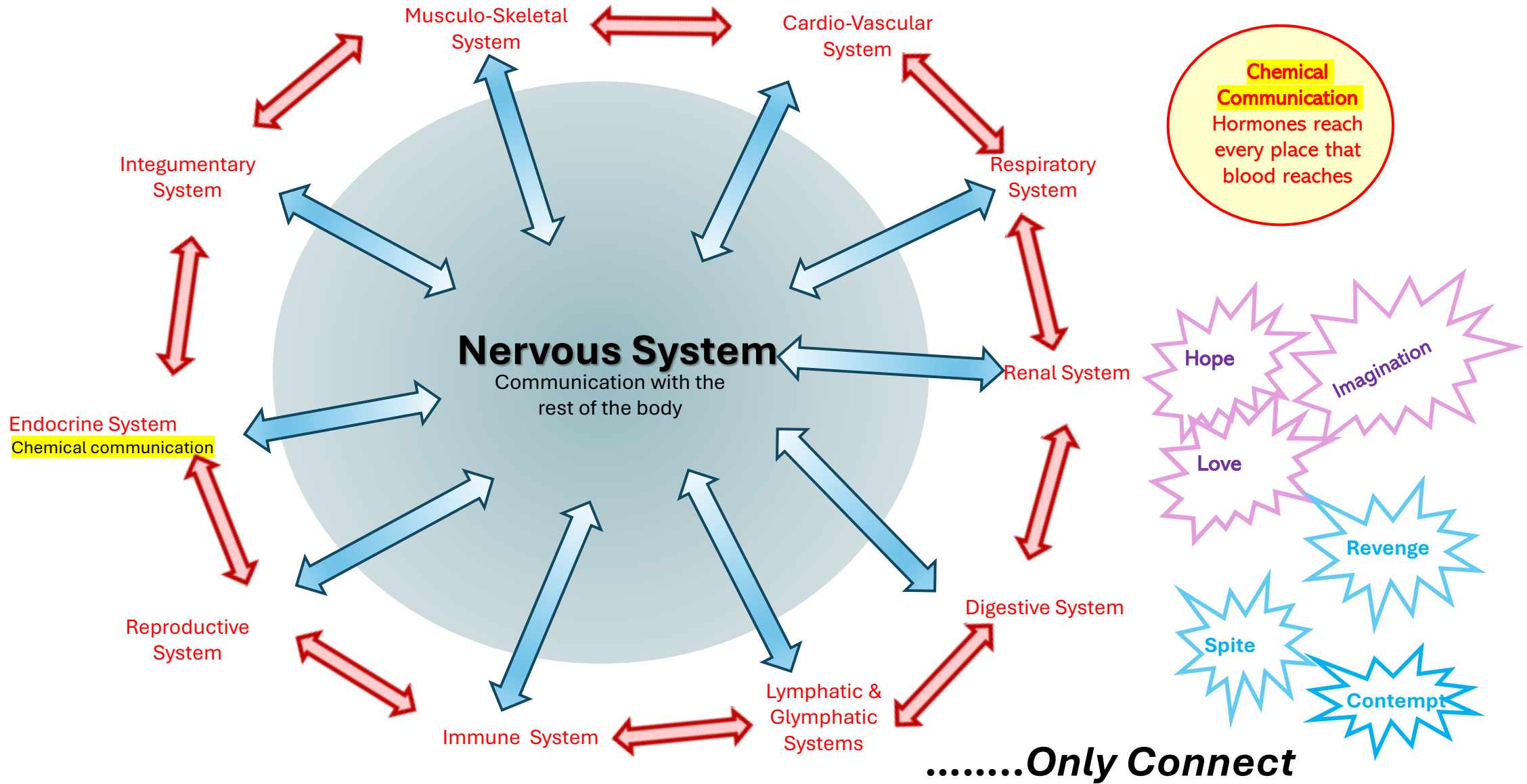


Nervous System *(“High Lights”)* and acupuncture

U3A Science Group 25th July 2024

Jan Athis

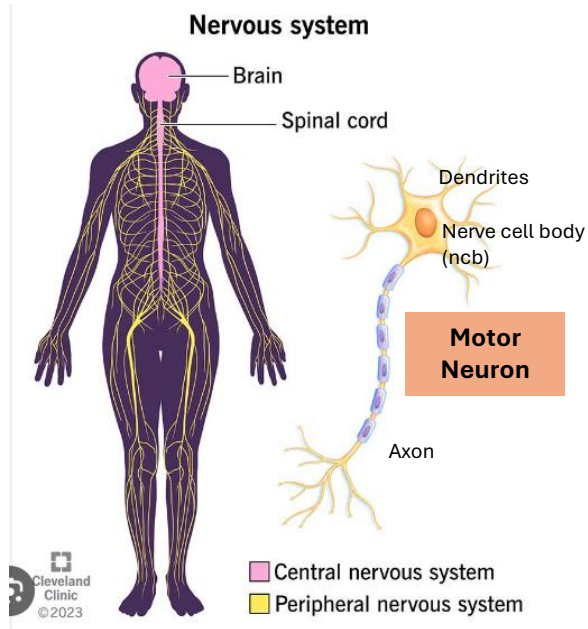


The Nervous System is Complex!

(sub text - Why on earth did I chose this topic!!)

This presentation is mostly on “physiology” ie how it WORKS –
but I have to give a bit of anatomy (how it's made up) as well

There are two main parts -



Central Nervous System (CNS)

inside the cranium [*the brain*] and inside the spinal column

Peripheral Nervous System (PNS)

the nerves & associated structures [*eg ganglia*] OUTSIDE the cranium & spinal column

Neurons (CNS & PNS) conduct impulses to other neurons & to cells in rest of the body

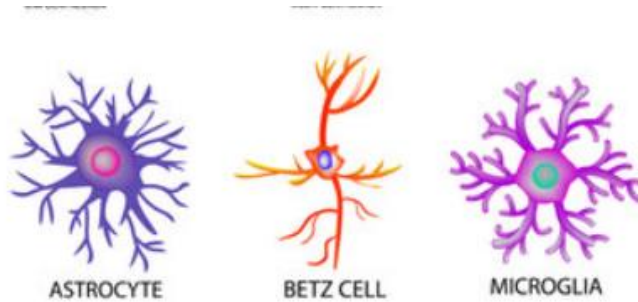
Dendrites (>1 per neuron) are cell extensions that connect to other neurons and pass impulse towards the nerve cell body (*contains nucleus*)

Axons (only 1 per neuron) conduct impulses away from nerve cell body

Axons vary in length from um to metre (*eg sciatic nerve*)

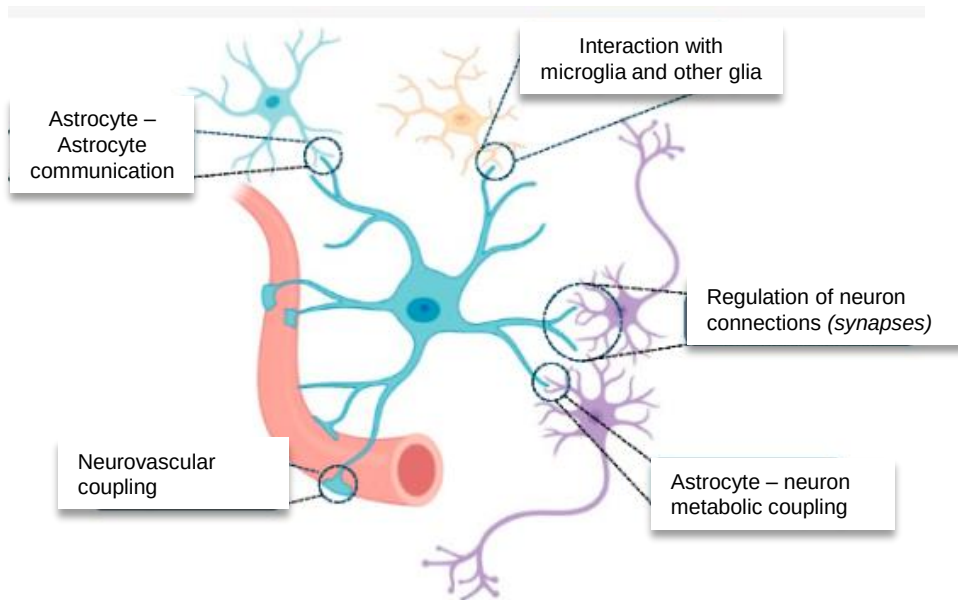
Each ‘nerve’ in the body has thousands of neurons

Central Nervous System



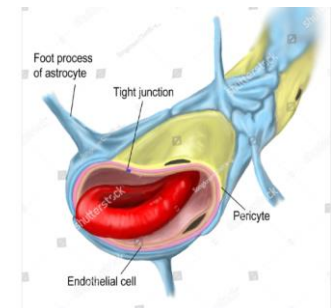
In addition to neurons, the CNS is PACKED with supporting cells , collectively called “**glia**”
The most studied are **astrocytes & microglia**

The true significance and function of these “glia” is only beginning to be recognised. In the past they were considered “just protecting cells” – a bit like bubble wrap



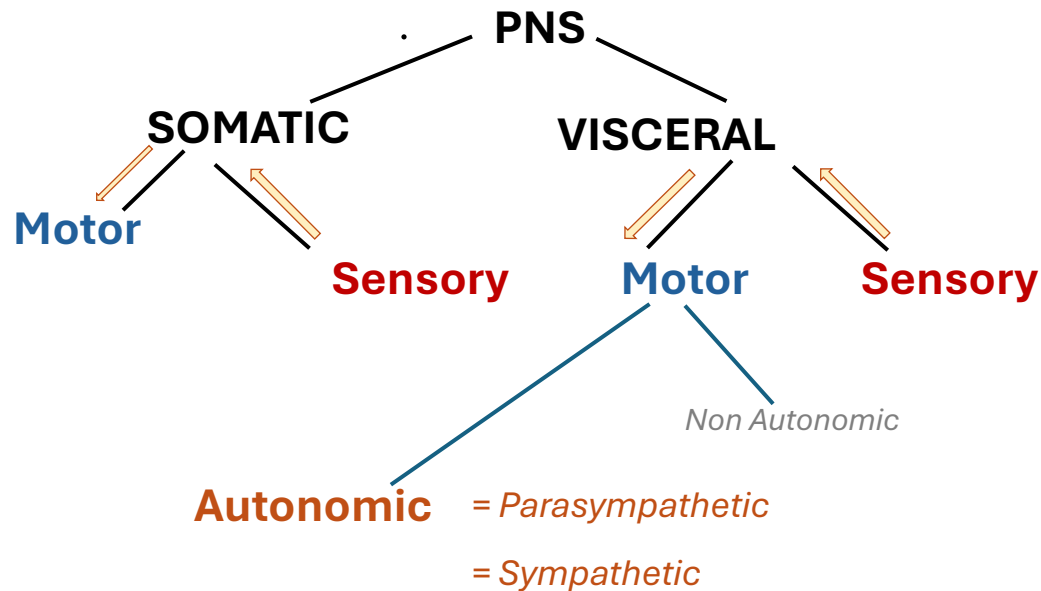
Astrocytes are integral to the functioning the glymphatic system –
An anatomical structure in the brain only identified in **past decade!**

The glymphatic system appears to **ONLY** function during sleep (*not coma or anaesthesia*) and clears metabolic waste including the tau & amyloid proteins, both of which have been associated with Alzheimer's.



.....Only Connect

Peripheral Nervous System



PNS is **functionally** divided into two branches
(1) **SOMATIC** (“body”) and (2) **VISCERAL** (“internal organs”)

Each of these branches is divided into **MOTOR** (*makes things move*) [efferent] and **SENSORY** (*afferent*)

The motor branch of the VISCERAL nervous system is further divided into the **Autonomic (ANS)**
aka **Parasympathetic & Sympathetic**

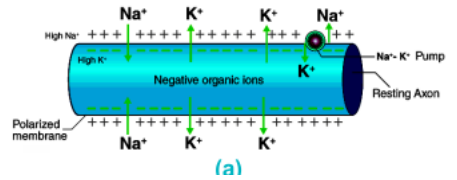
This system uses **sensory information** to adjust responses including all physiological and psychological changes during emotions.

Parasympathetic can be affected by guided imagery

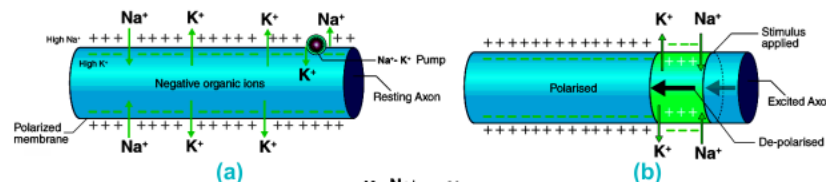
QUESTION: As our emotions are EXPRESSED in the viscera, why do we say they are “located” in NS?

Heart felt ... ; Cold-hearted ... ; Gut feeling ; Splenetic response....

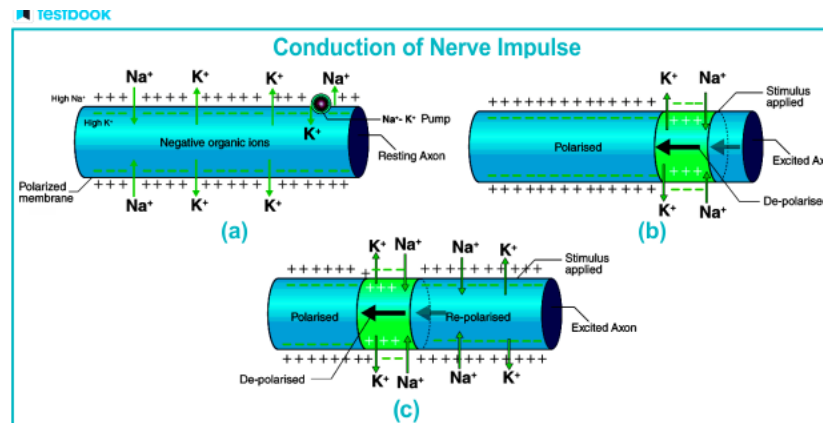
Nerve impulse -the simplified version!! (electrical part of transmission)



Resting state – Na^+ ions are actively kept outside the neuron; their charge is balanced by $-ve$ ions inside

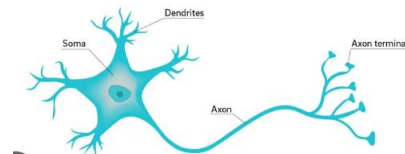


Stimulus applied, “gate” in neuron membrane opens & Na^+ ions flood in & K^+ ions out. This triggers more gates to open



All cells in body have “Resting Potential” $[-20 \text{ to } -100\text{mV}]$, but only neurons can generate ACTION POTENTIAL

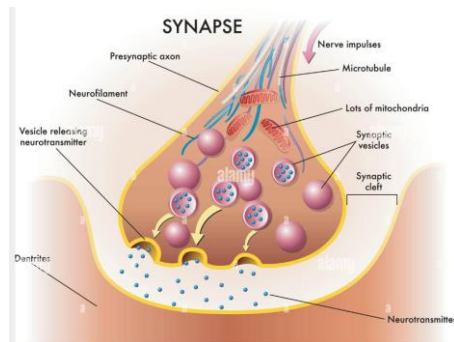
Wave of **DEPOLARISATION** travels along neuron extensions (i.e. axons / dendrites)



Subsequently, the Na^+ is pumped out and “resting potential “ restored

Nerve impulse -the simplified version!! (chemical part of transmission)

Nerve impulse travels along axon, to terminal (*aka “end plate”*), where neurotransmitter (chemical) released from storage vesicle into / across gap (40nm) between axon and dendrite . This causes depolarisation of distal membrane and nerve impulse travels on



Neurotransmitters are “inhibitory”
and “Excitatory”

Membranes physically separate neurons from other neurons.
The impulse must cross this boundary.
Synaptic vesicles store 1000s NT molecules.
Vesicles are replenished after discharge.

Examples neurotransmitters (>40 known)

ACETYL CHOLINE (excitatory) **parasympathetic NS**

GLUTAMATE (excitatory) - **in CNS** Imbalances associated with Parkinsonism; Alzheimer's; dementia

GAMA AMINO BUTYRIC ACID (GABA) (inhibitory) – **in CNS**

SEROTONIN (inhibitory) **in CNS** and **PNS**

GLYCINE (inhibitory) **in spinal cord**

HISTAMINE – **in NS** regulates sleep/wake cycle; cognitive function
- **in blood** acts as hormone
- **in tissues** acts as inflammatory mediator

ADRENALIN *aka epinephrin* (excitatory) – same as adrenal hormone **sympathetic NS**

NORADRENALIN *aka norepinephrin* – same as adrenal hormone **sympathetic NS**

DOPAMINE chemically same as hormone from adrenals MANY functions! See next slide!

The role of dopamine in the body

Dopamine as neurotransmitter is involved in

- MOVEMENT
- MEMORY
- PLEASURABLE REWARD AND MOTIVATION
- BEHAVIOUR AND COGNITION
- ATTENTION
- SLEEP AND AROUSAL
- MOOD
- LEARNING
- LACTATION

BRAIN

Dopamine as a hormone (ie released into bloodstream)

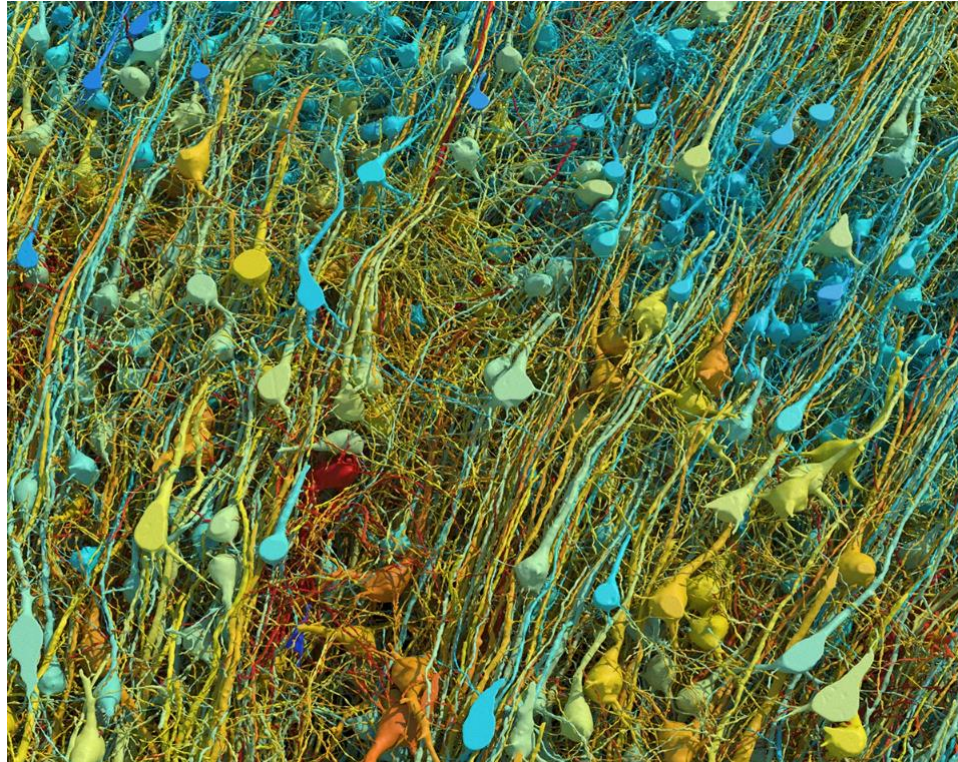
- PLAYS A SMALL ROLE IN THE FIGHT OR FLIGHT SYNDROME.
- AT LOW LEVELS, CAUSES BLOOD VESSELS TO RELAX
- AT HIGHER LEVELS, CAUSE BLOOD VESSELS TO CONSTRICT
- INCREASES SODIUM AND URINE REMOVAL FROM BODY
- REDUCES INSULIN PRODUCTION IN PANCREAS
- SLOWS GASTROINTESTINAL (GI) CONTENT MOVEMENT
- PROTECTS GI LINING
- REDUCES LYMPHOCYTE ACTIVITY IN IMMUNE SYSTEM

ADRENALS
(on kidneys)

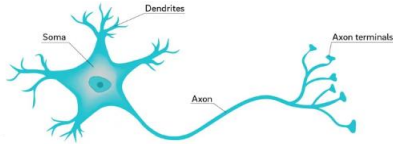
Diagrams can make thing look simple - reality is different!!

Google scientists have modelled a fragment of the human brain at **nanoscale** (i.e 1/1000 of micrometre) resolution, revealing cells with previously undiscovered features.

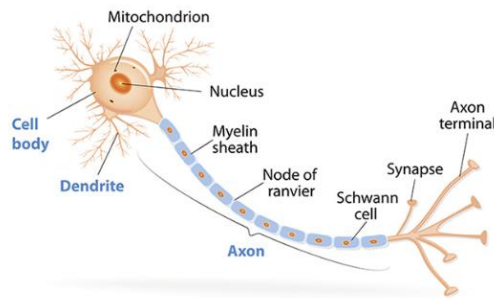
Human brain – 86 billion neurons form 100 trillion connections to each other



Nerve impulse - Enhancing speed of transmission



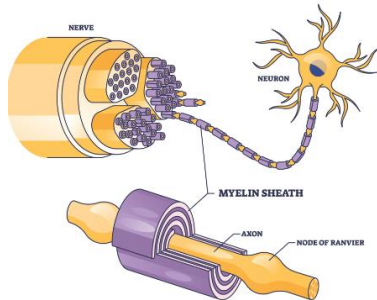
Within CNS distance between neurons (dendrites / axons) is small. Oligodendrite cells wrap insulation (myelin) around several axons



Within PNS distance between neurons & target tissues can be significant

During embryo development, fat filled cells (“Schwann cells”), wrap around individual axons of motor neurons. The gaps between are called “Nodes of Ranvier”, ~1um

MYELIN SHEATH



The fatty insulating material (*myelin*) in the Schwann cells means the impulse “jumps” from node to node
Every motor nerve incorporates numerous motor axons

Motor Neurone Disease – *Sports man died June 2024* For unknown reasons myelin sheath degrades, space between Ranvier nodes increases & become “too far” for the impulse to jump

Acupuncture



British Medical Journal says ...

“.... evidence shows that acupuncture works to **stimulate reflexes that activate peripheral nerves, transmit sensory information** from the spinal cord to the brain, then **activate peripheral autonomic pathways**, and eventually **modulate physiology...**”

> 10 000 randomised controlled trials on acupuncture published since 1975.

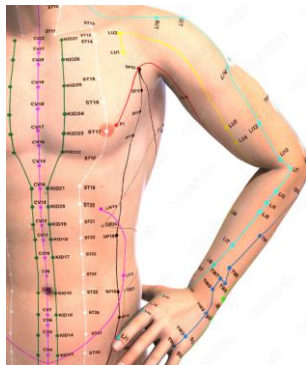
<https://www.bmj.com/content/376/bmj-2021-067475>

NHS website says...

Acupuncture involves stimulating sensory nerves under the skin and in the muscles, resulting in body producing endorphins & other natural and beneficial substances

<https://www.nhs.uk/conditions/acupuncture/?ContentisTextOnly=true>

Five Element
acupuncture
meridians,
with
acupoints

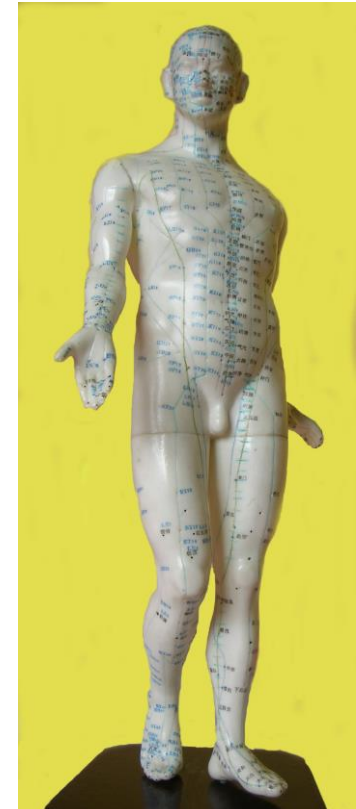


Currently, NICE only recommends considering acupuncture as a treatment option for:

- chronic (long-term) pain
- chronic tension-type headaches
- migraines
- prostatitis symptoms
- hiccups

Acupuncture is also often used to treat other conditions and symptoms, including:

- joint and muscle pain
- jaw pain
- cancer symptoms such as pain
- side effects of cancer treatment such as feeling or being sick from chemotherapy
- feeling sick or being sick after surgery

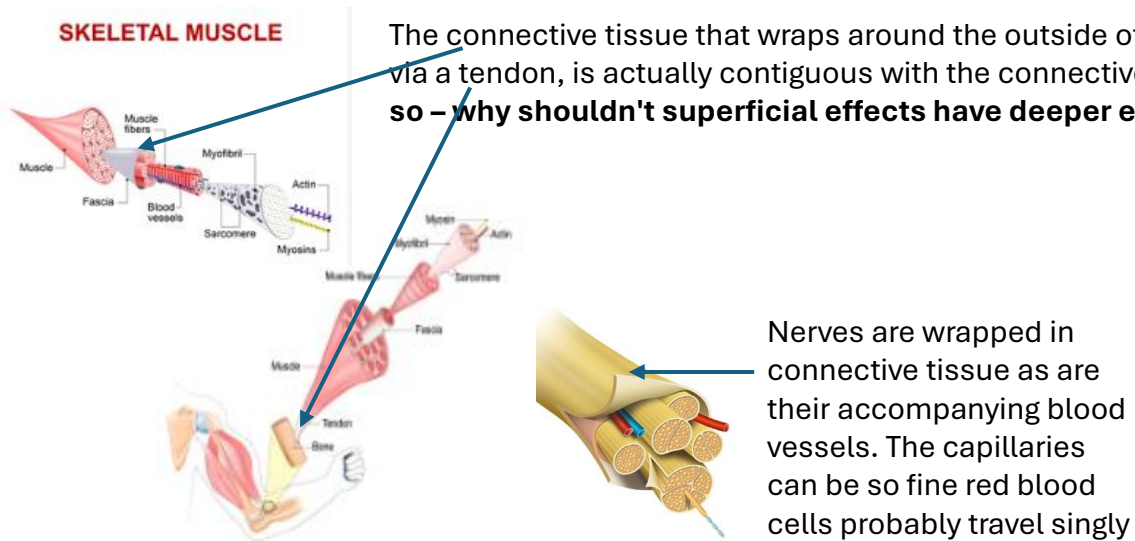


Acupuncture

Might we be missing the Bigger Picture?

By concentrating on the nervous system in isolation from the rest of the body, **are we losing sight of the whole?** *“Only Connect”*

The entire body is lined by connective tissue; both **outside** each organ and **inside** and **throughout** each organ.



Remember Astrocytes? (“bubble-wrap”)



50 yrs ago astrocytes were categorised as “just packing material”

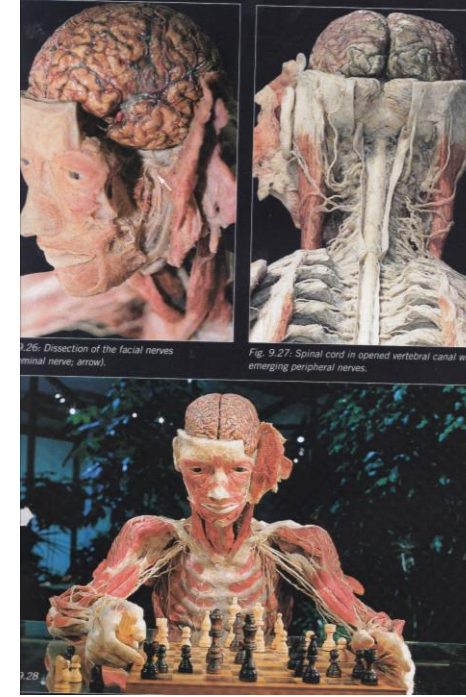
These glial cells make up the **majority** of cells in human CNS. In addition to functions mentioned earlier ...they perform metabolic, structural, homeostatic, and neuroprotective tasks eg clearing excess neurotransmitters, stabilizing and regulating the blood-brain barrier, and promoting synapse formation.

Fascia – The Forgotten System

by Optimal Movement | May 7, 2020 | Sports & Remedial Injuries, Injury Proofing, Members Health, Members Therapy | 0 comments



Fascia = connective tissue “a continuous web with no beginning or end” [Co-Pilot]. When stressed, it tightens up. As it **connects** everything, superficial adjustments could affect deep structures. And thereby our physiological and emotional state?



Human nervous system

In these dissections, the fascia have been removed to facilitate display – does this diminish the value of the image?

We still have lots to learn.....

Not that long ago, microbes were considered to be “just co-incidental” when not actually pathogenic... now we know they are vital to many functions

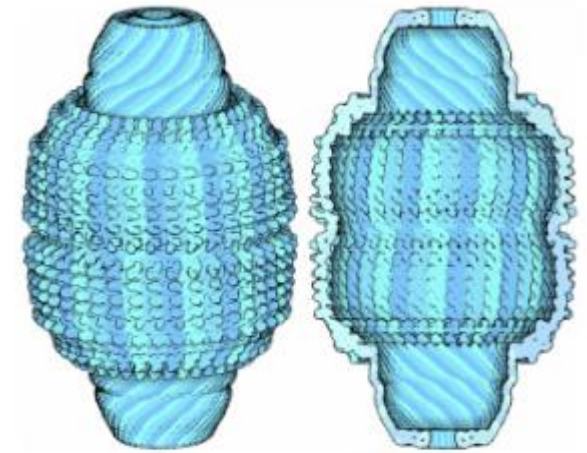
An example ...*(nothing to do with NS or acupuncture)*

Forty years ago UCLA researchers attempting to isolate cell vesicles (ribosomes) spotted apparent contaminant particles.

These barrel shaped particles are made of 3 protein types (*a ribosome might contain 100*) & 4% RNA. They were named “vaults”.

one of the biggest naturally occurring particles in cells.
difficult to stain & differentiate from other cellular bodies.

have traits suggesting important cellular function



Vaults

70 nm (= large)

Abundant (10,000 per human cell)

Highly conserved (unchanged over evolution)

No one has figured out what they might be for

<https://thebiologist.rsb.org.uk/biologist-features/unlocking-the-vault>

THANK YOU!

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“Co-Pilot” AI