Edexcel IAL Biology A-level

Topic 8: Coordination, Response and Gene Technology

Definitions and Concepts

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8.1-8.10 - Structure and Function of Nerve Tissue and Responses to Stimuli

Acetylcholine: A neurotransmitter used in the parasympathetic nervous system.

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

Afferent nerves: Nerves that carry signals toward the central nervous system from the periphery.

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 (visceral) reflexes: Reflex arcs that involve a glandular or non-skeletal muscular response carried out in internal organs such as the heart, blood vessels, or structures of the GI tract. They utilize neurons of the autonomic nervous system to elicit their actions.

Autonomic nervous system (ANS): 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 terminal: The button-like endings of axons through which axons make synaptic contacts with other neurons or with effector cells.

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

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

Dendron/ dendrite: 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.

Effector: A muscle or gland which produces a response to a stimulus.

Efferent nerves: Nerves that carry information away from the central nervous system, to the peripheral nervous system.

Ganglion: A cluster of neurons in the peripheral nervous system.

Grey matter: Areas in the central nervous system that consist primarily of neuronal cell bodies and glial cells, as opposed to white matter.

Hyperpolarization: The drop in membrane potential below the resting potential after repolarization due to open potassium ion channels.

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Iris: The pigmented muscular ring that surrounds the pupil and controls its diameter.

Monosynaptic reflex arc: A reflex arc that contains only two neurons: a sensory neuron and a motor neuron.

Motor Neuron: A type of neuron that transmits impulses from the CNS to effectors.

Myelin sheath: An insulating layer that forms around nerves, including those in the brain and spinal cord.

Myelination: The formation of a myelin sheath around nerve cells by Schwann cells.

Neuron: An electrically excitable cell that communicates with other cells via synapses, and the main component of nervous tissue in all animals except sponges and placozoa.

Neurotransmitter: A chemical which diffuses across the synaptic gap to stimulate other neurons or effector cells.

Node of Ranvier: A gap in the myelin sheath of a nerve, between adjacent Schwann cells, which facilitates the rapid conduction of nerve impulses.

Parasympathetic nervous system - A branch of the autonomic nervous system that is active under normal, resting conditions. It inhibits effectors, slowing down activity.

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.

Polysynaptic reflex arc: A reflex arc in which multiple relay neurons interface between the sensory and motor neurons in the reflex pathway.

Proprioceptors: Receptors located in subcutaneous tissues, as muscles, tendons, and joints, that respond to stimuli produced within the body, such as changes in limb position.

Pupil: The hole in the centre of the iris which can contract and dilate using the iris to alter the amount of light which contacts the retina.

Receptor: A structure which acts as a transducer by detecting changes in the environment and converting them into electrochemical impulses.

Reflex arc: A neural pathway that controls a reflex.

Reflex: An involuntary and nearly instantaneous movement in response to a stimulus. A reflex is made possible by neural pathways called reflex arcs which can act on an impulse before that impulse reaches the brain.

Relay neurons (interneuron): A type of neuron that exists in the CNS and connects the

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sensory system with the motor system.

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

Retina: The structure at the back of the eye which is composed of photoreceptors and is specialised to detect light.

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

Schwann cells: Cells that form the myelin sheath around nerve cells in the peripheral nervous system.

Sensory : A type of that transmits impulses from receptors to the relay neuron in the CNS.

Soma: The cell body of a neuron, which contains the nucleus and various other organelles.

Somatic reflexes: Reflexes that are based solely on skeletal muscle contraction and involve specialized sensory receptors called proprioceptors that monitor the position of our limbs in space, body movement, and the amount of strain on our musculoskeletal system.

Spinal cord: The cord of nervous tissue that extends from the medulla oblongata to the lumbar region of the vertebral column. It gives off the pairs of spinal nerves, carries impulses to and from the brain, and serves as a center for initiating and coordinating many reflex acts.

Spinal ganglion (dorsal root ganglion/posterior root ganglion): A cluster of neurons in a dorsal root of a spinal nerve.

Spinal nerve: A mixed nerve, which carries motor, sensory, and autonomic signals between the spinal cord and the body. The human body has 31 pairs of spinal nerves.

Spinal root: The sensory root of a spinal nerve, which carries sensory information to the spinal cord and enters the posterior side of the cord.

Stimulus: A change in internal or external conditions which brings about a response.

Sympathetic nervous system: A branch of the autonomic nervous system that is active under stressful conditions. It stimulates effectors, speeding up activity.

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

Ventral root: The motor root of a spinal nerve, which carries motor information from the spinal cord to the rest of the body and leaves from the anterior side of the cord.

White matter: Areas in the central nervous system that consist primarily of glial cells and myelinated axons, which gives the tissue a white colouring.

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8.11-8.16 - Plant Hormones, Coordination and the Brain

Amylase: An enzyme that catalyses the hydrolysis of starch into sugars. Alpha amylase (α-amylase) forms when cereal grains like wheat or barley germinate or sprout.

Cerebellum: A region of the brain that coordinates voluntary movement and controls balance.

Computed tomography (CT) scan: A type of medical imaging technique that uses several x-rays and computer software to create detailed images of structures and organs inside the body.

Dopamine: A neurotransmitter involved in signalling pathways associated with the brain's reward system.

Endocrine gland: A type of gland which secretes hormones directly into the bloodstream.

Endocrine signalling: A type of signalling that uses hormones secreted by endocrine cells into the blood to produce an effect on receptors.

Endocrine system: A chemical messenger system comprising feedback loops of the hormones released by internal glands of an organism directly into the circulatory system, regulating distant target organs. In humans, the major endocrine glands are the thyroid gland and the adrenal glands.

Functional magnetic resonance imaging (fMRI): A medical imaging technique that uses radio waves and a magnetic field to assess brain function through the visualisation of blood flow in brain capillaries.

Gibberellins (GAs): Plant hormones that regulate various developmental processes, including stem elongation, germination, dormancy, flowering, flower development, and leaf and fruit senescence.

Hormone: A chemical messenger which is carried in an organism's transport systems and binds to a specific receptor.

Hypothalamus: The region of the brain located near the pituitary gland that is involved in homeostatic control including thermoregulation.

Indoleacetic acid (IAA): A type of auxin mainly produced at growing plant tips which is used to promote cell growth and elongation.

L-DOPA: The precursor molecule to the neurotransmitter dopamine which can be given as a treatment for Parkinson's disease as it is able to cross the blood-brain barrier.

Left cerebral hemisphere: The left side of the brain which controls the right side of the body and is involved in linear reasoning tasks related to language.

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Magnetic resonance imaging (MRI): A medical imaging technique that uses radio waves and a magnetic field to produce images of internal body structures.

MDMA: An illegal drug that enhances the release of the neurotransmitters dopamine, noradrenaline and serotonin and can produce symptoms like increased energy and hallucinations when taken.

Medulla oblongata: A region of the brainstem which controls involuntary actions such as heart rate and breathing.

Parkinson's disease: A neurodegenerative disease which affects the dopamine secreting neurons and leads to a decrease in motor functions and tremors in resting muscles.

Phytochrome: Light sensitive pigments found in plants used to detect changes to external light conditions.

Pituitary gland: A pea-sized gland attached to the hypothalamus. It produces hormones that control several other hormone glands, including the thyroid and adrenals, the ovaries and testicles.

Positron emission tomography (PET): A medical imaging technique used to assess organ and tissue metabolic function through the use of radioactive molecules and computer analysis.

Right cerebral hemisphere: The right side of the brain which controls the left side of the body and is involved in holistic reasoning tasks related to language.

Serotonin: A neurotransmitter involved in signalling pathways associated with happiness and mood regulation.

8.17-8.22 - DNA Technology

Bioinformatics - The development of the computer tools and software required to organise and analyse unprocessed biological data.

DNA ligase: An enzyme which catalyses the formation of phosphodiester bonds between DNA fragments which is used to join Okazaki fragments in the lagging strand during replication. DNA ligase can be used to join fragments cut by restriction endonucleases during genetic engineering.

Ethical issues: Issues that conflict with the general moral views of society.

Gene gun: A method of injecting DNA combined with metals into a cell (typically a plant cell) using propulsion.

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Genetically modified organism (GMO): An organism which has had its genetic makeup altered through artificial means.

Microarrays - A method of DNA sequencing. The DNA sample hybridises with fragments of single-stranded DNA bound to a chip.

Moral issues: Issues that conflict with an individual's sense of right and wrong.

Personalised medicine: The provision of medical treatments that are specifically designed on a patient by patient basis.

Recombinant DNA: Artificially modified DNA which is made by the combination of genes from different sources.

Restriction endonucleases: Enzymes which break double stranded DNA at specific sequences which are used in genetic engineering.

Transgenic organism: An organism which has had foreign genetic material inserted into its genome.

Vector (gene technology): A carrier such as a virus or gene gun which is used for insertion of foreign DNA into an organism.

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