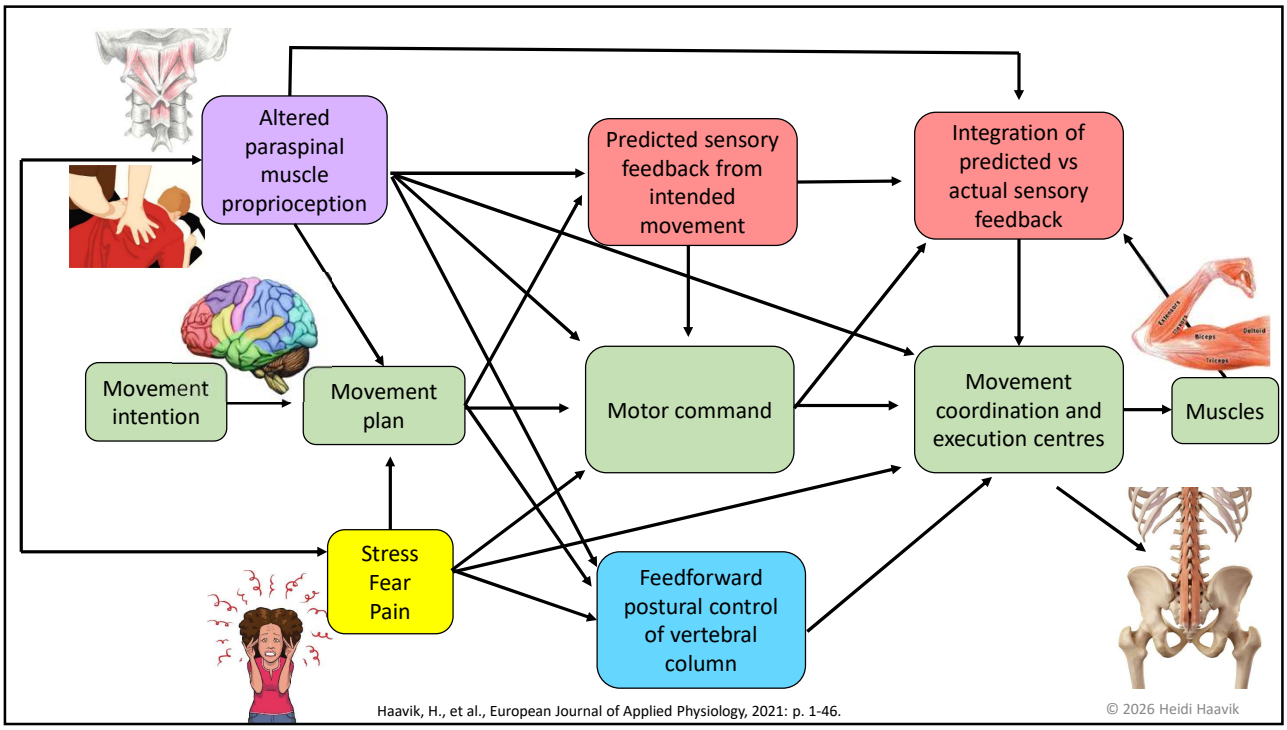

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(Alexander & Brown 2018 Scientific Reports)

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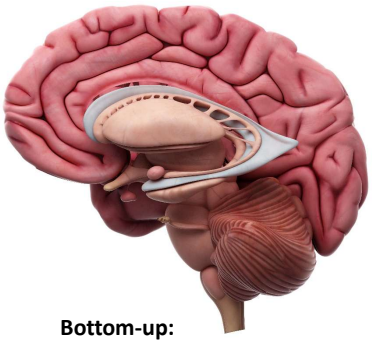
Top-down:
- Predictions flow downward
- Suppress / "explain away" error

Sensory information is processed across distributed cortical hierarchies

At each level incoming input is compared against top-down predictions and prediction errors are generated.

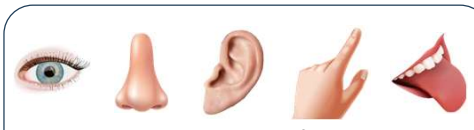
Front: Prediction & meaning

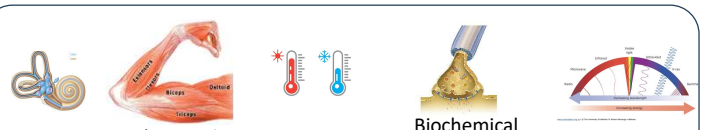


Back: Sensory input & error

These error messages are propagated upward and evaluated by salience-related systems (e.g., anterior cingulate and insula), while higher-order regions (e.g., prefrontal cortex) update internal models, which are then projected back down to shape ongoing perception.

Bottom-up:
- Error detection travel upward
- Update higher-level models





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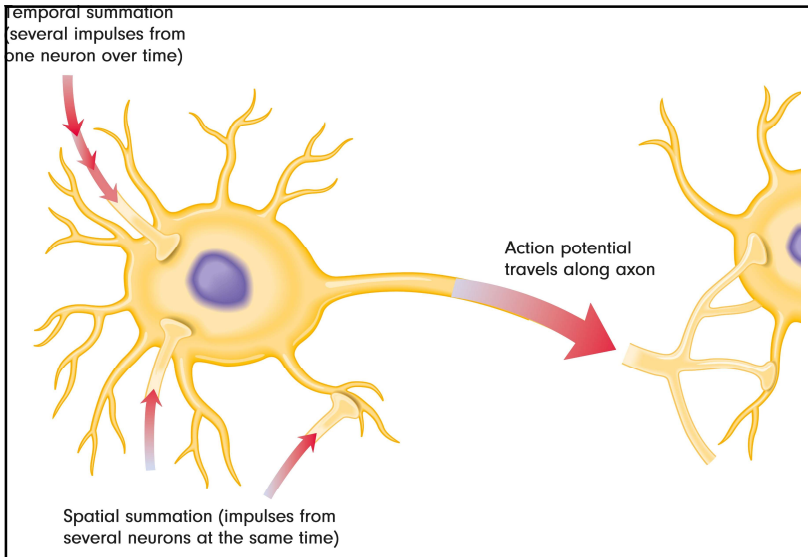

- If membrane function is altered:
  - signaling becomes unstable or inefficient
- If thresholds change:
  - neurons fire too easily or not enough
- If input is distorted:
  - the brain builds the wrong "map"
- If glial regulation shifts:
  - the system becomes:
    - overactive
    - underactive
    - inflamed
    - poorly adaptive

Before you ever see pain or dysfunction, you have altered signaling

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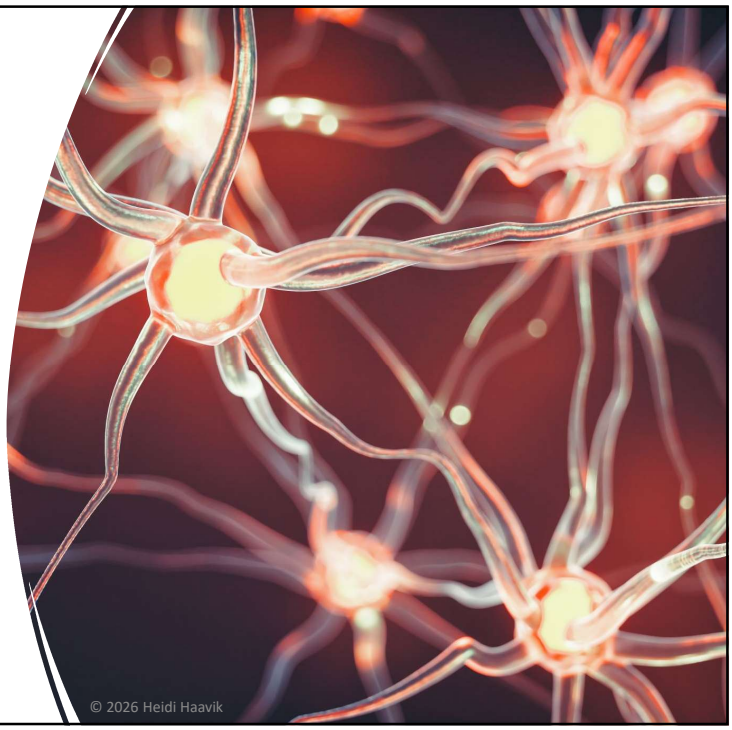
What can change these things?

1. Sensory input
   - Especially input that does not match expectations
2. Stress
   - Increases cortisol, autonomic shifts, neuromodulators from chronic stress, poor sleep, emotional load, hypervigilance from past trauma
3. Inflammation and metabolic environment
   - Glial cells end up activated altering neuronal signalling and communication and changing signal to noise ratios



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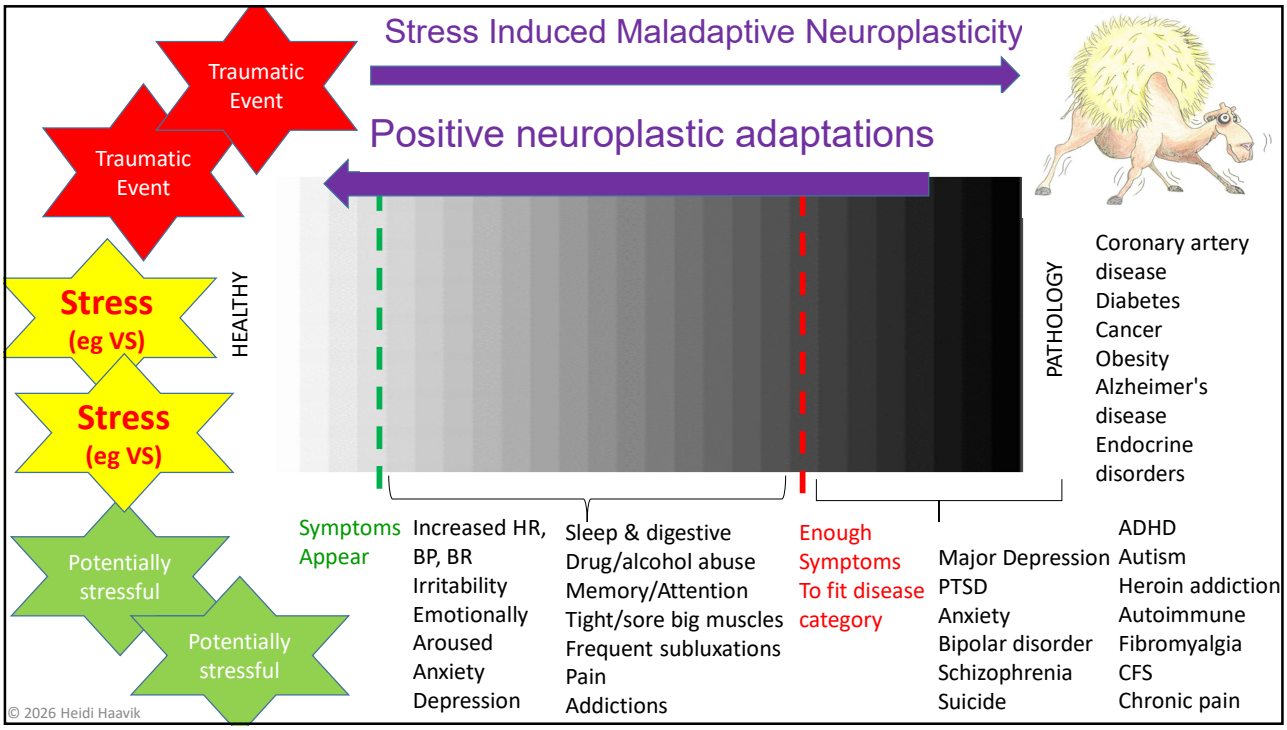

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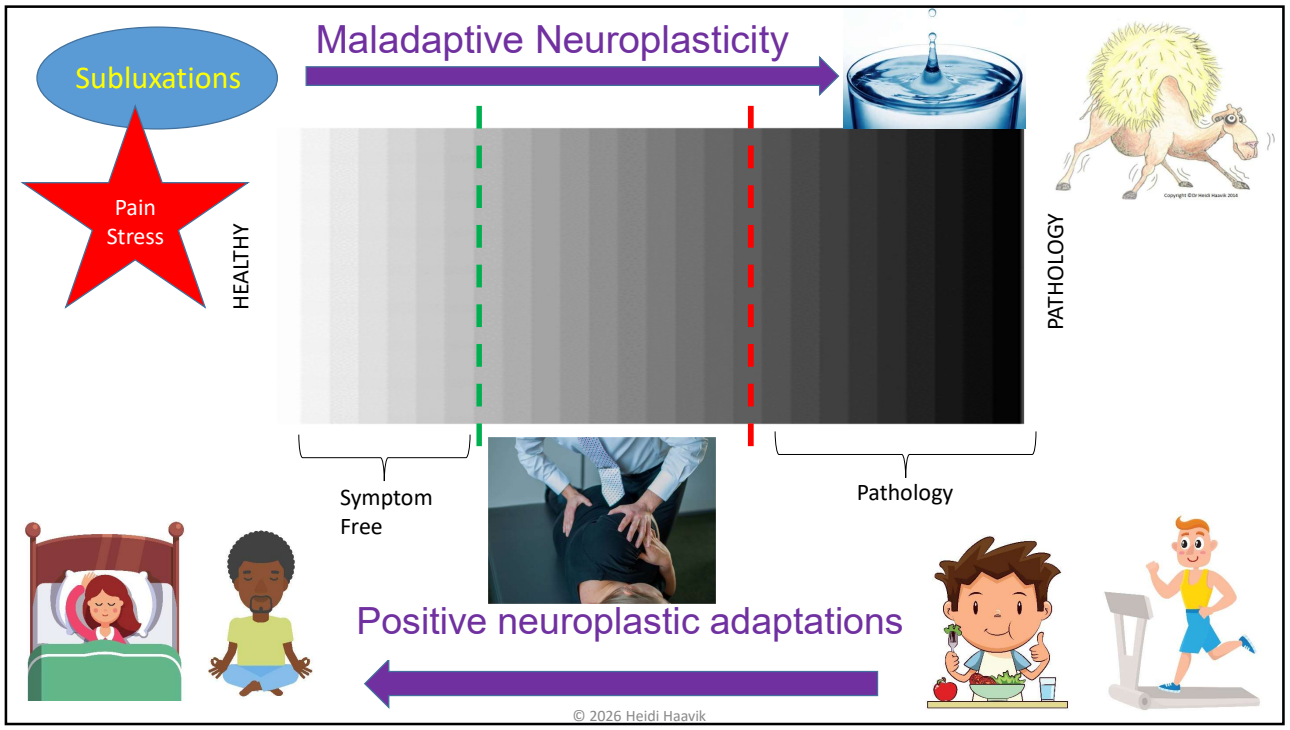
Subluxations
Pain
Stress
Maladaptive Neuroplasticity
HEALTHY
PATHOLOGY
Symptom
Free
Pathology
Positive neuroplastic adaptations
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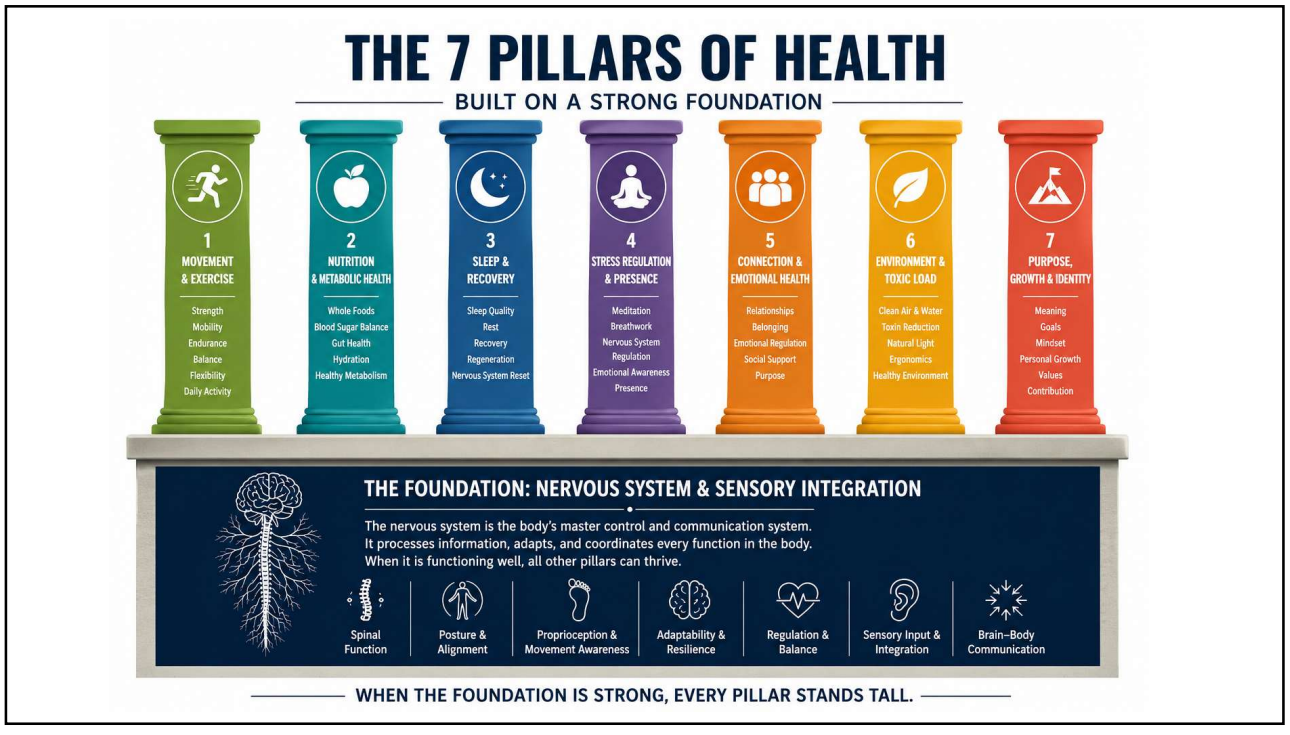
THE 7 PILLARS OF HEALTH
BUILT ON A STRONG FOUNDATION
1 MOVEMENT & EXERCISE
Strength
Mobility
Endurance
Balance
Flexibility
Daily Activity
2 NUTRITION & METABOLIC HEALTH
Whole Foods
Blood Sugar Balance
Gut Health
Hydration
Healthy Metabolism
3 SLEEP & RECOVERY
Sleep Quality
Rest
Recovery
Regeneration
Nervous System Reset
4 STRESS REGULATION & PRESENCE
Meditation
Breathwork
Nervous System Regulation
Emotional Awareness
Presence
5 CONNECTION & EMOTIONAL HEALTH
Relationships
Belonging
Emotional Regulation
Social Support
Purpose
6 ENVIRONMENT & TOXIC LOAD
Clean Air & Water
Toxin Reduction
Natural Light
Ergonomics
Healthy Environment
7 PURPOSE, GROWTH & IDENTITY
Meaning
Goals
Mindset
Personal Growth
Values
Contribution
THE FOUNDATION: NERVOUS SYSTEM & SENSORY INTEGRATION
The nervous system is the body's master control and communication system.
It processes information, adapts, and coordinates every function in the body.
When it is functioning well, all other pillars can thrive.
Spinal Function
Posture & Alignment
Proprioception & Movement Awareness
Adaptability & Resilience
Regulation & Balance
Sensory Input & Integration
Brain–Body Communication
WHEN THE FOUNDATION IS STRONG, EVERY PILLAR STANDS TALL.

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Questions