**Unit BY2 Biodiversity and Physiology of Body Systems**

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| **What you need to know** | Done? | Understood? | Revised? |
| **2.1 ALL ORGANISMS ARE RELATED THROUGH THEIR EVOLUTIONARY HISTORY.** |  |  |  |  |  |
| Biodiversity is a measure of the number of species on the planet. |  |  |  |  |  |
| A species is a group of organisms that can interbreed under natural conditions and produce fertile offspring. |  |  |  |  |  |
| The number of species per square kilometre increases as one move from the poles to the tropics. Tropical rain forests and coral reefs are the most diverse habitats on the planet |  |  |  |  |  |
| The fossil record shows that most species are now extinct. |  |  |  |  |  |
| Evolutionary history shows that biodiversity has gone through several bottlenecks called mass extinctions followed by radiations of new species.  |  |  |  |  |  |
| Natural selection (detailed mechanism in unit 5) drives the evolution of new species. |  |  |  |  |  |
| Darwin’s finches are an example of adaptive radiation. |  |  |  |  |  |
| The classification of organisms is based on their evolutionary relationships. |  |  |  |  |  |
| One classification concept is that of a simple phylogenetic tree. |  |  |  |  |  |
| All organisms can be placed into a hierarchical system of classification that includes – kingdom, phylum, class, order, family, genus, and species. |  |  |  |  |  |
| Organisms are more closely related with progression from kingdom to species. Taxonomy is dynamic and there are differences of opinion about whether morphology or genetics are more central for a basis of classification. |  |  |  |  |  |
| Candidates should understand the basic characteristics of the five kingdoms: **Prokaryotae** (unicellular, microscopic, no internal membrane based organelles, no nuclear membrane, cell wall not cellulose); **Protoctista** (eukaryotes, mainly single cell organisms, no tissue differentiation); **Plantae** (multicellular eukaryotes, photosynthetic, cellulose cell wall); **Fungi** (heterotrophic eukaryotes, rigid cell walls of chitin, reproduce by spores);**Animalia** (heterotrophic, multicellular eukaryotes, no cell wall, nervous coordination). |  |  |  |  |  |
| The animal kingdom is split into major phyla and several smaller ones. (names not required unless specified below) |  |  |  |  |  |
| Each phylum includes animals based on a shared basic blueprint. |  |  |  |  |  |
| A genus is a group of closely related species; the binomial system includes both a genus and species name. |  |  |  |  |  |

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| The basic features of some important phyla to include:**Annelids** (8000 named species) examples - earthworm, leech, and lugworm. Segmented worms with a closed circulatory system, hydrostatic skeleton; specialised segments responsible for different functions, thin permeable skin used for gas exchange. |  |  |  |  |  |
| **Arthropods** (1 million named species) examples – insects e.g. locust, crustaceans e.g. lobster, arachnids e.g. spider, myriapods e.g. millipedes and centipedes. These organisms are characterised by having jointed legs, an exoskeleton, and a fluid-filled body cavity. The advantages of the exoskeleton. Insects are the most successful group of animals on Earth. The presence of two pairs of wings and six legs in the adult stage is a diagnostic feature of the insects. (In the evolution of some insect groups these features may have been secondarily lost, e.g. no wings in fleas and lice.) |  |  |  |  |  |
| **Chordates** (60,000 named species). Known as ‘vertebrates’,possessing a vertebral column or backbone (no use of term‘notochord’), well developed CNS enclosed in cranium, internal skeleton. Phylum subdivided into: fish (scales, gills, live in water),amphibian (soft moist skin, simple lungs, live on land but waterneeded for life cycle), reptiles (dry scaly skin, lungs, land based, lay eggs with leathery shells), birds (endothermic, lungs, feathers, forelimbs modified for flight, eggs with hard shells), mammals (endothermic, lungs, hair, double circulation, internal gestation and mammary glands, sweat glands). |  |  |  |  |  |
| Closely related species are recognised by their similar morphology, e.g. the homology of the pentadactyl limb in vertebrates. Analogous structures such as the wings of a bird and insect are not an indication of relatedness. |  |  |  |  |  |
| Biochemical methods measure the proportion of genes or proteins shared between species to estimate relatedness. Proteins are usually displayed as bands on an electrophoresis gel. Biochemical methods can reduce the mistakes made in classification due to convergent evolution.  |  |  |  |  |  |

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| **2.2 ADAPTATIONS FOR GAS EXCHANGE** |  |  |  |  |  |
| Living things need to obtain materials such as carbon dioxide and oxygen from the environment and remove waste from their cells to the environment. |  |  |  |  |  |
| Requirements may be proportional to volume however diffusion is proportional to surface area  |  |  |  |  |  |
| In large organisms the surface area to volume ratio is much less than in very small organisms. |  |  |  |  |  |
| In small, unicellular organisms the surface area to volume ratio is so large that diffusion through the body surface is sufficient to supply their needs. |  |  |  |  |  |
| Also, distances within the body are small and transport by diffusion is again sufficient, e.g. *Amoeba*, its size and lifestyle in water enables diffusion to supply its needs. |  |  |  |  |  |
| Larger, multicellular organisms may have a surface area to volume ratio which is too small to supply all their needs.  |  |  |  |  |  |
| These organisms therefore possess special surfaces for gaseous exchange, gills for aquatic environments, lungs for terrestrial environments.  |  |  |  |  |  |
| These exchange surfaces have particular properties to aid diffusion: large surface area; thin, permeable surface. |  |  |  |  |  |
| The large moist area for gaseous exchange is a region of potential water loss. |  |  |  |  |  |
| Earthworms are multicellular, terrestrial animals restricted to damp areas. A moist body surface for diffusion, with a circulatory system and blood pigments, increase efficiency of gaseous exchange sufficient for a slow moving animal. |  |  |  |  |  |
| Bony fish are larger and more active. Their needs are supplied by a specialised area, the gills, with a large surface extended by gill filaments. |  |  |  |  |  |
| Water is a dense medium with a low oxygen content; therefore, to increase efficiency, it needs to be forced over the gill filaments by pressure differences so maintaining a continuous, unidirectional flow of water. |  |  |  |  |  |
| The gills have an extensive network of blood capillaries to allow efficient diffusion and haemoglobin for oxygen carriage. |  |  |  |  |  |
| Compared with parallel flow, counter current flow increases efficiency because the diffusion gradient between the adjacent flows is maintained over the whole surface.  |  |  |  |  |  |
| Terrestrial vertebrates have adapted for exchange with air, a less dense medium, instead of water, so have internal lungs.  |  |  |  |  |  |
| Internal lungs minimise loss of water and heat. |  |  |  |  |  |
| Amphibians have a larval form (tadpole) which develops in water and undergoes metamorphosis into the adult form.  |  |  |  |  |  |
| The inactive frog uses its moist skin as a respiratory surface but when active uses lungs.  |  |  |  |  |  |

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| Reptiles and birds have more efficient lungs than amphibians. |  |  |  |  |  |
| The human respiratory system includes epiglottis, trachea, bronchi, bronchioles, alveoli, pleural membranes, ribs, intercostal muscles, diaphragm. These are involved in two functions: ventilation and exchange of gases.  |  |  |  |  |  |
| The intercostal muscles, diaphragm, pleural membranes and pleural cavity enable ventilation movements to take place, creating volume and pressure changes that allow a continuous exchange of gases inside the body, so maintaining concentration gradients.  |  |  |  |  |  |
| Insects have evolved a different system of gaseous exchange to other land animals.  |  |  |  |  |  |
| Insects possess a branched, chitin-lined system of tracheae with openings called spiracles.  |  |  |  |  |  |
| Plants rely entirely on diffusion for the exchange of gases. Leaves are therefore thin to shorten distances for diffusion and have a large surface area and are permeated by air spaces.  |  |  |  |  |  |
| The structure of angiosperm leaf includes the cuticle, epidermis, palisade mesophyll, spongy mesophyll, vascular bundle, air space, stomata, guard cells. These structures allow the plant to photosynthesise effectively. |  |  |  |  |  |
| Leaf adaptation for light harvesting includes a large surface area and the ability to move by growth to the best position. |  |  |  |  |  |
| Palisade cells are elongated and densely arranged in a layer, or layers, and they contain many chloroplasts which arrange themselves according to the light intensity. |  |  |  |  |  |
| Light can pass through to the spongy mesophyll. The spaces between mesophyll cells allow carbon dioxide to diffuse to the cells and oxygen can diffuse away. The cells are moist so gases can dissolve. |  |  |  |  |  |
| Leaves have a cuticle to prevent water loss which also reduces gaseous exchange. |  |  |  |  |  |
| The presence of pores, stomata, allows water and gases through. |  |  |  |  |  |
| Guard cells around the stomata can change shape to open and close the stomata so helping to control gas exchange and water loss. |  |  |  |  |  |
| Guard cells change shape because of changes in turgor; in the light, water flows in by osmosis so the cells expand.  |  |  |  |  |  |
| The inner wall is inelastic so the pairs of cells curve away from each other and the pore opens. |  |  |  |  |  |
| Pores close due to the reverse process. |  |  |  |  |  |
| There are several theories about the mechanism and opening is affected by changing CO2 levels, but only the ‘malate’ theory is required. The movement of potassium ions from the epidermal cells into the guard cells creates a negative water potential in the guard cells. Water moves in by osmosis. |  |  |  |  |  |
| The movement of potassium ions is an active process requiring ATP. |  |  |  |  |  |
| Xerophytes may open stomata at night instead of during the day in order to conserve water, whilst other plants may close stomata during the day or night under drought conditions. |  |  |  |  |  |

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| **2.3 TRANSPOR T** |  |  |  |  |  |
| Multicellular animals have a transport system. |  |  |  |  |  |
| Insects have an open circulatory system, with a dorsal tube-shaped heart, and a fluid-filled body cavity (haemocoele). |  |  |  |  |  |
| The earthworm has a closed circulatory system, with blood under pressure. Organs are not in direct contact with the blood. Respiratory gases are transported in blood. |  |  |  |  |  |
| Mammals have a circulatory system comprising closed, double circulation and a heart with two atria and two ventricles.  |  |  |  |  |  |
| The major blood vessels of the heart include: aorta, vena cava, pulmonary veins, pulmonary arteries, coronary arteries. |  |  |  |  |  |
| The heart is a specialised organ having: cardiac muscle, own blood supply, variation in thickness of wall, valves. |  |  |  |  |  |
| Large vessels have three main layers in the walls: tough collagen, elastic muscular layer to sustain pressure and endothelium which is smooth to reduce friction; capillary walls are one cell thick.  |  |  |  |  |  |
| Veins have thinner muscle layer than arteries and along their length are semi-lunar valves to ensure flow in one direction. |  |  |  |  |  |
| Arteries have thick walls to resist pressure. |  |  |  |  |  |
| Arterioles adjust diameter to adjust blood supply. |  |  |  |  |  |
| Capillaries have a small diameter and friction with the walls slows the blood flow. Although the diameter is small, there are many capillaries in the capillary bed, providing a large total cross-sectional area which further reduces blood flow. This low velocity in very thin walled vessels enhances their ability to exchange materials with the surrounding tissue fluid.  |  |  |  |  |  |
| Venules/veins have larger diameters and thinner walls than arterioles/arteries and the pressure is reduced; valves prevent back flow. |  |  |  |  |  |
| The cardiac cycle refers to a sequence of events which takes place during the beating of the heart. The sinoatrial node is spontaneously active and its excitation spreads out across the atria, causing them to contract, but is prevented from spreading to the ventricles by a thin layer of connective tissue. Excitation spreads via the atrioventricular node, through the Bundle ofHis to the apex of the ventricle. The Bundle branches into Purkinje fibres in the ventricle walls which carry the wave of excitation upwards through the ventricle muscle. The contraction of the ventricles is therefore delayed after the atria. The pressure changes within the atria, ventricles and aorta during the cardiac cycle can be analysed graphically. These pressure changes are responsible for the opening and closing of the valves. |  |  |  |  |  |
| When blood leaves the heart the highest pressures are found in the aorta and main arteries which show a rhythmic rise and fall which corresponds to ventricular contraction. |  |  |  |  |  |

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| Friction with vessel walls causes progressive pressure drop. Arterioles have large total surface area and relatively narrow bore causing substantial reduction from aortic pressure. Their pressure depends on whether they are dilated or contracted. |  |  |  |  |  |
| There is even greater resistance in the capillaries with large cross sectional area. |  |  |  |  |  |
| The velocity of blood flow is directly related to the pressure. In the capillary beds the pressure drops further due to leakage from capillaries into tissues. |  |  |  |  |  |
| Return flow to the heart is non-rhythmic and the pressure in the veins is low but can be increased by the massaging effect of muscles.  |  |  |  |  |  |
| Heart rate can be modified by hormones or the nervous system.  |  |  |  |  |  |
| Blood components carry gases - haemoglobin carries oxygen as oxyhaemoglobin. |  |  |  |  |  |
| The functioning of different types of haemoglobin is demonstrated by plotting oxygen dissociation curves for normal mammalian haemoglobin compared with foetal haemoglobin. |  |  |  |  |  |
| Oxygen dissociation curves for llama haemoglobin and lugwormhaemoglobin. Demonstrate a physiological adaptation for life in oxygen depleted conditions. |  |  |  |  |  |
| The release of oxygen involves the Bohr effect where the lowered pH due to dissolved carbon dioxide reduces the oxygen affinity of haemoglobin, causing it to release oxygen where it is most required. |  |  |  |  |  |
| Some carbon dioxide is transported in red blood cells, but most is converted in the red blood cells to bicarbonate which is then dissolved in the plasma. The chloride shift refers to the influx of chloride ions into the red blood cells to preserve electrical neutrality as the bicarbonate leaves. |  |  |  |  |  |
| The blood transports other substances in the plasma: digested food products, hormones, proteins, albumin, fibrinogen, antibodies and ions and it also distributes heat.  |  |  |  |  |  |
| Water and small solutes pass through the capillary endothelium at the beginning of the capillary beds. The hydrostatic pressure here (forcing liquid out) is greater than the osmotic pressure (drawing water in). At the end of the capillary bed the hydrostatic pressure has dropped to a low value and thewater potential gradient causes an inward flow. About 99% of the fluid that leaves the blood at the arterial end of the capillary bed returns at the venous end. |  |  |  |  |  |
| The rest of the tissue fluid is returned via the lymphatic system. |  |  |  |  |  |
| Candidates should be able to draw the structure of a dicotyledon root to show position of vascular tissue. |  |  |  |  |  |

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| Most absorption of water is through the root hairs which provide a large surface area and are freely permeable.  |  |  |  |  |  |
| Soil solution soaks into the walls of epidermal cells and travels across the cortex through the cell walls or through the spaces between cells, drawn by the transpiration stream; this is the apoplast route. |  |  |  |  |  |
| Water can also cross the plasma membrane by osmosis. |  |  |  |  |  |
| It then moves through the cytoplasm of cells via the plasmodesmata; this is the symplast route. |  |  |  |  |  |
| Water can also travel through the cell vacuoles; the vacuolar pathway. |  |  |  |  |  |
| The endodermis is a layer of cells which surround the pericycle within which lies the vascular tissue (stele).  |  |  |  |  |  |
| The endodermis apoplast route is blocked by the Casparian band located tangentially in the cell wall and made of water-proof suberin. |  |  |  |  |  |
| At the Casparian band water passes across the plasma membrane and continues along the symplast route. |  |  |  |  |  |
| Since the xylem lacks cell contents the water is transferred to the apoplast in the pericycle. |  |  |  |  |  |
| Nitrogen usually enters the plant as nitrate ions/ammonium ions which diffuse along the concentration gradient into the apoplast stream but enter symplast by active transport against the concentration gradient and then flow via plasmodesmata in the cytoplasmic stream. |  |  |  |  |  |
| At the endodermis ions must be actively taken up to by-pass the Casparian band which allows the plant to selectively take up the ions at this point. |  |  |  |  |  |
| This lowers the water potential in the xylem, causing water to be drawn through the endodermis. |  |  |  |  |  |
| This produces a positive hydrostatic pressure inside the xylem, forcing water upwards. This positive pressure is known as root pressure. |  |  |  |  |  |
| Candidates should be able to draw the structure of the stem of a dicotyledon to illustrate the position of transporting tissue. |  |  |  |  |  |
| Xylem consists of dead, lignified tracheids and vessels with pits, supporting fibres and living parenchyma.  |  |  |  |  |  |
| Tracheids and vessels form a continuous system of channels for water transport. |  |  |  |  |  |
| Water passes through the root to the xylem, up through the stem to the leaves where most evaporates. |  |  |  |  |  |
| The columns of water in the xylem are held up by the cohesive force between water molecules and the adhesive forces between the water molecules and the hydrophilic lining of the xylem vessels. |  |  |  |  |  |
| Transpiration is the loss of water from the leaves which gives rise to the transpiration stream. The continued removal of water molecules from the top of the xylem vessels results in a tension causing a pull on the xylem column. |  |  |  |  |  |
| Transpiration is affected by various external factors such as temperature, humidity and air movement. |  |  |  |  |  |
| The opening and closing of stomatal pores can alter water loss through transpiration. |  |  |  |  |  |
| Plants can be classified, on the basis of structure in relation to the prevailing water supply, into hydrophytes, mesophytes and xerophytes. |  |  |  |  |  |
| Hydrophytes, e.g. water lily, live with their roots submerged in the mud at the bottom of a pond and have floating leaves on the surface. |  |  |  |  |  |
| Hydrophytes have little need for support or transport tissues; have little or no cuticle and stomata only on the upper surface of their leaves. There are large air spaces present in both stem and leaf tissue. |  |  |  |  |  |
| Xerophytes have adapted to living under conditions of low water availability so have modified structures to prevent excessive water loss. |  |  |  |  |  |
| Marram Grass demonstrates the role of a xerophyte with its leaf shape, sunken stomata, thick cuticle, hairs, in reducing water loss. |  |  |  |  |  |
| Mesophytes are plants of temperate regions and flourish in habitats with adequate water supply. They need to survive unfavourable times of the year by shedding their leaves, surviving underground or as dormant seeds. |  |  |  |  |  |
| Phloem consists of sieve tubes and companion cells linked byplasmodesmata with fibres and parenchyma. |  |  |  |  |  |
| The products of photosynthesis are transported in soluble form (sucrose) to all parts of the plant in the phloem. |  |  |  |  |  |
| The leaves are a source of sugars and the growing tissues act as a sink. |  |  |  |  |  |
| Early evidence about translocation of solutes was obtained from ringing experiments. |  |  |  |  |  |
| The technique of radioactive tracing combined with using aphid mouthparts demonstrated that translocation is a rapid process. |  |  |  |  |  |
| Radioisotope labelling using carbon dioxide combined with autoradiography shows that sucrose is transported bi-directionally to sinks. |  |  |  |  |  |
| The mass flow hypothesis suggests that there is a passive flow of sucrose from source to sink. (no details required). |  |  |  |  |  |
| The mass flow hypothesis does not account for all observations such as movement in opposite directions at the same time and at different rates.  |  |  |  |  |  |
| Other hypotheses have been proposed; including diffusion and cytoplasmic streaming. (no details required) |  |  |  |  |  |

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| **2.4 REPRODUCTIVE STRATEGIES** |  |  |  |  |  |
| There are two types of reproduction, asexual and sexual |  |  |  |  |  |
| Asexual reproduction produces individuals that are genetically identical whereas sexual reproduction produces offspring that are genetically different. |  |  |  |  |  |
| Genetic variability enables a species to adapt to environmental change. |  |  |  |  |  |
| There are advantages and disadvantages to both asexual and sexual reproduction. |  |  |  |  |  |
| Cells with the diploid number of chromosomes are produced by mitosis; haploid cells or gametes are produced by meiosis. |  |  |  |  |  |
| Males and females usually produce different sized gametes. |  |  |  |  |  |
| Fertilisation involves the fusion of the haploid sperm and haploid egg to produce a diploid zygote. |  |  |  |  |  |
| In most aquatic organisms fertilisation is external; an adaptation of land colonisation is internal fertilisation. |  |  |  |  |  |
| Internal fertilisation has a number of advantages. |  |  |  |  |  |
| In many animals the fertilised egg or zygote undergoes its development outside the body of the parent. Many eggs are produced to ensure that at least a few survive. |  |  |  |  |  |
| Amphibians, reptiles, birds and mammals exhibit a gradual adaptation to colonising land. |  |  |  |  |  |
| The gradual adaptation to life on land includes the evolution of an amniote egg in reptiles and birds. The egg has a fluid filled cavity surrounded by a membrane outside which is a protective shell which encloses the embryo within the yolk sac. Birds incubate eggs and the embryo completes its development outside the mother’s body. |  |  |  |  |  |
| In mammals the young are retained for a considerable time in the mother’s womb or uterus but there is no shell. The embryo is nourished there from the mother’s blood supply via the placenta. The young are born in a relatively advanced state of development. |  |  |  |  |  |
| Birds and mammals also exhibit parental care and there is a relationship between the degree of parental care and the number of offspring produced. |  |  |  |  |  |
| Insects are a particularly abundant and extremely diverse and widespread group of animals and affect the lives of all other terrestrial organisms, particularly humans.  |  |  |  |  |  |
| The zygote of insects develops into an intermediate form, either a nymph or a larva, before becoming an adult. |  |  |  |  |  |
| Nymphs resemble the adult and progress through a series of moults to become the adult; they undergo incomplete metamorphosis. |  |  |  |  |  |
| Larvae are different from the adult and the larval stage is followed by the pupal stage; they undergo complete metamorphosis. |  |  |  |  |  |
| There are similarities between the evolution of plants and animals in terms of reproductive strategies for land colonisation. |  |  |  |  |  |
| Flowering plants are well adapted for life on land in terms of their morphology and reproduction.  |  |  |  |  |  |
| A key feature of their success is their relationship with animals, particularly insects, for pollination and seed dispersal. |  |  |  |  |  |
| The evolution of the seed with a food store enables the embryo plant to develop until leaves are produced above ground.  |  |  |  |  |  |
| The seed also has a resistant coat that enables it to withstand adverse conditions. |  |  |  |  |  |

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| **2.5 ADAPTATIONS FOR NUTRITION** |  |  |  |  |  |
| Autotrophs use simple inorganic materials to manufacture complex organic compounds whereas heterotrophs consume complex organic food material. |  |  |  |  |  |
| There are a number of different types of heterotrophic nutrition. |  |  |  |  |  |
| An important group are the saprophytes or saprobionts, which include all bacteria and some fungi. |  |  |  |  |  |
| They feed by secreting enzymes onto the food material outside the body and then absorb the soluble products across the cell membrane by diffusion. This is known as extracellular digestion. |  |  |  |  |  |
| In heterotrophs food is processed as it passes along the gut. |  |  |  |  |  |
| In simple organisms, feeding on only one type of food, the gut isundifferentiated. |  |  |  |  |  |
| In more advanced organisms, with a varied diet, the gut is divided into various parts along its length and each part is specialised to carry out particular functions |  |  |  |  |  |
| These processes are ingestion, digestion, absorption and egestion. |  |  |  |  |  |
| The gut wall consists of four tissue layers surrounding a central cavity - serosa, longitudinal muscle layer, circular muscle layer, submucosa and mucosa. |  |  |  |  |  |
| The human alimentary canal consists of buccal cavity, tongue, salivary glands, oesophagus, stomach, duodenum, ileum, colon, rectum, anus and associated organs; liver and pancreas |  |  |  |  |  |
| There are a number of different glands which produce digestive secretions. |  |  |  |  |  |
| Some of these glands are found in the wall of the gut with the secretions passing directly into the gut cavity. |  |  |  |  |  |
| Other glands are found outside the gut with the secretions passing along ducts into the gut cavity. |  |  |  |  |  |
| Organisms with a varied diet require more than one type of enzyme to carry out the digestion of the different food substrates and usually more than one type of enzyme is needed for the complete digestion of a particular food. |  |  |  |  |  |
| Carbohydrate digestion involves the enzyme amylase, which hydrolyses the polysaccharide; starch, into the disaccharide, maltose. Another enzyme, maltase breaks down maltose to glucose. |  |  |  |  |  |
| Proteins are broken down by peptidases into polypeptides, then into single units, called amino acids. Endopeptidases hydrolyse peptide bonds within the protein molecule; the peptide bonds at the ends of these short lengths are hydrolysed by exopeptidases. |  |  |  |  |  |
| Fats are broken down to fatty acids and glycerol by just one enzyme, lipase. |  |  |  |  |  |
| The specialised regions of the mammalian have different pHs therefore the different enzymes have different pH optima. |  |  |  |  |  |

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| Mucus secretions lubricate the food as it passes along the gut and also protects the gut wall. |  |  |  |  |  |
| Absorption of the end products of digestion takes place in the ileum, the surface area of which is increased by villi and microvilli. |  |  |  |  |  |
| Glucose and amino acids are absorbed by diffusion and active transport into capillaries and then travel via the hepatic portal vein to the liver. |  |  |  |  |  |
| Fatty acids and glycerol are passed into the lacteal, then through the lymphatic system to the blood stream opening at the thoracic duct. |  |  |  |  |  |
| Most water is reabsorbed, along with soluble nutrients, in the small intestine. The colon absorbs the remaining water, together with vitamins (secreted by microorganisms in the colon) in order to produce solidified faeces. |  |  |  |  |  |
| Residues of undigested cellulose, bacteria and sloughed cells pass along the colon to be egested as faeces. |  |  |  |  |  |
| Cellulose fibre is required to provide bulk and stimulate peristalsis. |  |  |  |  |  |
| Glucose is absorbed from the blood by cells, for energy release in respiration, and any excess is converted to fat for storage. |  |  |  |  |  |
| Amino acids are absorbed for protein synthesis; excess cannot be stored so is deaminated, whereby the removed amino groups are converted to urea and the deaminated remainder is converted to carbohydrate and stored. |  |  |  |  |  |
| Lipids are used for membranes and hormones, and the excess is stored as fat. |  |  |  |  |  |
| Teeth are used in mechanical digestion in order to increase surface area for enzyme action. |  |  |  |  |  |
| Mammals have evolved different types of teeth with each type being specialised for a different function, incisors, canines, premolars and molars. |  |  |  |  |  |
| There are differences between the teeth of carnivores and herbivores reflecting their differing diets. |  |  |  |  |  |
| In herbivores the jaw moves in a horizontal plane whereas in carnivores the jaw moves vertically. |  |  |  |  |  |
| The gut of a carnivore is short reflecting the ease with which protein is digested. |  |  |  |  |  |
| Ruminants such as cow and sheep eat mainly grass, a large proportion of which consists of cellulose cell walls. |  |  |  |  |  |
| Ruminants have a specialised stomach or rumen in which mutualistic bacteria live.  |  |  |  |  |  |
| The presence of these bacteria together with their modified gut enables ruminants to achieve a more complete breakdown of cellulose. |  |  |  |  |  |
| **2.6 ADAPTATIONS FOR PARASITISM** |  |  |  |  |  |
| Parasites are organisms that live on or in another organism, called the host, and obtain nourishment at the expense of the host. |  |  |  |  |  |
| The pork tapeworm, *Taenia solium*, lives inside the gut and needs to survive in a hostile environment. |  |  |  |  |  |
| A simplified description of the life cycle to appreciate how the tapeworm has adapted by having a means of penetrating the host, attaching to the host, having a thick cuticle, producing large numbers of eggs and has resistant stages to overcome the period away from the host. (A detailed knowledge of the life cycle is not required). |  |  |  |  |  |