

## Definitions and Concepts for AQA Biology A-level

### Topic 6 - Organisms Respond to Changes in their Internal and External Environments

**Acetylcholine:** A type of neurotransmitter that is used for communication between neurones.

**Actin:** A type of protein filament found in myofibrils. It forms thin filaments consisting of two long twisted chains.

**Actinomyosin bridge:** The cross-bridge formed when a myosin head attaches to the myosin binding site on an actin filament.

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

**Adenylate cyclase:** An enzyme that catalyses the conversion of ATP to cAMP.

**Adrenaline:** A hormone that is secreted by the adrenal glands under stressful conditions. It increases blood glucose concentration by activating enzymes involved in glycogenolysis.

**Afferent arteriole:** The blood vessel that stems from the renal artery and supplies blood to the nephron. It has a larger diameter than the efferent arteriole and divides into a complex system of capillaries, the glomerulus.

**All-or-nothing:** A principle that states that all stimuli above a certain threshold value will generate the same size of action potential, regardless of the strength of the stimulus.

**Anisotropic (A) bands:** The darker bands in a myofibril, which consist of overlapping actin and myosin filaments.

**Antagonistic muscles:** Pairs of muscles that work in opposite directions.

**Antidiuretic hormone (ADH):** A hormone made by the hypothalamus and secreted by the posterior pituitary gland in response to a fall in blood water potential. It increases the permeability to water of the distal convoluted tubule and the collecting duct, allowing more water to be reabsorbed into the blood.

**Ascending limb:** The limb of the loop of Henle that rises into the cortex. It is wider in diameter than the descending limb and its walls are impermeable to water. Sodium ions are moved out of the ascending limb by active transport.

**Atrioventricular node (AVN):** A group of cells located between the atria that slow down the wave of excitation and pass it between the ventricles, along the bundle of His.



**Atrioventricular septum:** A layer of non-conductive tissue between the right atrium and left ventricle of the mammalian heart.

**Autonomic nervous system:** A branch of the motor 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.

**Auxins:** A class of plant hormones that control cell elongation.

**Axon:** A long fibre that conducts nerve impulses away from the cell body.

**Bundle of His:** A collection of Purkyne fibres which run from the AVN down to the apex of the ventricles.

**Cell body:** The region of the neurone that contains the organelles, notably the nucleus and the rough endoplasmic reticulum.

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

**Chemoreceptor:** A type of receptor found in the walls of the carotid arteries that detects changes in blood pH and transmits nerve impulses to the medulla oblongata. For example, if blood pH decreases, chemoreceptors increase the frequency of nerve impulses to the medulla oblongata.

**Cholinergic synapse:** An excitatory or inhibitory synapse formed between neurones or neurones and other effector organs. It uses the neurotransmitter, acetylcholine.

**Collecting duct:** The final region of the nephron that collects urine from the distal convoluted tubules and empties it into the renal pelvis. Its permeability to water is altered by ADH.

**Cone cells:** A type of light receptor cell that transduces light energy into a generator potential. Cone cells are concentrated in the fovea, detect light of high intensity, and lead to colour images. One cone cell forms a synapse with a single bipolar cell, giving high visual acuity.

**Control mechanism:** A self-regulating system consisting of five features: optimum point, receptor, coordinator, effector, and feedback mechanism.

**Coordinator:** Coordinates information from the receptors and sends instructions to the effectors.

**Cyclic AMP (cAMP):** A 'second messenger' involved in the action of adrenaline that activates protein kinase.

**Dendrites:** Short, branched extensions of the cell body that receive nerve impulses from other neurones.



**Dendrons:** Extensions of the cell body which branch into smaller fibres, dendrites.

**Depolarisation:** A sudden, temporary change in the membrane potential of a neurone in response to the transmission of a nerve impulse. The inside of the axon is less negative than the outside.

**Descending limb:** The limb of the loop of Henle that dips down into the medulla. It is smaller in diameter than the ascending limb. The walls of the descending limb are permeable to water, so the filtrate loses water as it moves down.

**Diabetes:** A disorder of metabolism in which blood glucose concentration is not regulated properly. There are two forms: Type I and Type II diabetes.

**Distal convoluted tubule:** The twisted region of the nephron between the loop of Henle and the collecting duct. It controls blood pH by reabsorbing ions and alters the concentration of water and salts reabsorbed. Its permeability to water is altered by ADH.

**Effector:** An organ, tissue, or cell that produces a response to a stimulus.

**Efferent arteriole:** The blood vessel that carries blood away from the glomerulus and sub-divides to form a network of capillaries. Its diameter is smaller than the afferent arteriole, creating a build up of hydrostatic pressure in the glomerulus.

**Excitatory synapse:** A synapse that produces new action potentials when neurotransmitters bind with receptor proteins on the postsynaptic neurone.

**Fast-twitch muscle fibres:** A type of muscle fibre that contracts more rapidly, with more power, over a shorter period. They are adapted for anaerobic respiration and intense activity.

**Feedback mechanism:** The mechanism by which the change to a system, brought about by the effector, is detected by the receptor.

**Fovea:** The point on the retina, opposite the pupil, that receives the highest intensity of light. It contains the greatest concentration of cone cells but no rod cells.

**Generator potential:** Depolarisation of the membrane of a sensory receptor cell that occurs in response to a stimulus.

**Glomerular filtrate:** The fluid produced by ultrafiltration of the blood into the renal capsule. It contains water, glucose, mineral ions and urea.

**Glomerulus:** A bundle of capillaries located in the renal capsule which are adapted for the filtration of blood. They later merge to form the efferent arteriole.

**Glucagon:** A hormone that is produced by  $\alpha$  cells of the islets of Langerhans. It increases blood glucose concentration by activating enzymes involved in gluconeogenesis and the conversion of glycogen to glucose.



**Gluconeogenesis:** The formation of glucose from sources that are not carbohydrate, e.g. amino acids and glycerol.

**Glycogenesis:** The formation of glycogen from glucose in the liver.

**Glycogenolysis:** The breakdown of glycogen into glucose in the liver.

**Gravitropism:** A plant's growth response to gravity.

**Homeostasis:** The maintenance of a constant internal environment in the body, despite fluctuations in internal and external conditions.

**Hormones:** Cell signalling molecules produced by endocrine glands and released into the blood. They travel to target cells and bind to specific receptors, initiating a response. The effects of hormones are usually long-lasting.

**Hyperpolarisation:** A decrease in the membrane potential of an axon, so that it is even more negative than the resting potential.

**Hypothalamus:** The region of the brain close to the pituitary gland that serves as the control centre for the autonomic nervous system. It is responsible for the regulation of body temperature and the water potential of body fluids.

**H-zone:** The lighter region in the centre of each A band.

**Indoleacetic acid (IAA):** A plant growth factor that is a type of auxin and controls cell elongation. It stimulates elongation in shoots and inhibits elongation in roots.

**Inhibitory synapse:** A synapse that decreases the likelihood of an action potential in the postsynaptic neurone by causing potassium ions ( $K^+$ ) to leave the postsynaptic neurone and chloride ions ( $Cl^-$ ) to enter. This results in hyperpolarisation of the postsynaptic neurone.

**Insulin:** A hormone that is produced by  $\beta$  cells of the islets of Langerhans. It decreases blood glucose concentration by activating enzymes involved in the conversion of glucose to glycogen and increasing the number of glucose transport channels in the cell surface membranes of target cells.

**Intermediate neurone:** A neurone located in the spinal cord that links the sensory neurone to the motor neurone.

**Iodopsin:** The pigment found in cone cells.

**Islets of Langerhans:** Clusters of hormone-producing cells located in the pancreas. They consist of  $\alpha$ -cells that secrete glucagon, and  $\beta$ -cells that secrete insulin.

**Isotropic (I) bands:** The lighter bands in a myofibril, which consist of non-overlapping actin and myosin filaments.



**Kinesis:** A response to a stimulus that is non-directional, changing the speed at which an organism moves and the rate at which its direction changes.

**Loop of Henle:** A loop consisting of a descending limb (dips into the medulla) and ascending limb (rises into the cortex) surrounded by blood capillaries. It creates a low water potential in the medulla, enabling the reabsorption of water.

**Medulla oblongata:** The part of the brain that controls heart rate. It is made up of two centres that are linked to the SAN. One centre is linked by the sympathetic nervous system and increases heart rate. The other is linked by the parasympathetic nervous system and decreases heart rate.

**Motor neurone:** A neurone 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.

**Myofibrils:** Tiny contractile muscle fibres which group together. Numerous myofibril bundles constitute muscles. Myofibrils consist of two protein filaments: actin and myosin.

**Myogenic:** Describes cardiac muscle tissue that initiates its own contraction without outside stimulation from nervous impulses.

**Myosin:** A type of protein filament found in myofibrils. It forms thick filaments, consisting of long tails with bulbous heads, positioned to the side.

**Myosin binding site:** A site on actin that is normally blocked by tropomyosin. During muscle contraction, it becomes exposed, allowing a myosin head to attach.

**Negative feedback:** A feedback mechanism that inhibits the original stimulus and reverses the change in conditions, restoring the optimum point.

**Negative tropism:** The growth of a plant away from a stimulus.

**Nephron:** The functional unit of the mammalian kidney.

**Nerve impulse:** A wave of depolarisation that travels across an axon membrane. It is self-propagating.

**Neuromuscular junction:** An excitatory synapse formed between a motor neurone and a muscle fibre that uses the neurotransmitter, acetylcholine.

**Neurones:** Nerve cells adapted to quickly transmit nerve impulses.

**Neurotransmitters:** Chemicals that are used for communication between neurones and their target cells. Neurotransmitters are stored in synaptic vesicles in the presynaptic neurone and released into the synaptic cleft.



**Nodes of Ranvier:** Gaps between adjacent Schwann cells in the myelin sheath at which action potentials can occur.

**Optic nerve:** A nerve that carries electrical impulses to the brain from the retina.

**Optimum point:** The point at which a system works most effectively.

**Osmoreceptors:** Sensory receptor cells located in the hypothalamus that detect a decrease in water potential.

**Osmoregulation:** The regulation of the water potential of the blood by the kidney.

**Pacinian corpuscle:** A sensory receptor that detects changes in mechanical pressure.

**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.

**Phosphocreatine:** A compound stored in muscles that serves as a phosphate reserve, enabling ATP regeneration.

**Phototropism:** A plant's growth response to light.

**Plant growth factors:** Hormone-like substances (e.g. IAA) that control the growth of plants in response to external stimuli.

**Polarisation:** Describes the condition in which an axon has a membrane potential of  $-65\text{mV}$  (resting potential).

**Positive feedback:** A feedback mechanism that enhances the original stimulus and increases the change in conditions, deviating the system further from the optimum point.

**Positive tropism:** The growth of a plant towards a stimulus.

**Posterior pituitary gland:** The gland responsible for the secretion of ADH into the bloodstream.

**Postsynaptic neurone:** The neurone after the synapse which contains specific receptor proteins on its membrane, complementary to the neurotransmitter.

**Pressure receptors:** A type of receptor found in the walls of the carotid arteries and aorta which detects changes in blood pressure and transmits nerve impulses to the medulla oblongata. For example, if blood pressure increases, pressure receptors increase the frequency of nerve impulses to the medulla oblongata.



**Presynaptic neurone:** The neurone before the synapse which releases neurotransmitters from synaptic vesicles into the synaptic cleft.

**Protein kinase:** An enzyme that catalyses the conversion of glycogen to glucose.

**Proximal convoluted tubule:** The twisted portion of the nephron between the renal capsule and the loop of Henle. Its walls consist of epithelial cells that are adapted for the reabsorption of glucose and water into the blood.

**Purkyne tissue:** Specialised cardiac muscle fibres which conduct the wave of excitation from the AVN down to the apex of the ventricles.

**Receptor:** Specialised structure that detects a specific type of stimulus.

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

**Reflex arc:** The pathway of neurones involved in a reflex action:

stimulus → receptor → sensory → intermediate → 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.

**Renal (Bowman's) capsule:** The cup-like structure at the start of a nephron that surrounds the glomerulus. The inner layer of the capsule, through which filtration of the blood takes place, is composed of podocytes.

**Repolarisation:** The re-establishment of the resting potential (-65mV).

**Response:** A change in an organism as a result of a stimulus.

**Resting potential:** An electrical potential difference of -65 mV across the membrane of an axon. The inside of the axon is more negative than the outside. The membrane is described as polarised.

**Retina:** The inner layer of the mammalian eye. It consists of light receptor cells that act as transducers, converting light energy into electrical energy.

**Rhodopsin:** The pigment found in rod cells which is broken down to create a generator potential.



**Rod cells:** A type of light receptor cell that transduces light energy into a generator potential. They are located at the periphery of the retina, detect light of low intensity and lead to black and white images. Many rod cells form a synapse with a single bipolar cell, giving low visual acuity.

**Saltatory conduction:** The process by which a nerve impulse is propagated along a myelinated neurone. Depolarisation occurs at the nodes of Ranvier and action potentials jump from node to node, speeding up transmission.

**Sarcomere:** Each repeating unit of striations between adjacent Z-lines.

**Sarcoplasm:** The cytoplasm shared by muscle fibres. It consists of a high concentration of mitochondria and endoplasmic reticulum.

**Schwann cells:** Cells that wrap around the axon. They have a range of roles including electrical insulation, axon protection, nerve regeneration and phagocytosis.

**Second messenger model:** The mechanism by which a hormone (e.g. adrenaline or glucagon) has an effect inside a cell by triggering the production of a second messenger such as cAMP.

**Sensory neurone:** A neurone that carries nerve impulses from the receptors to the CNS.

**Sinoatrial node (SAN):** A group of cells in the wall of the right atrium that generate electrical activity. The SAN is often referred to as the heart's pacemaker.

**Skeletal muscle:** A voluntary muscle responsible for movement. It makes up the majority of body muscle and is attached to the skeleton by tendons.

**Sliding filament theory:** The mechanism by which a muscle contracts. During contraction, myosin filaments pull actin filaments to the centre of the sarcomere. The actin filaments slide along the myosin filaments. The sarcomere is shortened and the muscle length is reduced.

**Slow-twitch muscle fibres:** A type of muscle fibre that contracts more slowly, with less power, over a greater period. They are adapted for aerobic respiration and enable endurance.

**Sodium-potassium pump:** A carrier protein found in the plasma membrane of an axon. It actively transports three sodium ions ( $\text{Na}^+$ ) out of the axon for every two potassium ions ( $\text{K}^+$ ) that it pumps into the axon.

**Spatial summation:** A type of summation involving the release of neurotransmitters from multiple presynaptic neurones. The concentration of neurotransmitter exceeds the threshold value and triggers an action potential in the postsynaptic neurone.





**Stimulus:** A change in an organism's internal or external environment that can be detected.

**Stretch-mediated sodium channel:** A type of sodium channel whose permeability to sodium changes upon distortion (e.g. pressure changes, stretching). They are found in the plasma membrane of the sensory neurone ending at the centre of the Pacinian corpuscle.

**Summation:** The build-up of neurotransmitters in the synaptic cleft, allowing low-frequency action potentials to trigger a new action potential in the postsynaptic neurone. There are two forms of summation: spatial and temporal.

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

**Synaptic cleft:** A small gap between neurones across which a nerve impulse is transmitted via neurotransmitters.

**Synaptic vesicles:** Secretory vesicles located in the presynaptic neurone that store neurotransmitters. Upon fusion with the presynaptic membrane, their contents are released into the synaptic cleft.

**Target cells:** Cells with specific receptor proteins on their cell surface membranes, complementary to the shape of a particular hormone.

**Taxis:** A response to a stimulus that is directional, i.e. the movement of an organism towards or away from a stimulus.

**Temporal summation:** A type of summation involving the release of neurotransmitters from a single presynaptic neurone at a high frequency. The concentration of neurotransmitter exceeds the threshold value and triggers an action potential in the postsynaptic neurone.

**Threshold value:** A certain size of stimulus that is required to generate an action potential.

**Transducer cells:** Cells that convert one form of energy into an electrical signal.

**Tropism:** The growth response of a plant to a directional stimulus.

**Tropomyosin:** A protein found in muscles that forms a fibrous strand wrapped around an actin filament.

**Type I diabetes:** A form of diabetes (insulin-dependent) in which the body cannot produce insulin. It has an early, rapid onset and is treated using insulin injections.

**Type II diabetes:** A form of diabetes (insulin-independent) in which the body does not respond to insulin due to the loss of or unresponsiveness of glycoprotein receptors. In some cases, the body may not produce enough insulin. It has a late, slow onset and is controlled by managing diet and exercise.



**Unidirectionality:** Describes synaptic transmission; synapses can only transmit information in a single direction, from the presynaptic neurone to the postsynaptic neurone.

**Visual acuity:** The clarity of vision.

**Z-line:** The line in the centre of each I band.

