AQA Biology – Organisation Part 1 Journey of Knowledge

Context and introduction to the unit: In this section we will learn about the human digestive system which provides the body with nutrients and the respiratory system that provides it with oxygen and removes carbon dioxide. In each case they provide dissolved materials that need to be moved quickly around the body in the blood by the circulatory system. Damage to any of these systems can be debilitating if not fatal. Although there has been huge progress in surgical techniques, especially with regard to coronary heart disease, many interventions would not be necessary if individuals reduced their risks through improved diet and lifestyle. We will also learn how the plant's transport system is dependent on environmental conditions to ensure that leaf cells are provided with the water and carbon dioxide that they need for photosynthesis.
Prior Knowledge: Cell Biology

CORE KNOWLEDGE

Cells are the basic building blocks of all living organisms (e.g. muscle cells, nerve cells, red blood cells). A tissue is a group of specialised cells with a similar structures and functions (e.g. epithelial tissue, connective tissue, muscle tissue). Organs are aggregations of tissues working together to perform specific functions (e.g. heart, brain, stomach). Organs are organised into organ systems which carry out specific processes (e.g. digestive system, nervous system, respiratory system). The organ systems work together to form the whole organism (e.g. animal or plant).

Food contains different nutrients (e.g. carbohydrates, lipids & proteins) that can be identified using qualitative reagents. A reagent is a chemical that indicates whether a specific substance is present or not, however the reagent does not tell us how much of the substance is present (i.e. they are not quantitative). To test for a nutrient, the food sample should be crushed before adding the reagent. The reagent will change colour if the nutrient is present. If starch (carbohydrate) is present, iodine solution will turn from brown to blue-black. If glucose (carbohydrate) is present, Benedict's reagent will turn from blue to brick-red when placed in a water bath. If protein is present, Biuret reagent will turn from blue to lilac. If lipids are present, ethanol will turn from clear to cloudy/white emulsion. Biuret reagent is caustic (corrosive), Benedict's reagent is an irritant and ethanol is flammable – these risks should be controlled by taking care using the reagents, wearing gloves/goggles, cleaning up spills immediately and by avoiding use of a traditional water bath involving a Bunsen burner.

The digestive system is an example of an organ system in which several organs work together to digest and absorb food. Digestion is the breakdown of large, insoluble molecules into small, soluble molecules. Food starts in the mouth, travels down the oesophagus by peristalsis (muscular contractions) to the stomach, from the stomach food enters the duodenum (start of the small intestine) before moving into and through the small intestine by peristalsis, this continues into the large intestine and eventually the waste food is stored in the rectum before exiting the body through the anus. The liver, pancreas and gall bladder are also involved in digestion, but food does not directly travel through these organs.

Digestion occurs due to digestive juices such as saliva, gastric juices and pancreatic juices containing enzymes that break down the food. The stomach contains hydrochloric acid which kills bacteria on food and provides the right conditions for enzymes in the stomach. Bile (produced by the liver and stored in the gall bladder) neutralises the acidic food as it leaves the stomach to provide the right conditions for enzymes in the small intestine. Bile also emulsifies lipids. The small intestine contains structures called villi which increase the surface area of the small intestine lining, allowing more small, soluble food molecules to be absorbed into the bloodstream.

Enzymes are known as biological catalysts, they break down the large, insoluble molecules into small, soluble molecules that can be absorbed into the bloodstream. Each enzyme is specific to the food molecule that it breaks down due to the shape of its active site. Amylase breaks down starch into glucose. Protease breaks down protein into amino acids. Lipase breaks down lipids into fatty acids & glycerol. The pancreas and small intestine produce and release all three enzymes, the salivary glands produce amylase only and the stomach produces protease (pepsin) only.

Enzyme action is affected by temperature and pH. The optimum temperature for enzymes is 37°C and the optimum pH for enzymes is pH7 except for pepsin which works best at pH2. If an enzyme is not at its optimum temperature or pH, it will not work as effectively or may become denatured meaning the active site will change shape. By using continuous sampling techniques, the rate of enzyme-action at different pHs/temperatures can be observed. Whichever factor is being changed, the other must be controlled. The rate of amylase action can be observed by using iodine solution to test for the presence of starch at regular intervals under different conditions.

Disciplinary Knowledge Food Tests RP: use qualitative reagents to test for a range of carbohydrates, lipids and proteins. Enzyme RP: investigate the effect of pH on the rate of reaction of amylase enzyme. WS 1.2, 1.3, 1.4, 1.5

Vocabulary Tissue, Organ, Organ System, Organism, Reagent, Peristalsis, Hydrochloric Acid, Bile, Neutralise, Emulsify, Villi, Enzyme, Amylase, Protease, Lipase, Active Site, Denature, Plasma, Red Blood Cells, White Blood Cells, Platelets, Artery, Vein, Capillary, Lumen, Atria, Ventricle, Pacemaker Cells, Double-Circulatory System, Non-Communicable, Coronary Heart Disease, Cancer, Risk Factor, Upper Epidermis, Palisade Mesophyll, Spongy Mesophyll, Lower Epidermis, Guard Cells, Stomata, Xylem, Phloem, Transpiration, Translocation, Transpiration Stream

Reading is Power What is Cancer?

Where Next? Paper 1: Infection & Response – pupils will apply knowledge of the structure of the leaf to plant defence against disease., Bioenergetics: pupils will apply knowledge of enzyme action to enzyme-controlled reactions & limiting factors, pupils will understand what happens to substances . Paper 2: Homeostasis – pupils will apply knowledge of enzyme action to how the body maintains stable conditions of pH and temperature. Inheritance & variation – pupils will apply knowledge of cancer & uncontrolled cell division to how genetic disorders can arise.

AQA Biology – Organisation Part 2 Journey of Knowledge

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Prior Knowledge: Cell Biology

CORE KNOWLEDGE **BIOLOGY (SEPARATES) ONLY**

Blood is a type of connective tissue consisting of plasma in which the red blood cells, white blood cells and platelets are suspended. RBCs transport oxygen around the body, WBCs defend the body from pathogens, platelets clot the blood and plasma transports substances such as hormones, carbon dioxide, glucose and enzymes around the body. Haemoglobin is the red pigment inside of red blood cells which binds with oxygen. Each haemoglobin can bind with four oxygen molecules; this is a reversible reaction. Hb + 4O2 ⇌ HbO8 | Haemoglobin + Oxygen ⇌ Oxyhaemoglobin

The body contains three different types of blood vessels; arteries, veins and capillaries. Arteries carry blood away from the heart (a = away), veins carry blood back to the heart (vein = in), capillaries carry blood between arteries and veins to cells and tissues. Arteries have thick, muscular, elastic walls to withstand high blood pressures, this makes the lumen relatively narrow allowing high blood pressure to be maintained. Veins have thinner walls and therefore a wider lumen due to lower blood pressures, however they do contain valves to prevent the back flow of blood. Capillaries have a very narrow lumen that only allows one cell at a time to pass through, as well as walls that are only one cell thick to assist in the diffusion of substances into cells and tissues.

The heart is an organ made of cardiac muscle cells/tissue. The heart contains four chambers, the atria (A = ↑) are the two top chambers whilst the ventricles (V = ↓) are the two bottom chambers. The right ventricle pumps deoxygenated blood to the lungs through the pulmonary artery for gas exchange to take place. The left atrium receives oxygenated blood from the lungs through the pulmonary vein. The left ventricle pumps oxygenated blood around the rest of the body through the aorta artery. The right atrium receives deoxygenated blood from the rest of the body through the vena cava vein. This is referred to as a double circulatory system as blood enters the heart twice for every circuit of the body. The septum separates the left and right sides of the heart, keeping oxygenated and deoxygenated blood apart. Heart rate is controlled by a group of cells located in the right atrium called pacemaker cells. When labelling a heart, it is important to understand that when you're looking at it on paper, the left and right sides appear reversed — like looking at a mirror image. The left side of the diagram is actually the right side of the heart, and the right side of the diagram is actually the left side of the heart. This is because diagrams are usually drawn as if you're facing the person whose heart you're looking at. An easy way to work out which side is which is by observing which side has a thicker wall, the left side of the heart has the thickest wall as the muscle needs to be much larger to pump blood all around the body.

Health is the state of physical and mental well-being. Diseases, both communicable diseases and non-communicable, are major causes of ill health. Other factors including diet, stress and life situations may have a profound effect on both physical and mental health. Different types of disease may interact. Defects in the immune system mean that an individual is more likely to suffer from infectious diseases. Viruses living in cells can be the trigger for cancers. Immune reactions initially caused by a pathogen can trigger allergies such as skin rashes and asthma. Severe physical ill health can lead to depression and other mental illness. There are human and financial costs of non-communicable diseases to an individual, a local community, a nation or globally.

Lifestyle factors including diet, alcohol and smoking impact on the incidence of non-communicable diseases at local, national and global levels. Risk factors are linked to an increased rate of a disease. They can be aspects of a person's lifestyle or substances in the person's body or environment. A causal mechanism has been proven for some risk factors, but not in others. For example, diet, smoking and exercise can impact cardiovascular disease, obesity is a risk factor for Type 2 diabetes, alcohol on the liver and brain function. Smoking is a risk factor of lung disease and lung cancer. Carcinogens, including ionising radiation, are risk factors in cancer. Many diseases are caused by the interaction of a number of factors.

The coronary arteries supply the heart muscle with oxygenated blood. In coronary heart disease layers of fatty material known as plaque build-up inside the coronary arteries, narrowing them. This reduces the flow of blood through the coronary arteries, resulting in a lack of oxygen for the heart muscle. This lack of oxygen can result in heart failure or heart attack. Stents are used to keep the coronary arteries open. Statins are widely used to reduce blood cholesterol levels which slows down the rate of fatty material deposit. In some people heart valves may become faulty, preventing the valve from opening fully, or the heart valve might develop a leak. Faulty heart valves can be replaced using biological or mechanical valves. Artificial pacemakers are electrical devices used to correct irregularities in the heart rate. In the case of heart failure, a donor heart, or heart and lungs can be transplanted. Artificial hearts are occasionally used to keep patients alive whilst waiting for a heart transplant, or to allow the heart to rest as an aid to recovery.

Cancer is the result of changes in cells that lead to uncontrolled growth and division. Benign tumours are growths of abnormal cells which are contained in one area, usually within a membrane. They do not invade other parts of the body. Malignant tumour cells invade neighbouring tissues and spread to different parts of the body in the blood where they form secondary tumours. As well as lifestyle risk factors, there are also genetic risk factors for some cancers.

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AQA Biology – Organisation Part 3 Journey of Knowledge

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Prior Knowledge: Cell Biology

CORE KNOWLEDGE

The leaf is a plant organ composed of many tissues. The top and bottom of the leaf is coated in a wax like layer called the waxy cuticle, which prevents water loss from the leaf and protects the plant. The top tissue is the upper epidermis upper epidermis is thin & transparent to allow light to pass through. The palisade mesophyll contains palisade cells tightly packed together which contain many chloroplasts for maximum photosynthesis. The spongy mesophyll contains internal air spaces that increase the surface area for the diffusion of gases. The lower epidermis contains guard cells & stomata. Guard cells are responsible for opening and closing the stomata. The stomata are tiny pores on under-side of leaf where gas exchange occurs.

The stem is a plant organ that contains two tissues; the xylem and phloem. Together with the roots and leaves, the stem forms an organ system for transport of substances around the plant. Root hair cells are adapted for the efficient uptake of water by osmosis and mineral ions by active transport by having a projection to increase the surface area and many mitochondria to provide energy for active transport. The xylem tissue is a hollow tube of lignified (dead) cells that carries water and mineral ions upwards from the roots to the leaves of the plant. This process of transporting water and mineral ions is known as the transpiration stream, which is a physical process occurring due to the adhesive property of water. The phloem tissue is a tube of perforated, elongated cells known as sieve tubes that carry dissolved sugars from the leaves all around the plant, meaning transport happens both upwards and downwards. This process of transporting dissolved sugars is known as translocation, which is an active process requiring energy from respiration. To facilitate this, companion cells next to the sieve tubes contain many mitochondria.

Water can be lost through the stomata in a process known as transpiration, which requires energy from the sun for the end water molecule to evaporate. This process along with the adhesive property of water is what creates the transpiration stream. Transpiration can be increased by an increase in temperature, air movement and light intensity or a decrease in humidity. To prevent too much water from being lost from the plant, the guard cells open/close the stomata at specific points in the day. During the night when no photosynthesis is occurring, guard cells close the stomata as no gases are required. Guard cells also partially close the stomata at around mid-day, when temperatures reach their highest.

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