NEURONS & NEUROTRANSMISSION

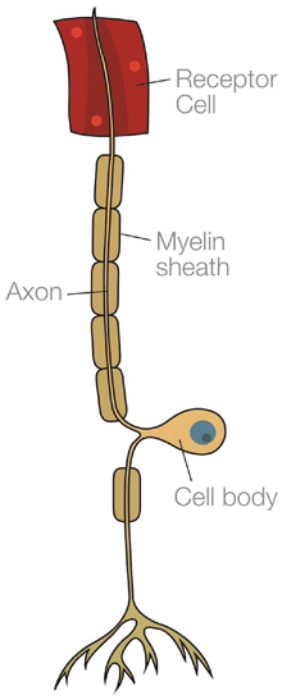
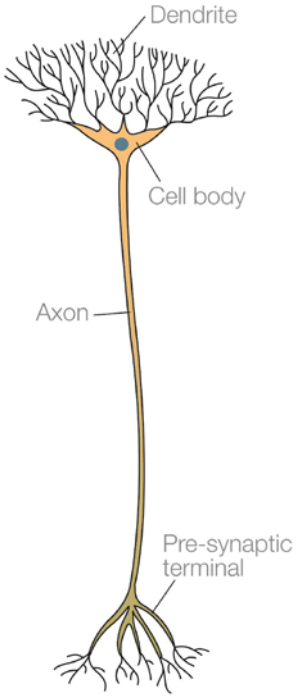
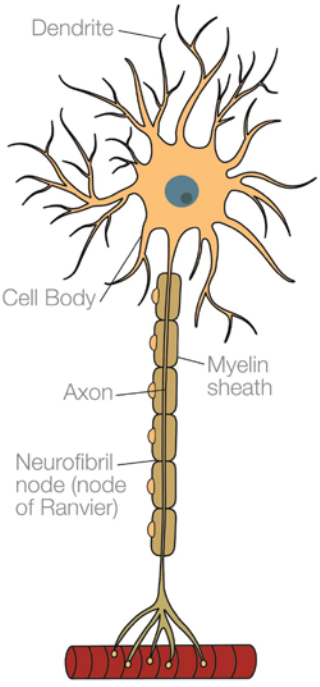
Topic: The structure and function of sensory, relay and motor neurons. The process of synaptic transmission, including reference to neurotransmitters, excitation and inhibition.

WHAT YOU NEED TO KNOW
1. Outline the structure and function of: a. Sensory neurons b. Relay neurons c. Motor neurons
2. Outline the process of synaptic transmission and explain the difference between: a. Excitation b. Inhibition

1. Sensory, relay and motor neurons

There are three main types of neurons, including: sensory, relay and motor. Each of these neurons has a different function, depending on its location in the body and its role within the nervous system.

Note: All three types of neuron consist of similar parts, however their structure, location and function are different and this is what you need be aware of.

SENSORY	RELAY	MOTOR
		

Sensory neurons are found in receptors such as the eyes, ears, tongue and skin, and carry nerve impulses to the spinal cord and brain. When these nerve impulses reach the brain, they are translated into 'sensations', such as vision, hearing, taste and touch. However, not all sensory neurons reach the brain, as some neurons stop at the spinal cord, allowing for quick reflex actions.

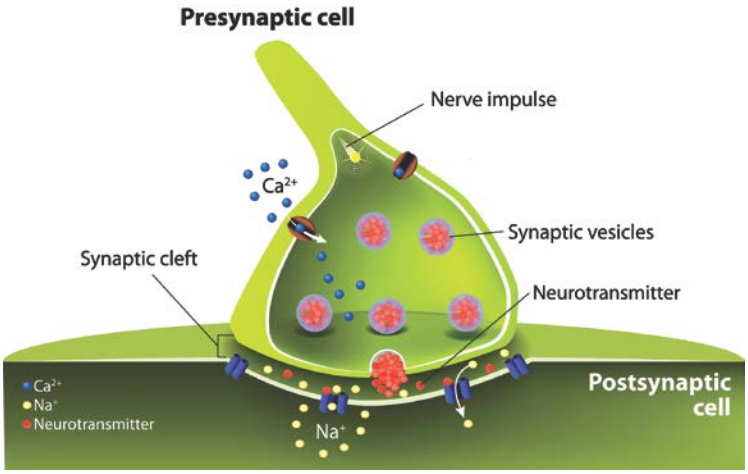
Relay neurons are found between sensory input and motor output/response. Relay neurons are found in the brain and spinal cord and allow sensory and motor neurons to communicate.

Motor neurons are found in the central nervous system (CNS) and control muscle movements. When motor neurons are stimulated they release neurotransmitters that bind to the receptors on muscles to trigger a response, which lead to movement.

As you can see from the diagrams above, all three neurons consist of similar parts. The **dendrites** receive signals from other neurons or from sensory receptor cells. The dendrites are typically connected to the cell body, which is often referred to as the 'control centre' of the neuron, as it's contains the nucleus. The **axon** is a long slender fibre that carries nerve impulses, in the form of an electrical signal known as **action potential,** away from the cell body towards the axon terminals, where the neuron ends. Most axons are surrounded by a **myelin sheath** (except for relay neurons) which insulates the axon so that the electrical impulses travel faster along the axon. The **axon terminal** connects the neuron to other neurons (or directly to organs), using a process called **synaptic transmission**.

2. Synaptic transmission

Information is passed down the axon of the neuron as an **electrical impulse** known as **action potential**. Once the action potential reaches the end of the axon it needs to be transferred to another neuron or tissue. It must cross over a gap between the pre-synaptic neuron and post-synaptic neuron – which is known as the **synaptic gap.** At the end of the neuron (in the axon terminal) are the **synaptic vesicles** which contains chemical messengers, known as **neurotransmitters.** When the electrical impulse (action potential) reaches these synaptic vesicles, they release their contents of neurotransmitters.



Neurotransmitters then carry the signal across the synaptic gap. They bind to receptor sites on the post-synaptic cell that then become activated. Once the receptors have been activated, they either produce **excitatory** or **inhibitory** effects on the post-synaptic cell.

Some neurotransmitters are excitatory and some are inhibitory. **Excitatory neurotransmitters** (e.g. noradrenaline) make the post-synaptic cell more likely to fire, whereas **inhibitory neurotransmitters** (e.g. GABA) make them less likely to fire. For example, if an excitatory neurotransmitter like noradrenaline binds to the post-synaptic receptors it will cause an electrical charge in the cell membrane which results in an **excitatory post-synaptic**

potential (EPSP), which makes the post-synaptic cell more likely to fire. Whereas, if an inhibitory neurotransmitter like GABA binds to the post-synaptic receptors it will result in an **inhibitory post-synaptic potential (IPSP),** which makes the post-synaptic cell less likely to fire.

Possible Exam Questions

1. Complete the following sentence (1 mark): Motor neurons…
    a. are found in receptor cells
    b. carry nerve impulses to the brain
    c. are found between the brain and spinal cord
    d. are found in the central nervous system

2. Briefly outline the process of synaptic transmission. (4 marks)

3. Outline two differences between sensory neurons and motor neurons. (4 marks)

4. Jack is 8-years-old and has recently been prescribed Ritalin to help with his ADHD. Jack's mother searches for Ritalin on the internet and learns that Ritalin elevates the level of dopamine, which is an excitatory neurotransmitter. Outline the role of excitatory neurotransmitters, referring to Jack in your answer. (4 marks).