

OCR (B) Biology A-level

Topic 5.2 - Nervous Control

Definitions and Concepts

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5.2.1 The nervous system and the identification and consequences of damage

Action potential - The temporary change in electrical potential across the membrane of an axon in response to the transmission of a nerve impulse.

Alcohol - A depressant drug which slows impulse transmission by binding to GABA receptors and blocking glutamate receptors.

All-or-nothing principle - The principle that describes how any generator potential which reaches or exceeds the threshold potential will produce an action potential of equal magnitude.

Autonomic nervous system - A branch of the nervous system that carries nerve impulses to muscles and glands. It controls involuntary activities and has two divisions: the sympathetic nervous system and the parasympathetic nervous system.

Axon - An extension from a nerve cell that carries impulses away from the cell body.

Blink reflex - A brain stem reflex which causes both eyelids to close when the cornea is stimulated by bright light or touch. The impulse travels from the sensory neuron of the trigeminal nerve to the spinal nucleus of the trigeminal nerve. Interneurons coordinate a response and transmit impulses to the facial motor nerve, which stimulates the effector muscle orbicularis oculi.

Cannabis - A stimulant drug which contains THC, a chemical which can bind to cannabinoid receptors and trigger dopamine release.

Cell surface membrane - A semipermeable lipid bilayer studded with proteins that surrounds the cell and many organelles.

Central nervous system (CNS) - The brain and spinal cord.

Cerebellum - The region of the brain that controls muscle coordination and non-voluntary movement (e.g. balance, posture).

Cerebrum - The largest region of the brain, consisting of two hemispheres. It receives sensory information from receptors and sends information via the motor neurones to effectors. It is responsible for all voluntary and some involuntary responses.

Cholinergic synapse - A synapse which uses the neurotransmitter acetylcholine.

Computerised Tomography scan (CT scan) - A non-invasive imaging modality which uses X-rays to produce cross-sectional images. Denser structures absorb more radiation and appear lighter.

Corpus callosum - A band of nerve fibres between the two hemispheres of the brain.

Dendrite - A branch of a dendron.



Dendron - An extension from a nerve cell that carries impulses towards the cell body.

Depolarisation - The rapid influx of sodium ions into the cell which cause it to lose its negative charge and the membrane potential to increase.

Dopamine - A stimulant neurotransmitter.

Drug dependency - Occurs when the number of dopamine receptors in the brain increases, making it more difficult for the brain to naturally stimulate the same level of reward. A lack of the drug therefore causes physical withdrawal symptoms e.g. nausea, fever. Psychological 'conditioning' associates drug use with an emotional stimulus.

Electroencephalogram (EEG) - A technique used to diagnose epilepsy and to investigate brain injury, inflammation and tumours. Electrodes attached to the scalp detect electrical signals between neurons, which are recorded by a machine.

Excitatory postsynaptic potential (EPSP) - An impulse which stimulates an action potential in the postsynaptic neuron.

Functional Magnetic Resonance Imaging (fMRI) - A technique which uses MRI technology to study brain activity based on blood flow since oxyhaemoglobin absorbs high frequency radio signals and deoxyhaemoglobin reflects them.

GABA - An inhibitory neurotransmitter which causes Cl^- ion channels to open, hyperpolarising the cell.

Glutamate - An excitatory neurotransmitter.

Haemorrhagic stroke - Bleeding in the brain causes cell death.

Heroin - A stimulant drug with a similar shape to opiates which can bind to complementary receptors and trigger dopamine release.

Hyperpolarisation - The drop in membrane potential below the resting potential after repolarisation due to open potassium ion channels.

Hypothalamus - The region of the brain that serves as the control centre for the autonomic nervous system. It is responsible for production of hormones, the regulation of the water potential of body fluids and the control of behavioural patterns.

Inhibitory postsynaptic potential (IPSP) - An impulse which inhibits the next neuron from generating an action potential.

Iris reflex - When retinal photoreceptors detect high light intensity, they send an impulse via the parasympathetic nervous system which causes circular muscles to contract and radial muscles to relax, so the pupil constricts. The converse occurs when retinal photoreceptors detect low light intensity.

Ischaemic stroke - A loss of blood flow to the brain causes cell death.



L-Dopa - A dopamine precursor that can cross the brain blood barrier.

Lewy bodies - Clumps of alpha synuclein protein associated with Parkinson's disease.

Magnetic Resonance Imaging (MRI) - An imaging modality used for producing cross-sectional images of soft tissue. A powerful magnetic field causes protons from hydrogen atoms in water molecules to align. Radio waves then knock protons out of alignment. When protons realign after the radio waves turn off, they emit radiation to receivers.

Medulla oblongata - The region of the brain that regulates autonomic activities such as ventilation, heart rate and peristalsis. It is made up of regulatory centres of the autonomic nervous system.

Methamphetamine - A drug with a similar shape to dopamine which moves into the cell via complementary transmembrane proteins and forces dopamine out of vesicles.

Motor neuron - A neuron that carries nerve impulses from the CNS to the effectors.

Myelin sheath - An electrically insulating layer consisting of the membranes of Schwann cells. It increases the speed of nerve impulses.

Neurotransmitters - Chemicals that are used for communication between neurons and their target cells. Neurotransmitters are stored in synaptic vesicles in the presynaptic neuron and released into the synaptic cleft.

Nodes of Ranvier - Unmyelinated sections of nerve cells which allow for the propagation of an action potential due to their many ion channels.

Occipital lobe - A region at the back of the brain which includes the visual cortex.

Parietal lobe - A region at the top of the brain responsible for movement, orientation, memory and recognition.

Parkinson's disease - A neurodegenerative disorder caused by loss of dopaminergic neurons in the cerebral cortex of the brain, characterised by the formation of Lewy bodies. It affects movement and cognitive function.

Peripheral nervous system (PNS) - Pairs of nerves that originate from the CNS and carry nerve impulses into and out of the CNS. It is divided into the sensory nervous system and motor nervous system.

Pituitary gland - A small, hormone-producing gland located at the base of the brain. It is divided into two regions, the anterior pituitary and the posterior pituitary.

Plantar reflex - Applying firm pressure to the sole of foot from heel to toe triggers a flexor response (toes curl downwards) in healthy adults. An extensor response (toes fan upwards) is common in healthy babies & toddlers, but can indicate nerve damage in adults.

Positron emission tomography scan (PET) - An imaging technique that shows amyloid plaques and tumours. A radioactive isotope e.g. of carbon is injected and used by the body



to synthesise molecules. When the isotope decays, it emits gamma radiation to a detector. Active areas show higher radioactivity.

Postsynaptic neuron - The neuron after the synapse which contains specific receptor proteins on its membrane, complementary to the neurotransmitter.

Presynaptic neuron - The neuron before the synapse which releases neurotransmitters from synaptic vesicles into the synaptic cleft.

Reaction time - The time it takes someone to respond to a stimulus, affected by age, distraction, biological sex, level of fatigue and drug intake.

Reflex - A rapid, automatic response to a sensory stimulus by the body. It serves as a protective mechanism.

Reflex arc - The pathway of neurons involved in a reflex action:

stimulus → receptor → sensory → relay → motor → effector → response
 neurone neurone neurone

Refractory period - The time period after an action potential during which further action potentials are prevented. This ensures that action potentials can only be propagated in one direction. It limits the frequency of action potentials and ensures nervous impulses are discrete.

Relay neuron - A neuron located in the spinal cord that links the sensory neuron to the motor neuron.

Repolarisation - The stage of the action potential during which voltage-gated Na^+ channels close and voltage-gated K^+ channels open. The facilitated diffusion of K^+ ions out of the cell down their electrochemical gradient makes the potential difference across the membrane more negative.

Resting potential - The potential difference across the cell membrane of a neurone at rest which is typically between -60 and -70 millivolts (mV).

Saltatory conduction - The setting up of localised circuits between nodes of Ranvier which allows for the rapid propagation of an action potential.

Sensory neuron - A neuron that carries nerve impulses from the receptors to the CNS.

Somatic nervous system - A branch of the nervous system that carries impulses to the skeletal muscles. It controls voluntary activities.

Student's t-test - A statistical test used to analyse whether there is a significant difference between the means of data values of two populations.

Synapse - The junction between two nerve cells or a nerve cell and an effector.



Temporal lobe - A region of the brain below the temples which processes auditory signals.

5.2.2 Monitoring visual function

Aqueous humour - A fluid secreted from the ciliary epithelium which fills the anterior and posterior chambers of the eye.

Bipolar neuron - A neuron with a defined axon and dendron.

Blind spot - The area at the back of the eye where the optic nerve exits the eye. It has no photoreceptor cells so there is no image detection.

Choroid - The vascular region of the eye between the sclera and retina.

Ciliary body - The region of the eye consisting of the ciliary muscles and ciliary epithelium.

Ciliary epithelium - The cell layer of the ciliary body that secretes the aqueous humour.

Ciliary muscles - Muscles that control the shape of the lens.

Colour blindness - An inability to distinguish between different colours.

Cone cells - Photoreceptor cells containing iodopsin which are located mainly in the central fovea of the retina.

Conjunctiva - The tissue that covers the sclera and the inside of the eyelid.

Cornea - The outer protective layer of the eye.

Farnsworth-Munsell 100 hue test - A test for colour blindness in which individuals are asked to arrange colours in order of their shades.

Fovea - A region of the retina with a high density of cone cells.

Ganglion cells - A group of neurons in the PNS.

Iodopsin - Pigments found in cone cells. There are three types, which absorb red, green or blue wavelengths of light.

Iris - A pigmented ring associated with the circular and radial muscles, which control the size of the pupil and thereby regulate the amount of light that enters the eye.

Ishihara test - A test for colour blindness in which individuals are asked to read coloured numbers on a differently-coloured background.

Lens - A transparent structure at the front of the eye which helps to refract light onto the retina. Its shape is controlled by the ciliary muscles.

Optical coherence tomography (OCT scan) - An imaging method which uses light waves to take cross-sectional images of the eye's internal structures.



Pupil - The aperture of the iris which allows light to pass through to the retina.

Receptor - A structure which detects a change in the environment

Retina - The region of specialised cells at the back of the eye. It consists of ganglia from the optic nerve, bipolar neurons and photoreceptor cells.

Rhodopsin - A pigment in rod cells which absorbs all wavelengths of light, resulting in monochromatic images.

Rod cells - Photoreceptor cells containing rhodopsin which are evenly distributed on the periphery of the retina, but are not present on the central fovea.

Sclera - The white portion of the eye, consisting mainly of elastic fibres and collagen.

Transducer - Structure which converts one form of energy to another.

Visual acuity - The ability of the eye to distinguish details, measured by a person's ability to see certain letters from a set distance.

Vitreous humour - The jellylike substance between the retina and the lens of the eye.

5.2.3 The effect of ageing on the nervous system

Alzheimer's disease - A disease associated with the buildup of amyloid plaques in the brain. Symptoms include memory loss, confusion, and mood swings.

Cataracts - A clouding over of the lens caused by the clumping together of proteins, often due to ageing.

Glaucoma - Damage caused to the optic nerve by increased pressure in the eye, often due to a buildup of fluid in the front of the eye.

Macular degeneration - Damage to the central part of the retina.

Reaction time - The time it takes someone to respond to a stimulus, affected by age, distraction, biological sex, level of fatigue and drug intake.

