Year 10 Topics

In year 10 we teach the following topics over the course of the year. Each topic draws on prior learning from previous years and builds on understanding from the KS3 programme of study. Each topic develops and deepens the Core knowledge that will underpin all areas of the curriculum at KS4 and KS5.

Topic	Rationale	Knowledge acquisition	Key vocabulary	Skills and enrichment
4.1 Cell Biology	Cells are the basic unit of all forms of life. In this section we explore how structural differences between types of cells enables them to perform specific functions within the organism. These differences in cells are controlled by genes in the nucleus. For an organism to grow, cells must divide by mitosis producing two new identical cells	Eukaryotes v prokaryotes- what is the difference?	Eukaryotic, prokaryotic, plasmid, nucleus, DNA	Practical use of Microscopes and numeracy skills when calculating magnification and when using standard form. Literacy skills in developing an evaluation regarding the impact of stem cells- socially and ethically
		Structure of plant and animal cells	Cell membrane, cell wall, cytoplasm, nucleus, chloroplast, vacuole, ribosomes, mitochondria, chloroplasts	
		How are different cells specialised?	Sperm, neurone, muscle, epithelial, palisade, root hair	
		What is cell differentiation?	Differentiation, specialisation, stem cells, differentiate, cell division	
		Microscopes	Microscope, focus, light, electron, sub-cellular, magnification, standard form	
		How should we group microbes?	Sterile, petri dish, culture, inoculating loop, incubator, aseptic technique	
		Chromosomes and DNA	DNA, mitosis, chromosomes, genes	
		Mitosis and the cell cycle	Mitosis, cell division, interphase, cytokinesis	
		Stem cells and therapeutic cloning	Embryo, stem cells, therapeutic cloning, genes, rejection, ethical, clones, meristems	
		Transport in cells- diffusion, osmosis, active transport	Diffusion, concentration gradient, osmosis, partially permeable membrane, dilute, concentrated, active transport ATP.	

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4.2 Organisation	Organisation from cell to complex organ systems is fundamental to all multicellular organisms. In this section 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. 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.	How are organisms organised from cells to systems?	Cell, tissue, organ, system, Human digestive system.	Numeracy skills - calculating rates of reaction and expressing data in standard form. Practical skills development – investigating in science e.g. the effect of variables on enzyme action e.g. pH/temperature. Practical skill development- use of Qualitative reagents to test for chemicals in food. Literacy skills/evaluative skills using stimulus material to compare the use of heart valves from biological and mechanical sources. Skills in analysis of risk factors in the development of CHD. Skills in graphical analysis of data, frequency tables, bar charts and histograms Numerical skills -calculation of means and processing of data.
		Plant tissues and organ systems.	Epidermal, palisade, mesophyll, xylem and phloem, root, stem, stomata.	
		What are enzymes? – how does the lock and key theory explain how enzymes function.	Lock & key theory, enzyme, catalysts substrate, active site, complex, Temperature, pH.	
		How do digestive enzymes help us to break down food?	Small, soluble, molecule, carbohydrase's, proteases, lipases.	
		What is the role of bile in digestion of lipids?	Bile, liver, emulsify, surface area.	
		Qualitative tests for presence of carbohydrates (starch/sugar), proteins and lipids.	Starch, iodine, sugar, benedict's reagent, protein, biuret reagent. Qualitative test.	
		Structure of the heart, role of the pacemaker and the bodies double circulatory system.	Atria, ventricles, aorta, pulmonary artery, vena cava, pulmonary vein. Pacemaker, double pump.	
		Coronary heart disease (CHD) and evaluation of CHD treatments. Heart valves and stenting.	Coronary artery, fatty material, stents, statins, heart valves, biological, mechanical.	
		Blood vessels – structure and role of arteries, veins and capillaries.	Blood vessel, artery, vein, capillary, exchange, muscle.	
		Blood composition.	Blood cells, plasma, tissue, platelets.	
		Health and health issues. Effect of diet, stress, and life situations on health and well-being.	Health, disease, interact, communicable, asthma, skin rashes, depression, cancer	
		Effect of lifestyle on the development of non-communicable diseases.	Lifestyle diseases, obesity, alcohol, smoking, carcinogens, diabetes, risk factor, cardiovascular disease.	
		Cancer and tumour types.	Malignant, benign, uncontrolled, cell division, secondary tumour.	

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4.3 Infection and response	The study of infection and response will allow us to explore how we can avoid diseases by reducing contact with them, as well as how the body uses barriers against pathogens. Pathogens are microorganisms such as viruses and bacteria that cause infectious diseases in animals and plants. They depend on their host to provide the conditions and nutrients that they need to grow and reproduce. They frequently produce toxins that damage tissues and make us feel ill. Once inside the body our immune system is triggered which is usually strong enough to destroy the pathogen and prevent disease. When at risk from unusual or dangerous diseases our body's natural system can be enhanced by the use of vaccination. Since the 1940s a range of antibiotics have been developed which have proved successful against a number of lethal diseases caused by bacteria. Unfortunately, many groups of bacteria have now become resistant to these antibiotics. The race is now on to develop a new set of antibiotics.	Pathogens and spread of disease. Communicable diseases.	Bacteria, virus, fungi, protist, microorganisms, toxins, infectious.	Numeracy skills - Calculation of clear zones using TTr^2 OR Calculating numbers of bacteria given the mean division time. Expressing processed data in standard form. Practical skills – streak plating sterile water, growing microbes, looking at the effect of disinfectants on microbial growth using agar plates and paper discs Evaluative skills – global use of vaccination to prevent disease. Evaluative skills – uses of monoclonal antibodies in medicine.
		Bacterial and Viral diseases.	Salmonella, Gonorrhoea, HIV, Measles, Antiretroviral, Sexually transmitted disease (STD).	
		Bacterial reproduction (BIOLOGY ONLY – 4.1.1.6 link)	Binary fission, mitosis, agar, nutrient broth, temperature.	
		Antibiotics, painkillers and antibiotic resistance.	Antibiotic, penicillin, infective, painkiller, medicine, MRSA.	
		Plant diseases – TMV (viral) RBS (fungal).	Tobacco mosaic virus, Rose black spot, discolouration, fungicide.	
		Protist diseases	Malaria, vector, mosquito.	
		Growing uncontaminated cultures of microorganisms on petri-dishes. (BIOLOGY ONLY)	Uncontaminated culture, petri dish, inoculating loop, sterilised, flame, transfer, microorganisms.	
		Plant mineral ion deficiency, Plant disease and detection. (BIOLOGY ONLY)	Nitrate, magnesium, deficiency, stunted, chlorosis, decay, spots, malformed, discolouration.	
		Plant defence mechanisms from pathogens and herbivores. (BIOLOGY ONLY)	Physical, chemical, mechanical antibacterial chemicals, poisons, thrones, leaves, cellulose.	
		Human defence mechanisms non-specific (barriers).	Skin, nose, trachea, bronchi, stomach, non-specific defence.	
		Human defence mechanisms – specific (white blood cells).	Phagocytosis, antibody, antitoxin, white blood cell.	
		Vaccination and herd immunity principle.	Inactive/dead pathogen, white blood cells, antibodies, specific.	
		Testing and development of drugs. Drugs from plants and microbes.	Digitalis, aspirin, penicillin, pre-clinical, placebo, double blind.	
		Monoclonal antibody production and uses in science/medicine (BIOLOGY ONLY)	Lymphocyte, cancer, tumour, hybridoma, pregnancy test, diagnosis, cancer treatment.	

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4.4 Bioenergetics **Photosynthesis**	In this section we will explore photosynthesis. Why is it important? How can we measure it? What are limiting factors and how do plants and humans use the products of photosynthesis?	What is photosynthesis and why do we need it? Recall the word and balanced symbol equation of photosynthesis	Carbon dioxide, oxygen, water, light, chlorophyll, glucose, exothermic, endothermic, chloroplasts	**Required practical activity 6:** investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed. Use data to relate limiting factors to the cost effectiveness of adding heat, light or carbon dioxide to greenhouses.
		What factors that affect the rate of photosynthesis?	Light, temperature, carbon dioxide, limiting factors	
		RP6- pond weed practical. Measuring the rate of photosynthesis		
		HT ONLY- What are limiting factors? Describe and explain the impact of these on the rate of photosynthesis	Light, temperature, carbon dioxide, limiting factors	
		HT ONLY- understand and use inverse proportion- inverse square law and light intensity in the context of photosynthesis.	Inverse, square	
		Uses of glucose from photosynthesis	Insoluble starch, fats, cellulose, amino acids, protein synthesis	
Aerobic respiration **Anaerobic respiration** **Response to exercise**	Both animals and plants use this oxygen to oxidise food in a process called aerobic respiration. Conversely, anaerobic respiration does not require oxygen to transfer energy. During vigorous exercise the human body is unable to supply the cells with sufficient oxygen and it switches to anaerobic respiration.	Aerobic respiration- what is it and why do we need it? Recall the word and balanced symbol equation	Aerobic, oxygen, energy, ATP, carbon dioxide, water, heat	Investigations into the effect of exercise on the body.
		Anaerobic respiration- what is it and why do we need it? Recall the word and symbol equation	Anaerobic, oxygen debt, energy, ATP, carbon dioxide, water, heat, lactic acid	
		Anaerobic respiration in plants and yeast, understand the importance and uses of fermentation	Fermentation, lactic acid, bread, yeast, respiration	
		Responding to exercise- how does the body do this and why is it important?	Respiration, glucose, blood, ATP, temperature, oxygen, heart rate, carbon dioxide.	
		(HT only) Blood flowing through the muscles transports the lactic acid to the liver where it is converted back into glucose. Oxygen debt is the amount of extra oxygen the body needs after exercise to react with the accumulated lactic acid and remove it from the cells.	Lactic acid, carbon dioxide, oxygen debt, neutralise	
		Metabolism- what is it and why is it important? What factors affect the rate of metabolism in the body?	Respiration, metabolism, metabolic reactions, enzymes, molecules, conversion	

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4.5 Homeostasis and Response	The study of Homeostasis will allow us to understand how cells in the body can survive within narrow physical and chemical limits. Cells require a constant temperature and pH as well as a constant supply of dissolved food and water. In order to do this the body requires control systems that constantly monitor and adjust the composition of the blood and tissues. These control systems include receptors which sense changes and effectors that bring about changes. In the context of organisms responding to the environment we will explore the structure and function of the nervous system and how it can bring about fast responses. We will also explore the hormonal system which usually brings about much slower changes. Hormonal coordination is particularly important in reproduction since it controls the menstrual cycle. An understanding of the role of hormones in reproduction has allowed scientists to develop not only contraceptive drugs but also drugs which can increase fertility.	Structure and function of the nervous system: nervous pathways.	Stimulus, receptor, coordinator, effector and response.	Mathematical skills: calculation of reaction times and converting between s and ms. Evaluative skills: benefits and risks of procedures used to analyse brain function. Practical skills: Measuring reaction times using a ruler drop test. Interpreting diagrams showing negative feedback. Evaluative skills: comparing the relative advantages and disadvantages of kidney transplants to dialysis treatments.
		Reflex actions – automatic rapid responses to stimuli.	Neurone, sensory, relay, motor, synapse, chemical effector, conscious, brain.	
		Brain structure and brain mapping (BIOLOGY ONLY)	Cerebral cortex, medulla, cerebellum, neuroscientist, MRI.	
		Structure and function of the eye, response to dim, bright light (BIOLOGY ONLY)	Retina, optic nerve, sclera, cornea, iris, ciliary muscle, suspensory ligaments.	
		Eye defects and accommodation (BIOLOGY ONLY)	Myopia, hyperopia, convex, concave, light rays, retina, near, distant.	
		Human endocrine system and the principle of homeostasis.	Glands, bloodstream, internal, adrenaline, environment, pituitary gland.	
		Control of blood glucose concentration & -ive feedback.	Insulin, glucagon, hormone, pancreas, liver, muscle, negative feedback.	
		Diabetes – type 1 and type 2	Glucose, manipulation of diet, injections.	
		Control of body temperature in mammals (BIOLOGY ONLY)	Thermoregulatory centre, vasodilation, vasoconstriction, sweating, shivering,	
		Kidneys and excretion of nitrogenous waste. (BIOLOGY ONLY)	Filtering, water, ions, glucose, urea, reabsorption, osmosis, ADH.	
		Treating Kidney disease transplants and dialysis. (BIOLOGY ONLY)	Dialysis, partially permeable, transplant, immunosuppressant drug.	
		Hormones in human reproduction and the menstrual cycle.	Testosterone, Oestrogen, LH, FSH, Progesterone, menstrual cycle.	
		Infertility treatments and Contraction.	FSH, LH, Hormonal, Non-hormonal, contraceptive pull, IUD, condom.	
		Plant tropisms – responses to stimuli (BIOLOGY ONLY)	Phototropism, gravitropism, auxin, gibberellin, unequal distribution.	
		Uses of plant hormones to control plant growth and in agriculture and horticulture. (BIOLOGY ONLY)	Weed killer, rooting powder, germination, dormancy, flowering, auxin, ethene, gibberellin.	

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4.6 Inheritance, Variation and Evolution	In this topic we will discover how the number of chromosomes are halved during meiosis and then combined with new genes from the sexual partner to produce unique offspring. Gene mutations occur continuously and on rare occasions can affect the functioning of the animal or plant. These mutations may be damaging and lead to a number of genetic disorders or death. Very rarely a new mutation can be beneficial and consequently, lead to increased fitness in the individual. Variation generated by mutations and sexual reproduction is the basis for natural selection; this is how species evolve. An understanding of these processes has allowed scientists to intervene through selective breeding to produce livestock with favoured characteristics. Once new varieties of plants or animals have been produced it is possible to clone individuals to produce larger numbers of identical individuals all carrying the favourable characteristic. Scientists have now discovered how to take genes from one species and introduce them in to the genome of another by a process called genetic engineering. Despite its potential it remains controversial.	DNA structure and organisation into chromosomes (BIOLOGY ONLY)	Polymer, Double helix, Nucleotides, Sugar, Phosphate, Genome	<u>Mathematical skills</u>: Interpreting pedigree charts and determining the %, ratio or fraction of offspring with inherited disorders. Extract and interpret information from graphs and charts. <u>Evaluative skills</u>: Pros/cons of genetic engineering of plants for use by humans e.g. those resistant to Bt toxin. Pros/Cons of screening embryos for genetic disorders. Ideas for rejection of Darwin's theory <u>Practical skills</u>: Modelling the behaviour of chromosomes during meiosis.
		Protein Synthesis (BIOLOGY ONLY) and mutations	Ribosomes, carrier molecules, amino acid, protein chain, mutation.	
		Genetic crosses – inheritance of characteristics and sex	Dominant, recessive, genotype, phenotype, sex chromosomes, allele.	
		Genetic disorders – polydactyly and cystic fibrosis	Dominant allele, recessive allele, pedigree chart	
		History of Genetics – Gregor Mendel (BIOLOGY ONLY)	Mendel, Homozygous, heterozygous, Units of inheritance, DNA, chromosomes.	
		Cell Division - Meiosis	Chromosomes, gametes, divides, Variation, fertilisation.	
		Genetic Engineering of bacteria and plants (GM crops).	Gene, enzyme, genetically modified, vector, plasmid, resistant, herbicide, pesticide	
		Selective breeding of animals and plants.	Desired characteristics, breed, mate, generations, artificial selection.	
		Cloning of plants and animals (BIOLOGY ONLY)	Tissue culture, cuttings, embryo transplants, adult cell cloning.	
		Evolution – Natural selection exemplified by MRSA bacteria.	Variation, characteristics, adapted, survive, reproduce, genes, resistant	
		Evolution – theories – Darwin and Lamarck (BIOLOGY ONLY).	Origin of species, variation, characteristics, evidence, acquired characteristics.	
		Classification/Evolutionary trees	Linnaeus, Woese, kingdom, phylum, class, order, family, genus, species.	
		Speciation (BIOLOGY ONLY)	Genetic variation, geographic isolation, biotic, abiotic, natural selection,	
		Fossil formation and evidence for evolution.	Decay, mineralisation, traces, soft bodied, early life forms,	
		Extinction of organisms	Permanent loss, species, predators, diseases, food, environmental change.	

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4.7 Ecology	The Sun is a source of energy that passes through ecosystems. Materials including carbon and water are continually recycled by the living world, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis. All species live in ecosystems composed of complex communities of animals and plants dependent on each other and that are adapted to particular conditions, both abiotic and biotic. These ecosystems provide essential services that support human life and continued development.	What are biological communities and how are they organised?	Ecosystem, organisms, interdependence, competition and community, habitats	Biological drawings first-hand observations of organisms. Interpret graphs used to model predator-prey cycles. Explain how waste, deforestation and global warming have
		Adaptations of plants and animals- what do they compete for and why?	Adaptations, water, light, nutrients, food, mates, territory, space	
		Abiotic v biotic factors- what is the difference and how do they affect the ecosystem?	Biotic, living, abiotic, non-living, ecosystem, niche	
		Interdependence and food chains	Community, ecosystem, population, competition	
		Levels of organisation- how are ecosystems organised?	Producer, sun, primary, secondary, consumers, apex predators,	
		Required practical activity 9: measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species.		
		How are materials cycled? Carbon, water and nitrogen cycles.	Decay, decomposition, carbon, nitrogen, water, evaporation, recycled, carbon dioxide, combustion, soil, building blocks	
		Decomposition- what is it and why is it important?	Decay, decomposition, carbon, compost, fertilizers	
		Anaerobic decay and the use of biogas generators	Methane, anaerobic, global warming, climate change	
		Required practical activity 10: investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.		
		(HT only) impact of environmental change- how does a change in the environment affect species in an ecosystem?	Distribution, ecosystem, species, water, temperature, atmospheric gases.	
		Biodiversity- an old wooden ship or something else?	Ecosystem, biodiversity, dependence, deforestation, global warming, waste	

	In order to continue to benefit from these services humans need to engage with the environment in a sustainable way. In this section we will explore how humans are threatening biodiversity as well as the natural systems that support it. We will also consider some actions we need to take to ensure our future health, prosperity and well-being.	Why do we need to manage our waste?	Water, sewage, fertiliser, toxic chemicals, acid rain, smoke, landfill, pollution, biodiversity	an impact on biodiversity
		For Peat's sake! Why should we stop destroying peat bogs?	Peat bogs, compost, habitats, carbon dioxide, global warming, biodiversity	
		Deforestation- why do we do it? What are the environmental implications of deforestation	Trees, cattle, crops, biofuels, space	
		Global warming- causes, consequences and solutions	Greenhouse gases, climate change, extreme weather, habitat destruction	
		Trophic levels, biomass and pyramids of biomass. How do we calculate the efficiency of biomass transfer between trophic levels?	Producer, consumer, herbivores, carnivores, decomposers,	Students should be able to construct accurate pyramids of biomass from appropriate data.
		Factors affecting food security. Will there be "food wars" in the future?		Understand that some people have ethical objections to some modern intensive farming methods.
		Farming techniques and sustainable fishing	Factory farming, free range, intensive, organic	Evaluate the advantages and disadvantages of modern farming techniques.
		How can we use biotechnology to increase food production?	Quorn (*Fusarium*), GM crops	There are links with this content to Genetic engineering.