National 5 Biology - Unit 2 Multi-cellular Organisms

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<tr><th>Key Area</th><th>Key Terms</th><th>Summary of topic</th></tr>
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<td>1. Cells, tissues and organs</td>
<td>cell

tissue

organ

organ system

organism

division of labour</td>
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Cells are the basic unit of life
Specialised cells e.g. red blood cell, white blood cell, squamous epithelium, root hair cells, sperm cells, xylem vessels, phloem sieve tube
Division of labour

cells are organised into tissues. Examples of tissues – blood, ciliated epithelium, nerve tissue, smooth muscle tissue, mesophyll layer, xylem, phloem
tissues are organised into organs. Examples of organs – stomach, heart, liver, skin, kidney, root, stem, leaf, flower.

A system is a group of related organs or tissues. Examples of systems – circulatory system, reproductive system, endocrine system, digestive system

You must be able to relate the structure of specialised cells, tissues and organs to their functions. E.g. the root of a plant provides anchorage and allows for the absorption of water. Other examples are summarised below.
<table>
<tr><th>specialised cell</th><th>structure</th><th>function</th></tr>
<tr><td>red blood cell</td><td>biconcave disc, contains haemoglobin</td><td>transport of oxygen</td></tr>
<tr><td>xylem vessel</td><td>hollow tube, lignin in cell walls</td><td>support, transport of water</td></tr>
<tr><td>goblet cell</td><td>cup shaped</td><td>produces mucus</td></tr>
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<tr><th>organ</th><th>Function</th></tr>
<tr><td>kidney</td><td>maintains water balance</td></tr>
<tr><td>heart</td><td>pumps blood</td></tr>
<tr><td>leaf</td><td>photosynthesis and gas exchange</td></tr>
<tr><td>Stem</td><td>transport of water and soluble foods</td></tr>
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Key Area	Key Terms		Summary of topic
2. Stem cells and meristems	Stem cells Embryonic stem cells Tissue Bone marrow transplantation Corneal damage Skin graft Tissue stem cells Diabetes Parkinson's disease Alzheimer's disease Ethics Stem line Nuclear transfer technique	Meristems Root cap Root squash Mitosis Apical meristems Shoot tip Root tip Lateral meristems Cambium Unspecialised Undifferentiated	• Stem cells are unspecialised cell that are self-renewing (can reproduce by repeated mitosis without specialising) and capable of differentiating into specialised cells for growth and repair. • Two types of stem cells o Embryonic stem cells (ESC) – capable of developing into all types of cell found in the human body o Tissue stem cells (TSC) – found in skin, bone marrow; capable of producing one or more types of specialised cell related to the tissue in which they are found. • Potential uses of stem cells - Bone marrow transplantation, skin grafts, cornea repair. • Future therapeutic uses of stem cells – treatments of degenerative disorders such as diabetes, Alzheimer's and Parkinson's disease. • Ethical issues o ESC – cells from an early human embryo; ESC obtained from discarded IVF embryos. o Nuclear transfer technique – remove nucleus from egg cell and replace with nucleus from donor cell. Hybrid cells are used in research. o TSC – no ethical issues – use the patient's own cells, or have been obtained with the adult's permission. • Meristems o Unspecialised cells that can differentiate into any type of plant cell. o Apical meristems are found at the root tips and the shoot tips. Unspecialised cells that undergo continuous cell division. o Lateral meristems are found between the xylem and the phloem and are responsible for secondary thickening in a plant. • After cell division, plant cells will elongate and then differentiate.

Key Area	Key Terms		Summary of topic
3. Control and communication	Nervous system Nerves Brain Medulla Cerebellum Cerebrum Neurons Reflex arc Spinal cord Synapse Reflex action Protection Hormones Thyroid Glycogen Glucose Liver Insulin Glucagon diabetes	Central nervous system Co-ordination Stimulus Receptor Effector Response Sensory neuron Motor neuron Relay neuron Sensory fibre Axon fibre Knee jerk reflex action Endocrine glands Target tissues Pituitary gland Adrenal glands Pancreas Osmotic imbalance Type 1 diabetes Type 2 diabetes Negative feedback	• Nervous Control o Central nervous system (brain and spinal cord) and the nerves o The brain consists of the medulla (controls breathing and heart rate), cerebellum (controls balance and muscular co-ordination), cerebrum (memory, reasoning and conscious thought) o Stimulus → receptor→co-ordinator→effector → response o Reflex arc – 3 types of neuron; Stimulus → receptor→sensory neuron → relay neuron → motor neuron→effector → response o The effector is always a muscle (contracts) or a gland (secretes) o Neuron has a cell body and nerve fibres – the sensory fibre carries the impulse towards the cell body, the axon fibre carries the impulse away from the cell body. o Synapse – gap between two neurons; a chemical (neurotransmitter) diffuses across the gap. o Reflex action – the transmission of a nerve impulse through a reflex arc; rapid, automatic, involuntary response to a stimulus; example include limb withdrawal or pupil reflex; protects the body from damage. • Hormonal control o Hormones are proteins that act as chemical messengers, they are released from endocrine glands and travel in the bloodstream to specific target tissues. o Examples – pituitary gland secretes growth hormone and ADH; adrenal glands secrete adrenaline; islets of Langerhans in pancreas secrete glucagon and insulin. o Blood glucose regulation ▪ Too much or too little glucose in the blood stream could cause an osmotic imbalance. ▪ Glucose is stored in the liver as glycogen. ▪ Insulin converts glucose to glycogen ▪ Gl**ucago**n converts gl**ycoge**n to glucose (do not misspell these words) ▪ Diabetes is the inability to control blood glucose levels; type I – the pancreas is unable to produce insulin; type II the target tissues (liver) do not respond to insulin. ▪ untreated diabetes can lead to health problems

Key Area	Key Terms	Summary of topic
4. reproduction	Gametes fertilisation testes sperm ovaries eggs gonads ovulation oviduct zygote Reproduction Diploid Haploid Sexual reproduction Flowers Pollen Anthers Ovules Ovary Pollination Pollen tube	• body cells are diploid (2n) and gametes are haploid (n) • Reproduction is the production of offspring; sexual reproduction involves the fusion of the nuclei of two gametes at fertilisation. • Mammals o Gamete production in mammals occurs in gonads ▪ Testes are the site of sperm production; sperm have a head containing the nucleus and a tail for movement. ▪ Ovaries are the site of egg production; eggs contain a store of food in the cytoplasm. o Eggs are released at ovulation; the sperm swim into the oviduct where fertilisation takes place. o Fertilisation is the fusion of the sperm nucleus with the egg nucleus to form a diploid zygote. • Flowers are the site of sexual reproduction in plants o Gamete production in flowering plants ▪ Pollen grains contain the male gamete; produced in the anthers. ▪ Ovules contain the female gamete; produced in the ovary. o Pollination is the transfer of pollen grain from the anther to a stigma; o pollen tube grows down the style to the ovule; the nucleus from the pollen grain fuses with the egg nucleus in fertilisation to form a zygote. o Zygote divides by mitosis to become an embryo, which grows into a plant when the seed germinates.

Key Area	Key Terms		Summary of topic

5. Variation and inheritance	Variation
	Discrete variation
	Continuous variation
	Bar graph
	Histogram
	Genetics
	Sexual reproduction
	Normal distribution curve
	Monohybrid inheritance
	Polygenic inheritance
	Additive effect
	Genetic variation
	Environmental variation
	Family tree
	Genetic counsellor
	Cystic fibrosis
		Phenotype
		True-breeding
		Genotype
		Dominant
		Recessive
		Homozygous
		Heterozygous
		3:1 phenotypic ration
		F1 generation
		F2 generation
		Gene
		Alleles
		Symbols
		Carriers
			• Variation exists between members of the same species
			  ○ Discrete variation – two or more distinct groups, plotted as a bar chart e.g. blood groups (A, B, AB, o), unaffected by environmental factors
			  ○ Continuous variation – range from one extreme to another, plotted as a histogram, a normal distribution curve is produced e.g. height, influenced by environmental factors
			• Sexual reproduction contributes to variation within a species
			• Phenotype – physical characteristics
			• Genotype – genes (alleles) possessed by an individual
			• Alleles – different forms of the same gene
			• Single gene (monohybrid)inheritance – learn definitions for true-breeding (AA or aa), dominant (A), recessive (a), homozygous (AA or aa), heterozygous (Aa), 3:1 phenotypic ratio, 1:2:1 genotypic ratio, F1 generation, F2 generation
			• Polygenic Inheritance – more than one gene, characteristic shows continuous variation, additive effect.
			• Family trees (pedigree chart) can be used by genetic counsellor to provide advice on passing on genetic disorders to children.
			• Cystic fibrosis is a single gene mutation
			  ○ sufferer produces thick, sticky mucus causing congestion in lungs and other organs
			  ○ caused by a recessive allele
			  ○ parents who are carriers for cystic fibrosis will have a 1 in 4 chance of having a child with cystic fibrosis.

Key Area	Key Terms		Summary of topic

6. The need for transport - plants	Diffusion
	Transport systems
	Xylem
	Phloem
	Root hair cell
	Osmosis
	Mesophyll cells
	Transpiration
	Stomata
	Turgor
	Translocation
	lignin
		Bubble potometer
		Large surface area
		Unicellular organisms
		Multi-cellular organisms
		Surface area : volume ratio
		Temperature
		Wind
		Humidity
		Guard cells
		Xylem vessel
		Sieve tube elements
		Sieve plate
		Companion cells
			• Surface area : volume ratios
			  ○ Unicellular or small organisms (jelly fish) have a large SA:V ratio and diffusion is sufficient to transport materials to all parts of the organism.
			  ○ Large organisms (giraffe) have a smaller SA:V ratio and require a specialised transport system
			• Plants require two transport systems – water from root to leaves; sugar from leaves to other parts of a plant.
			• Water transport in plants
			  ○ Root hair cells provide a large surface area for the absorption of water by osmosis.
			  ○ Xylem vessels transport water and mineral salts
			  ○ Transpiration – evaporation of water from the aerial parts of a plant, occurs through stomata (pores)
			  ○ Opening and closing of stomata are controlled by changes in turgor of the guard cells
			  ○ Transpiration can be investigated using a bubble potometer (revise experimental design of a photometer e.g. stem cut and apparatus assembled under water to prevent air entering the xylem)
			• Factors affecting transpiration rate – temperature, humidity, wind speed
			• Revise the internal structure of a leaf including the function of the waxy cuticle, upper epidermis, palisade mesophyll, spongy mesophyll, air space, guard cell, stomata, vein.
			• Sugar is transported in the phloem and can be in both directions depending on requirements of the plant.
			• Structure
			  ○ Xylem – dead, hollow vessels, no cell contents, strengthened with lignin
			  ○ Phloem – living cells – sieve tube elements (no nucleus) and companion cells (contain a nucleus). Sieve plates in the end walls allow for the continuity of cytoplasm.

Key Area	Key Terms		Summary of topic
6. The need for transport - animals	Surface area : volume ratio Exchange surfaces Absorbing surfaces Heart blood vessels Pulmonary artery Pulmonary vein High pressure Low pressure Coronary artery Heart attack Red blood cells Oxyhaemoglobin Large surface area Capillary network Gas exchange Oxygenated Deoxygenated Circular muscles Small intestine Villus Lacteal Fatty acids	Blood Atrium Ventricles Vena cava Aorta Valves Artery Vein Capillary Haemoglobin Lungs Cartilage Cilia Mucus Alveoli Digestion Digestive system Peristalsis Contract Relax Glucose Amino acids	• Structures to increase the surface area for absorption - Villi in the small intestine; Alveoli in the lungs • Mammals have a double circulation (lungs and body) consisting of the heart (pump), blood vessels and blood. • Heart – ventricles (pump blood), Atria (receive blood), made of cardiac muscle, contains valves to prevent the backflow of blood, 4 associate blood vessels – pulmonary vein, aorta, vena cava, pulmonary artery, left ventricle is thicker (pumps to body), coronary arteries supply blood to the heart muscle (blockage can lead to a heart attack) • Blood vessels o **A**rteries carry blood **A**way from the heart, thick muscular wall, blood under high pressure, pulse, oxygenated blood (PA = deoxy) o Veins carry blood back to the heart, thinner muscular walls, blood under low pressure, contain valves to prevent the backflow of blood, deoxygenated blood (PV = oxy) o Capillaries – thin walled, provide a large surface area for exchange of materials, one cell thick, link arteries to veins • Red blood cells – biconcave disc, haemoglobin, large surface area for oxygen transport, flexible to squeeze through narrow capillaries • Haemoglobin + oxygen → oxyhaemoglobin • Gas exchange organs –lungs - trachea, bronchi, bronchioles, alveoli o Trachea supported by rings of cartilage o Mucus and cilia trap dirt and microorganisms and sweep them away from lungs o Alveoli – provide large surface area for gas exchange, thin, moist, dense capillary network • Digestive system – transport and absorption of food o Peristalsis – contraction of circular muscle to squeeze food along oesophagus, stomach and intestines. o Absorption in small intestine – long, folded, contains villi – large surface area for absorbing food • Villus – lining one cell thick, dense network of capillaries for the absorption of glucose and amino acids, lacteal (tiny lymphatic vessel) absorption of fatty acids and glycerol.

Key Area	Key Terms		Summary of topic
7. Effects of lifestyle choices on human transport and exchange systems	Inherited factors Environmental factors Disorder Disease Lifestyle choice High-fat diet High-salt diet High blood pressure Moderate-intensity activity Vigorous-intensity activity High-stress experiences Toxic heavy metals Carbon monoxide pollution Radiation Ultra-violet rays	Tobacco Nicotine Carbon monoxide Obesity Exercise Alcohol Lung cancer Pulse rate Cirrhosis Reaction time Stress Iron Haemoglobin Anaemia Skin cancer	• The health of a person's body will be influenced by inherited and environmental factors; the state of a person's health will be determined by their lifestyle choices • High Fat Diet - health risks associated with obesity include heart disease, diabetes, kidney disease, arthritis; eating a high fat diet can be in response to an underlying condition such as anxiety, low self esteem, depression, stress • High-salt diet - increases the risk of high blood pressure, increases the person suffering cardiovascular disease, increases risk of heart attack, increases risk of stroke • Lack of exercise - 5-18 year olds → 1 hour physical activity per day; Lack of physical activity increases the risk of obesity • Use of tobacco - Smoking related diseases include lung cancer, emphysema, bronchitis, coronary heart disease, throat cancer; Smoking is a **high-risk activity** • Alcohol - Long term harmful effects - cirrhosis of the liver, brain damage, increases the risk of cancer, stress • Continuous high levels of stress or high-stress experiences can lead to ill health – headaches, anxiety, irritability, loss of sleep, inability to concentrate, depression • Adverse effects of poor lifestyle choices - Increasing chance of atherosclerosis, blood clots, heart attacks, diabetes, strokes, stress leading to heart disease and obesity • Healthy lifestyle choices - Regular exercise; Diet low in fat and salt; Not smoking; Reducing alcohol intake; Reducing stress • Iron is an essential component of haemoglobin, lack or iron can cause anaemia • Environmental factors with adverse effects - Toxic heavy metals, Carbon monoxide pollution, Radiation • Vitamin D required for healthy bone growth - deficiency can cause rickets – formation of soft and abnormal bones • UV radiation - Increases the risk of skin cancer, use high factor sun creams