WJEC (Wales) Biology A-level

Topic 2.3 - Adaptations for Transport

Definitions and Concepts

Adhesion (water movement) - The formation of hydrogen bonds between carbohydrates in the xylem vessel walls and water molecules. This contributes to the capillarity of water and transpiration pull.

Adult haemoglobin - Haemoglobin in an adult that has a lower affinity for oxygen than fetal haemoglobin. This enables the fetus to obtain oxygen from the mother's blood.

Aorta - The artery that takes oxygenated blood away from the heart to the body.

Aphid - A small insect that sucks sap through a mouthpart (known as a stylet) which is inserted into a sieve tube. The sap exuding from the stylet can provide evidence that sugars are carried in the phloem.

Apoplast route - One of three pathways by which water and minerals move across the root. Water moves through intercellular spaces between cellulose molecules in the cell wall.

Arteriole - A type of blood vessel that connects the arteries and capillaries. The walls of the arterioles contain large amounts of smooth muscle, some elastic fibres and some collagen.

Artery - A type of blood vessel that carries blood away from the heart to the tissues, under high pressure. The walls of the arteries contain collagen, smooth muscle and elastic fibres.

Atrial systole - The stage of the cardiac cycle in which the atria contract, pushing blood into the ventricles. The AV valves are pushed open fully and the atria are emptied of blood.

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 (AV) valves - The valves found between the atria and ventricles. They prevent the backflow of blood from the ventricles into the atria. There are two types of atrioventricular valves: bicuspid and tricuspid.

Autoradiography - A technique used to record the distribution of radioactive material within a specimen. Autoradiographs produced using carbon dioxide labelled with radioactive carbon can provide evidence for translocation occurring in the phloem.

Bicuspid valves - The atrioventricular valves found between the left atrium and left ventricle.

Blood - The transport medium in the mammalian circulatory system. It consists of plasma, red blood cells, white blood cells and platelets.

Bohr effect - The loss of affinity of haemoglobin for oxygen as the partial pressure of carbon dioxide increases.

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

Capillaries - Microscopic blood vessels that form a large network through the tissues of the body and connect the arterioles to the venules. They are the site of exchange of substances between the blood and the tissues.

Capillarity - The tendency of water to move up the xylem, against gravity, due to adhesive forces that prevent the water column dropping back.

Carbaminohaemoglobin - A compound of carbon dioxide and haemoglobin that enables the transport of carbon dioxide in the blood.

Carbonic acid - A compound formed from water and carbon dioxide in the blood that dissociates to hydrogen and hydrogencarbonate ions.

Carbonic anhydrase - An enzyme that catalyses the reversible reaction between water and carbon dioxide to produce carbonic acid.

Cardiac cycle - Describes the sequence of events involved in one complete contraction and relaxation of the heart. There are three stages: atrial systole, ventricular systole and diastole.

Casparian strip - A waterproof strip surrounding the endodermal cells of the root that blocks the apoplast pathway, forcing water through the symplast route.

Chloride shift - The process by which chloride ions move into the erythrocytes in exchange for hydrogen carbonate ions which diffuse out of the erythrocytes. This is a one-to-one exchange and it maintains the electrochemical equilibrium of the cell.

Circulatory system - The transport system in animals.

Closed circulatory system - A circulatory system in which the blood pumped by the heart is contained within blood vessels. The blood does not come into direct contact with the cells. Closed circulatory systems are found in earthworms.

Cohesion (water movement) - The formation of hydrogen bonds between water molecules. This contributes to the capillarity of water and plays an important part in maintaining the transpiration stream.

Cohesion-tension theory - The model that explains the movement of water from the soil to the leaves, in a continuous stream.

Companion cells - The active cells of the phloem located adjacent to the sieve tube elements. They retain their nucleus and organelles, producing ATP for metabolic processes in both themselves and the sieve tube elements.

Cytoplasmic strands - Small extensions of the cytoplasm between adjacent sieve tube elements and companion cells that allow communication and the exchange of materials. They also hold the nucleus in place.

Diastole - The stage of the cardiac cycle in which the heart muscle relaxes. The atria and ventricles fill with blood.

Dicotyledonous plants - Plants that produce seeds that contain two cotyledons. They have two primary leaves.

Double circulatory system - A circulatory system in which the blood flows through the heart twice in two circuits. Blood is pumped from the heart to the lungs before returning to the heart. It is then pumped around the body, after which it returns to the heart again. Double circulatory systems are found in mammals.

Electrocardiogram (ECG) - A technique used to indirectly measure the spread of electrical activity through the heart by measuring tiny changes in the skin's electrical conductivity. This produces a trace which is used to detect abnormalities in heart rhythm.

Endodermis - The innermost layer of the cortex of a dicotyledon root. It is impregnated with suberin which forms the Casparian strip. Endodermal cells actively transport mineral ions into the xylem.

Erythrocyte - A type of blood cell that is anucleate and biconcave. It contains haemoglobin which enables the transport of oxygen and carbon dioxide to and from the tissues.

Fetal haemoglobin - Haemoglobin in a fetus that has a higher affinity for oxygen than adult haemoglobin due to the presence of two different subunits that allow oxygen to bind more readily. This enables the fetus to obtain oxygen from the mother's blood.

Haemoglobin - The red pigment found in erythrocytes that binds reversibly with four oxygen molecules to form oxyhaemoglobin. It is a globular protein that consists of four polypeptide chains, each with a prosthetic haem group.

Hydrophytes - Plants that are adapted to live and reproduce in very wet habitats, e.g. water lilies.

Hydrostatic pressure - The pressure exerted on the sides of a vessel by a fluid.

Inferior vena cava - The vein that returns deoxygenated blood to the heart from the lower body.

Lymph - Modified tissue fluid that drains into the lymphatic system. It carries less oxygen and fewer nutrients than tissue fluid, but also contains fatty acids.

Mass flow theory - The main theory to explain translocation in the phloem. It suggests that sugars flow passively from the source (highest sugar concentration) to the sink (lowest sugar concentration).

Mesophytes - Terrestrial plants that are adapted to live in environments with average conditions and an adequate water supply. They have features that enable their survival at unfavourable times of the year.

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

Open circulatory system - A circulatory system in which the transport medium pumped by the heart is not contained within vessels, but moves freely. The transport fluid comes into direct contact with the cells. Open circulatory systems are found in invertebrates, e.g. insects.

Osmotic pressure - The movement of water into the blood by osmosis due to the tendency of plasma proteins to lower the water potential of the blood.

Oxygen dissociation curve - A graph that describes the relationship between the partial pressure of oxygen and the percentage saturation of haemoglobin in the blood.

Phloem - A living plant transport vessel responsible for the transfer of assimilates to all parts of the plant. The phloem consists of sieve tube elements and companion cells.

Plasma - The main component of the blood that carries red blood cells. It is a yellow liquid that contains proteins, nutrients, mineral ions, hormones, dissolved gases and waste. It also distributes heat.

Potometer - An apparatus used to measure water uptake from a cut shoot.

Pulmonary arteries - The arteries that carry deoxygenated blood away from the heart to the lungs.

Pulmonary veins - The veins that carry oxygenated blood from the lungs to the heart.

Purkyne tissue - Specialised cardiac muscle fibres which make up the bundle of His and conduct the wave of excitation through the septum, from the AVN down to the apex of the ventricles.

P wave - A characteristic pattern on an ECG that represents depolarisation of the atria during atrial systole.

QRS wave - A characteristic pattern on an ECG that represents depolarisation of the ventricles, leading to ventricular systole.

Root hair cells - Specialised cells responsible for the uptake of water and minerals from the soil. They have long hair-like extensions known as root hairs, which are adapted as exchange surfaces.

Root pressure - The force that drives water into and up the xylem by osmosis due to the active transport of minerals into the xylem by endodermal cells.

Semilunar valves - A pair of valves found between the ventricles and arteries. They prevent the backflow of blood from the arteries into the ventricles.

Septum - The wall of muscle which separates the left side of the heart from the right side of the heart, preventing oxygenated and deoxygenated blood from mixing.

Sieve plates - The perforated end walls of sieve tube elements that allow plant assimilates to flow between cells unimpeded.

Sieve tube elements - The main cells of the phloem. They are elongated cells laid end-to-end with sieve plates between. They contain few organelles.

Single circulatory system - A circulatory system in which the blood travels one circuit; blood flows through the heart and is pumped around the body before returning to the heart. Single circulatory systems are found in fish.

Sinks (plants): The regions of a plant that remove assimilates e.g. roots, meristem, fruits.

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

Sources (plants): The regions of a plant that produce assimilates e.g. leaves, storage organs.

Suberin - A waterproof, waxy material that forms the Casparian strip in the endodermis.

Superior vena cava - The vein that returns deoxygenated blood to the heart from the head and upper body.

Symplast route - One of three pathways by which water and minerals move across the root. Water enters the cytoplasm through the plasma membrane and moves between adjacent cells via plasmodesmata. Water diffuses down its water potential gradient by osmosis.

Tissue fluid - The fluid that surrounds the cells of animals. It has the same composition of plasma but does not contain red blood cells or plasma proteins.

Translocation - The movement of organic compounds in the phloem, from sources to sinks.

Transpiration - Water loss from plant leaves and shoots via diffusion and evaporation. The rate of transpiration is affected by light, temperature, humidity and air movement.

Transpiration stream - The flow of water from the roots to the leaves in plants, where it is lost by evaporation to the environment.

Tricuspid valves - The atrioventricular valves found between the right atrium and right ventricle.

T wave - A characteristic pattern on an ECG that represents repolarisation of the ventricles during ventricular diastole.

Vacuolar route - One of three pathways by which water and minerals move across the root. Water enters the cytoplasm through the plasma membrane and moves between vacuoles of adjacent cells. Water diffuses down its water potential gradient by osmosis.

Vascular bundle - The vascular system in herbaceous dicotyledonous plants. It consists of two transport vessels, the xylem and the phloem.

Vascular system - A network of transport vessels in animals and plants.

Vein - A type of blood vessel that carries blood towards the heart under low pressure. They have a wide lumen, a smooth inner lining and valves. The walls of the veins contain large amounts of collagen, smooth muscle and little elastic fibre.

Ventricular systole - The stage of the cardiac cycle in which the ventricles contract, pushing blood into the arteries. The semilunar valves are pushed open fully.

Venule - A type of blood vessel that connects the capillaries and veins. The walls of the venules contain small amounts of collagen and smooth muscle.

Xerophytes - Plants that are adapted to live and reproduce in dry habitats where water availability is low, e.g. cacti and marram grass.

Xylem - A non-living plant transport vessel responsible for the transfer of water and minerals from the roots to the shoots and leaves.