

IGCSE Biology:

Coordination and Response

Lesson 14.01

Nervous Control in Humans

Revision Notes

Cambridge will assess your ability to:

- State that electrical impulses travel along neurones
- Describe the mammalian nervous system in terms of:
 - the central nervous system (CNS) consisting of the brain and the spinal cord
 - the peripheral nervous system (PNS) consisting of the nerves outside of the brain and spinal cord
- Describe the role of the nervous system as coordination and regulation of body functions
- Identify in diagrams and images sensory, relay and motor neurones
- Describe a simple reflex arc in terms of: receptor, sensory neurone, relay neurone, motor neurone and effector
- Describe a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with the responses of effectors (muscles and glands)
- Describe a synapse as a junction between two neurones
- Describe the structure of a synapse, including the presence of vesicles containing neurotransmitter molecules, the synaptic gap and receptor proteins
- Describe the events at a synapse as:
 - an impulse stimulates the release of neurotransmitter molecules from vesicles into the synaptic gap
 - the neurotransmitter molecules diffuse across the gap
 - neurotransmitter molecules bind with receptor proteins on the next neurone
 - an impulse is then stimulated in the next neurone
- State that synapses ensure that impulses travel in one direction only

• Nerves:

- Nerves are bundles of neurones, resembling an electric cable.
- Neurones:
 - Neurones are individual nerve cells that carry electrical impulses throughout the body.



Mammalian nervous system:





- Nervous system is in charge of the coordination and regulation of body functions.
- It consists of:
 - Central nervous system:
 - Brain
 - Spinal cord
 - Peripheral nervous system:
 - Nerves connecting to the central nervous system

- There are two types of actions:
 - Voluntary actions:
 - These are actions that can be controlled, such as moving and running around.
 - Involuntary actions:
 - These are actions that cannot be controlled, such as heartbeat and digestion.
 - The nervous system controls these body functions automatically.
- Types of neurones in human body:



- Sensory neurones:
 - These neurones carry impulses from the sensory organs to the central nervous system. Some of these sensory organs are skin, nose, and eyes.
- Relay neurones:
 - These neurones are only present in the central nervous system.
 - They help in communication between the central nervous system and the sensory or motor neurones.
- Motor neurones:
 - These neurones carry impulses from the central nervous system to the muscle or gland.
- Reflex actions:
 - A reflex action is a means of automatically and rapidly integrating and coordinating stimuli with the responses of effectors (muscles and glands).

 Reflex actions include knee-jerk reflex, sneezing, and moving body parts away from pain sources like when one accidentally touches a hot surface.



- The pathway for such actions is known as a reflex arc.
- Illustration of the knee-jerk reflex arc:



- When a hammer strikes the knee, the sensory receptors in the knee pick up the stimulus.
- These sensory impulses are carried to the brain via the sensory neurones.
- The **sensory impulses** are then **passed through relay neurones** onto the **motor neurones** in the **brain**.
- The motor neurones then pass these impulses back to the effector (muscles), triggering the muscles to contract.
- This causes the **knee** to **jerk up**.
- This entire pathway is known as the reflex arc.
- The purpose of the knee-jerk test is to check the functions of the nerves.
 - There will be a **reflex action** if the **nerves** are not **damaged**.
 - The nerves from the knee are connected to the spinal cord.
- Impulses:
 - Signals are carried from one end of neurone to another end of another neurone.
 - These signals are referred to as an impulse.

- An **impulse** always travels in **one direction only** because of a structure called **synapse.**
 - A synapse is a structure that allows signals from a neurone to be passed to another neurone. It is like a junction between two neurones.



- The **synapse** can be broken up into three parts:
 - presynaptic neurone
 - synaptic gap
 - postsynaptic neurone





• Events at a synapse:

When an impulse reaches the end of the axon, it signals the synaptic vesicles to release the neurotransmitters into the synaptic gap.



• An example of a **neurotransmitter** is **acetylcholine**.



• Neurotransmitter then binds with the receptors on the postsynaptic neurone, causing another impulse.



- The **impulse** is transferred from **neurone** to **neurone** this way until it reaches its **destination**.
 - This is because of the unique structure of the synapse, where neurotransmitters are only synthesised on the presynaptic neurone.
- There is a high concentration of mitochondria at the nerve endings as more energy is required here.
- As neurotransmitters are only synthesised on the presynaptic neurone and receptors are only found in the postsynaptic neurone, impulses can travel in only one direction.
- In a normal situation, the neurotransmitters are reabsorbed back into the presynaptic neurone, or broken down by enzymes after the transmission of impulses.

Sample examination question on this topic:

1) What is the name of the junction between two neurones?

A. effector

B. receptor

C. gland

D. synapse

Answer: D

Option **A**, **"effector,"** is **incorrect** because it is a **structure** that responds to **signals** from the **nervous system**.

Option **B**, **"receptor,"** is **incorrect** because it is a structure that detects **stimuli** from the **environment** or within the **body**.

Option **C**, **"gland,"** is **incorrect** because it is an **organ** that produces and releases substances like **hormones** or **enzymes**.

Option D is the correct answer because it refers to the junction between two neurons where signals are transmitted.



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