



Ask Weber Session 3

Nervous system

Weber Liu



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Nervous system 1

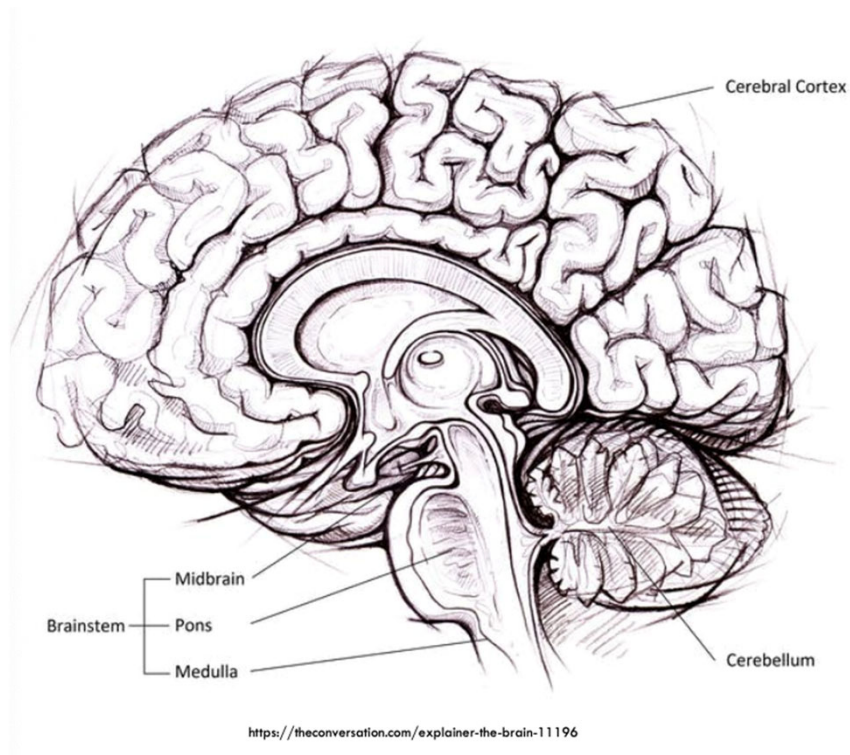


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CNS vs PNS

- **Name two components of the CNS**
 - Brain
 - Spinal cord
- **Is the autonomic nervous system part of the CNS or the PNS?**
 - Peripheral nervous system

Brain descriptors



– In the figure to the left

– Describe what components are within the ‘forebrain’

- Cerebrum
- Thalamus
- Hypothalamus
- Pineal gland
- Limbic system

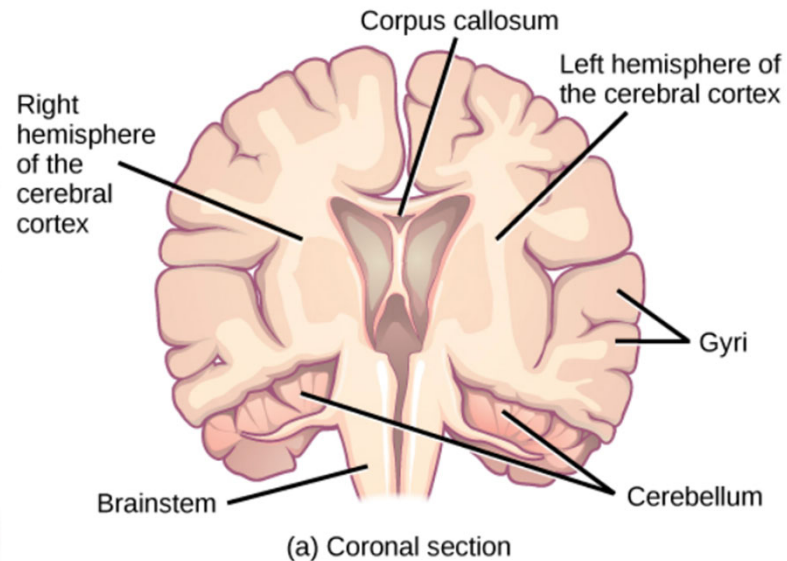
– Describe what components are within the ‘hindbrain’

- Midbrain, brainstem cerebellum

Cerebrum divisions

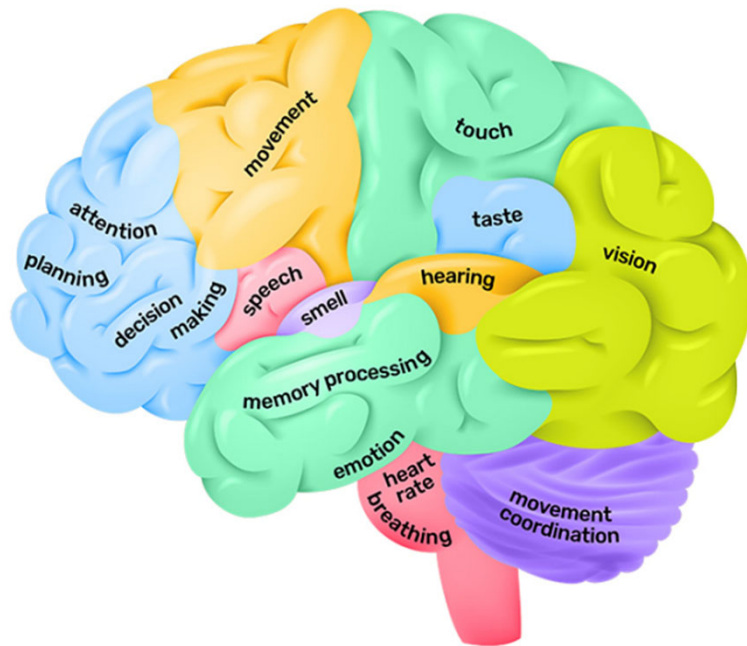
- **Name the 4 lobes of the cerebrum**
 - Frontal
 - Occipital
 - Temporal
 - Parietal
- **Define sulci and gyri**
 - Sulcus = fold (in)
 - Gyrus = outward bump
- **Does the inside or the outside of the cerebrum consist of cell bodies?**

Cerebral anatomy



- What structure in the brain acts as a bridge with massive neural connections between the left and right hemispheres of the brain? Hint – the rain man lacked this structure!
 - Corpus callosum

Cerebrum anatomy



- **Harder question: What side of the brain is involved in the processing of verbal language and speaking?**
 - Left – these areas are Wernicke's and Broca's areas respectively and are typically found on the left side of the brain
- **What areas of the brain integrate sensory information?**
 - Parietal lobe (Look up the homunculus and its mapping)
- **An elderly patient has an infarct in the posterior aspect of his brain. What lobe is this, and what is likely to be affected?**
 - Occipital lobe – may affect vision

More cerebrum anatomy

The functions of the lobes

Frontal lobe

- The frontal lobe is generally where higher executive functions including emotional regulation, planning, reasoning and problem solving occur.

Parietal lobe

- The parietal lobe is responsible for integrating sensory information, including touch, temperature, pressure and pain.

Temporal lobe

- The temporal lobe is responsible for processing sensory information, and is particularly important for hearing, recognising language, and forming memories.

Occipital lobe

- The occipital lobe is the major visual processing centre in the brain.

– **An elderly patient has a stroke and develops an aphasia (i.e. he cannot speak appropriately). What side and which lobe was likely affected by this?**

– Brocas aphasia, left temporal lobe

– **An elderly patient has a stroke and cannot feel his right hand. Where was this stroke likely?**

– Look at homunculus – likely left parietal lobe

Forebrain functions

- The thalamus processes sensory information.
- The hypothalamus is the major control centre of the autonomic motor system. It is involved in some hormonal activity and connects the hormonal and nervous systems. The hypothalamus also helps regulate homeostasis.
- The pineal gland produces the hormone melatonin, which regulates our sleep-wake cycles. Just like the hypothalamus, it is also involved in regulating hormonal functions.
- The limbic system regulates behavioural and emotional responses. Most important parts are the hippocampus and the amygdala.
- The basal ganglia are involved in including control of voluntary motor movements, habit learning, eye movements, cognition and emotion.

– In the CT brain scans of many elderly patients, you will tend to find a calcified pineal gland. What hormone is primarily regulated by this gland and what does it do?

– Melatonin – regulates sleep/wake cycle

– Which structure in the brain is responsible for regulating hormone release from the pituitary glands?

– Hypothalamus

– Which hormones are released by the hypothalamic neurons into the posterior pituitary?

– Oxytocin and ADH

Forebrain functions

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– **When you are casually doing something and then something extremely scary happens (e.g. a car crashes in front of you), you tend to develop a very strong memory of the event. This is due to a behavioural response to the situation (most typically fear). Which component of the brain is responsible for the (a) emotional response, (b) memory formation and (c) the name of the system that links this together**

– A – amygdala

– B – hippocampus

– C – limbic system

More brain

The cerebellum

- coordinates gait and maintains posture,
- controls muscle tone and voluntary muscle activity
 - but is unable to initiate muscle contraction.

The cerebellum receives information about

- voluntary muscle movements from the cerebral cortex and from the muscles, tendons, and joints.
- balance from the vestibular nuclei.

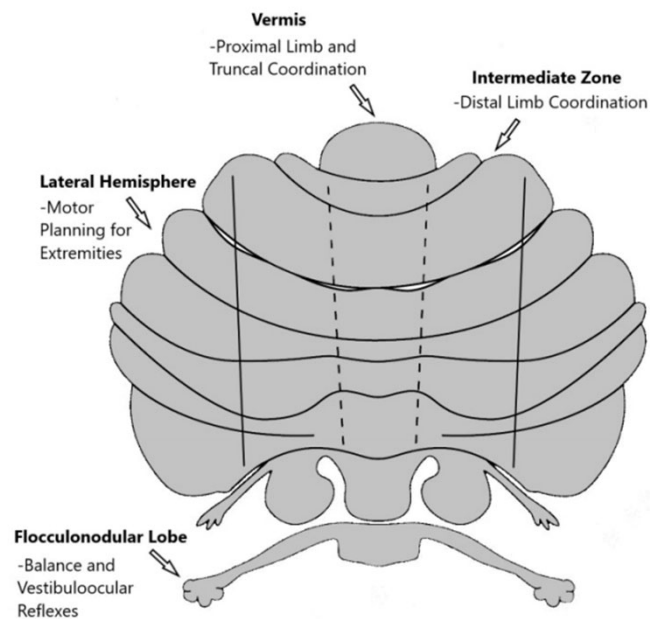
Damage results in a loss in the ability to control fine movements, maintain posture, and motor learning.

– **When Stephen curry trains for his games, he needs to shoot many (MANY) shots. Each time he misses, he corrects himself based on the feedback (seeing himself miss) and his experience of shooting (from his muscles, joint positions, etc.). What brain component is responsible for this?**

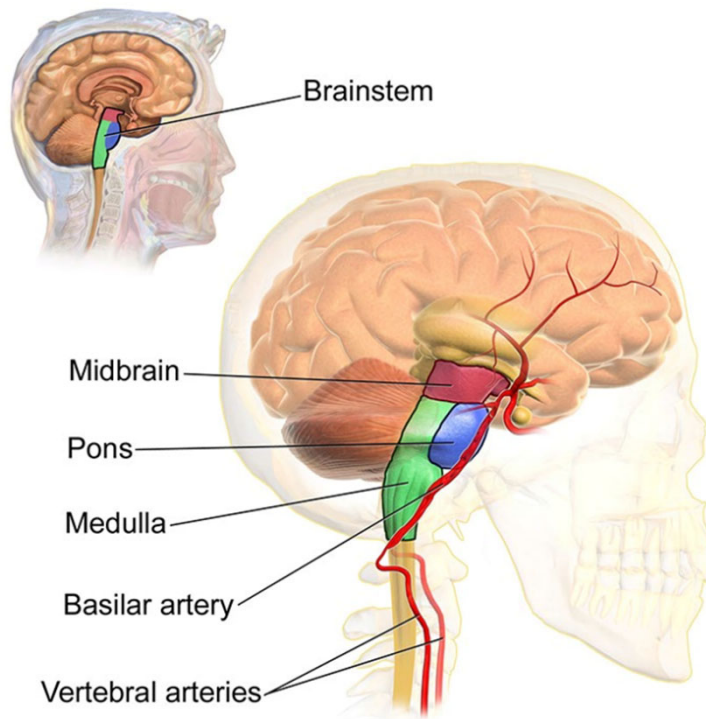
– Cerebellum

Cerebellum regions

- Name the regions/zones of the cerebellum and their individual functions

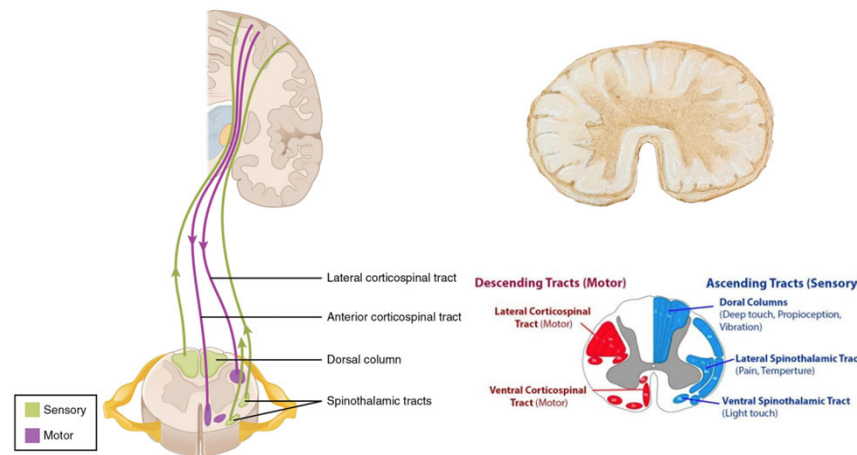


Anatomy of brainstem



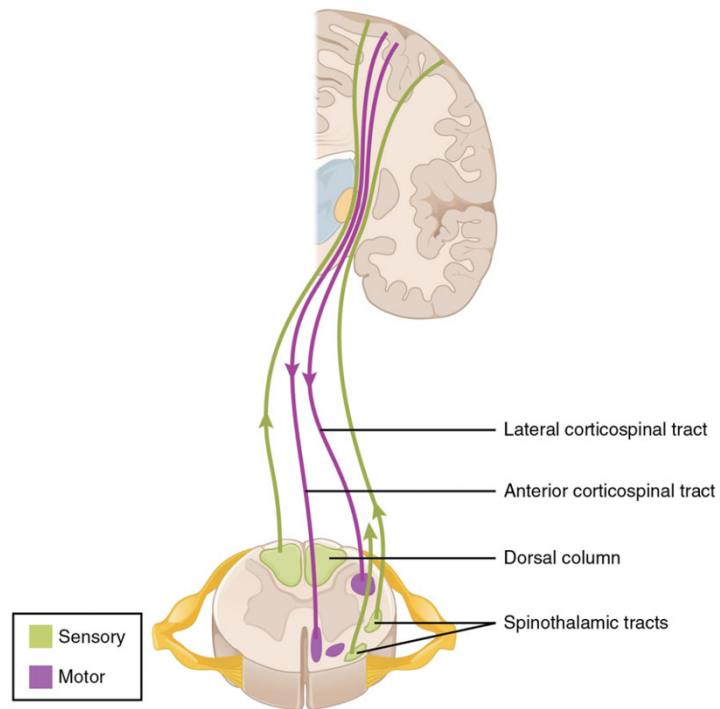
- Using your anatomical terms, describe the location of your medulla relative to your pons
 - Medulla is inferior to pons

Spinal cord anatomy



- Is the peripheral or central component of the spinal cord made up of cell bodies?
 - Central spinal cord made of cell bodies – this is opposite to what you see in the cerebrum
- Name the tract responsible for carrying motor fibres for voluntary muscle control
 - Cortic(al) to spinal – this is the corticospinal tract
- What is the function of the lateral spinothalamic tract?
 - Pain and temperature

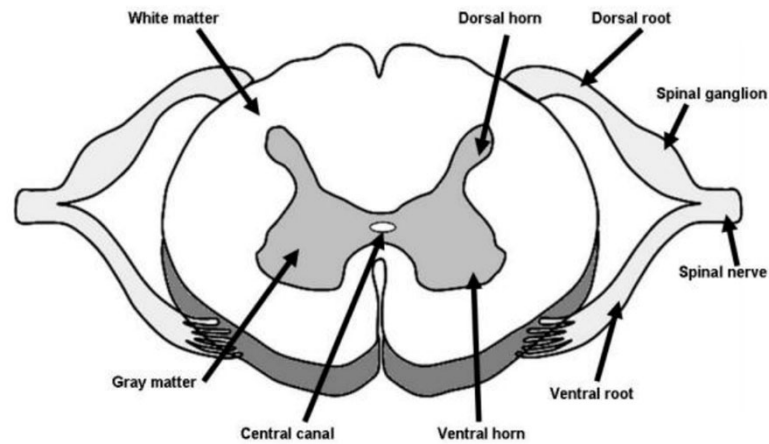
Spinal cord anatomy



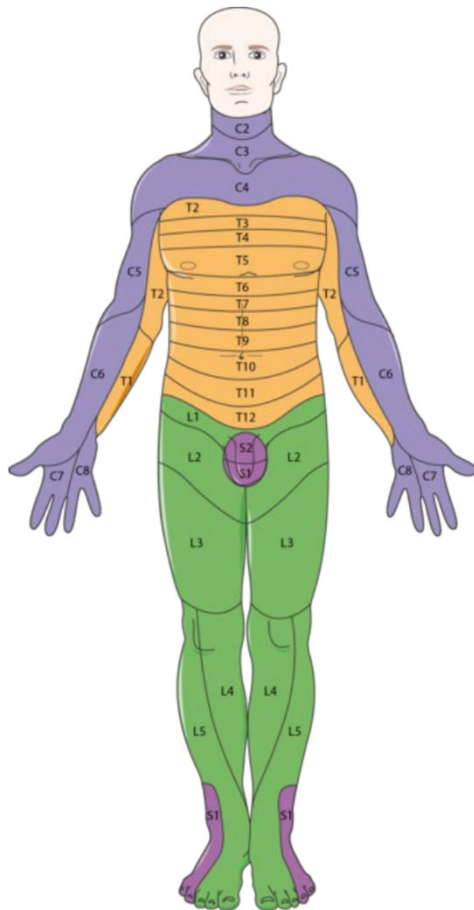
- **Name the sensory modalities**
 - Pain + Temperature
 - Fine touch
 - Deep touch, vibration + proprioception (Dorsal columns)
- **Do lateral corticospinal tract neurons carry upper or lower motor neurons?**

Spinal cord anatomy

– Draw a labelled spinal cord section

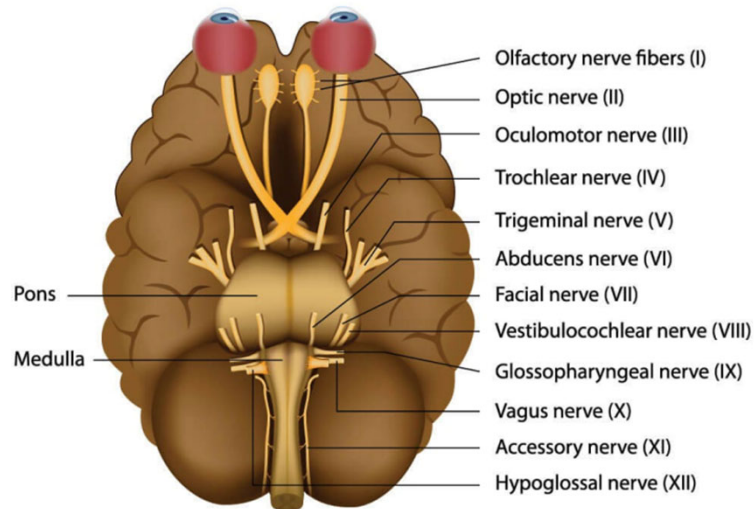


Dermatome



- Which spinal nerve supplies sensory innervation to the nipples and the belly button?
 - T4 for nipple
 - T10 to belly button

Cranial nerves



– Name the 12 cranial nerves

- Olfactory
- Optic
- Oculomotor
- Trigeminal
- Abducens
- Facial
- Vestibulocochlear
- Glossopharyngeal
- Vagus
- Accessory
- Hypoglossal

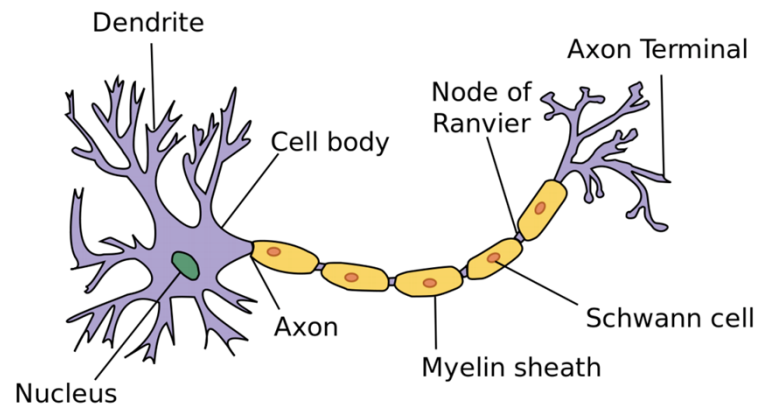
Nervous system 2



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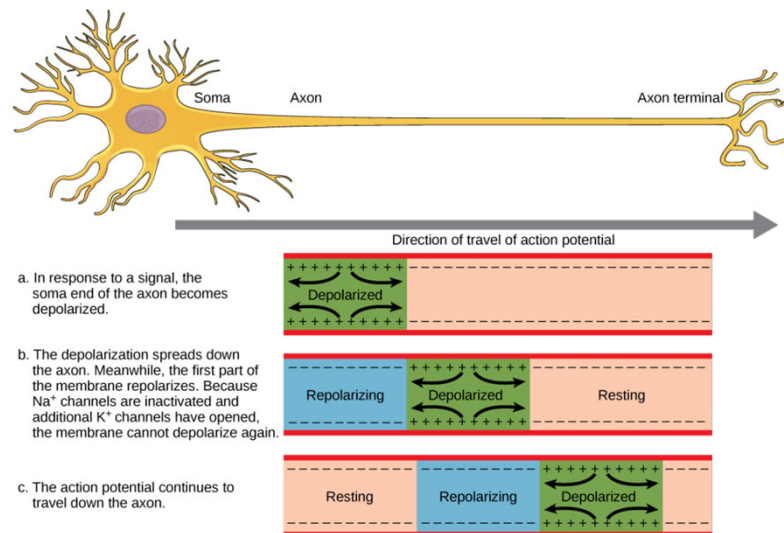
Neurons

- Draw a neuron and label its components

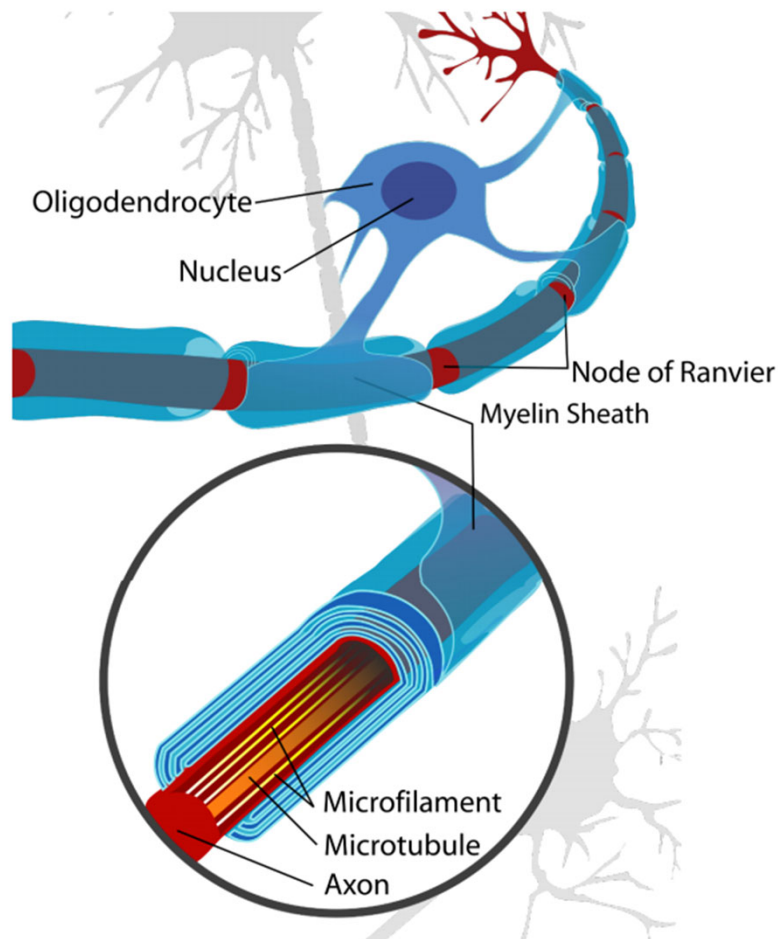


The AP

- Describe the process in which an action potential travels down a neuron



Speedy neurons



- Describe the function of the **oligodendrocyte / Schwann cell** in nerve conduction
 - Forms the myelin sheath around neurons, insulates axons and results in nodes of ranviers which allows jumping of action potentials

Synaptic transmission

Neurotransmitters are synthesised in the cell body, transported to the end of the axon and stored at the end of presynaptic nerves.

When an action potential reaches the end of the axon Ca^{2+} moves in allowing neurotransmitter release.

Neurotransmitters diffuse across the synaptic cleft to bind with receptors on the post synaptic membrane.

Neurotransmitters are

- Broken down by enzymes or
- Undergo reuptake into the presynaptic neurone

– **What final electrolyte/ion is responsible for the release of neurotransmitters into the synaptic cleft?**

– Ca^{2+}

– **Neostigmine is a drug which inhibits the acetylcholinesterase (the enzyme which remove acetylcholine from the synaptic cleft). If ACh is responsible for activation of a muscle, what would the addition of neostigmine likely do?**

– Likely increase free ACh in the neuromuscular junction, resulting in muscle hyperactivity; clinically used in anaesthesia to reverse an NMJ blocking agent (rocuronium)

Nerve stimulation

- Describe the concept of an EPSP/IPSP in the context of neuronal action potentials

