WJEC (Wales) Biology A-level

Topic 3.7 - Homeostasis and the Kidney

Definitions and Concepts

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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.

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 DCT 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 ascending limb and its walls are impermeable to water. Sodium ions and chloride ions are moved out of the ascending limb by active transport.

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.

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.

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

Cortex - The outer region of the kidney.

Deamination - The removal of the amino group from a molecule. In the liver, amino acids are deaminated to form ammonia, which is then converted to urea.

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.

Dialysis - A medical procedure that artificially filters the blood of patients with kidney failure. It relies on a partially permeable membrane between the patient's blood and dialysis fluid. There are two types: haemodialysis and peritoneal dialysis.

Distal convoluted tubule (DCT) - The twisted region of the nephron between the loop of Henlé and the collecting duct that 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.

Endocrine glands - Glands of the endocrine system that secrete hormones directly into the bloodstream.

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Excretion - The process of removing metabolic waste from an organism. Excretory products differ between organisms.

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.

Homeostasis - Maintaining a constant internal environment around an optimum despite external change.

Loop of Henlé - 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. The length of the loop varies depending on the mammal's environment.

Mammalian kidney - One of a pair of organs in the abdomen that has a role in osmoregulation and nitrogenous excretion.

Medulla - The inner region of the kidney consisting of renal pyramids made up of nephrons.

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

Nephron - The functional unit of the mammalian kidney.

Osmoreceptors - Sensory receptor cells located in the hypothalamus that detect the concentration of the blood plasma.

Osmoregulation - The regulation of the water potential of the blood by the kidney.

Peritubular capillaries - Small blood vessels supplied by the efferent arteriole that surround the PCT, loop of Henlé and DCT, and enable selective reabsorption.

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

Posterior pituitary gland - A gland of the endocrine system that secretes hormones (such as ADH) directly into the bloodstream.

Proximal convoluted tubule (PCT) - 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.

Receptor - A specialised structure that detects a specific type of stimulus.

Renal arteries - Blood vessels that carry oxygenated blood to the kidneys.

Renal pelvis - The central region of the kidney that serves as a funnel for the flow of urine into the ureter.

Renal veins - Blood vessels that drain the kidneys.

Selective reabsorption - The selective reuptake of useful substances (small molecules and ions) in the proximal convoluted tubule using membrane transport proteins.

Set point - A desired value or range of values determined by a coordinator.

Transplant - A medical procedure in which an organ or tissue in an individual is replaced.

Ultrafiltration - The removal of small molecules, water and ions from the blood in the glomerulus of the kidney at high pressure.

Vasa recta - Long, U-shaped blood vessels that run parallel to the loop of Henlé and supply the medulla with blood.