

Year 11 GCSE Trilogy Biology topics

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Topic 4.4	Rationale (layering, why this why now?)	Knowledge goals: <i>You need to know that how to</i>	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
Bioenergetics Understanding processes in bioenergetics will allow us to better understand how plants and animals survive using raw materials and why they are interdependent on one another. Plants harness the Sun's energy in photosynthesis in order to make food. This process produces oxygen which has built up over millions of years in the Earth's atmosphere. Both animals and plants use this	 KS3 NC: links to material cycles and energy: cellular respiration. Photosynthesis.  KS4 ladders to work on: Limiting factors. Measurement of the rate of photosynthesis. Uses of glucose produced in photosynthesis. Aerobic respiration. Anaerobic respiration. Effect of exercise on the body. Metabolism. Factors affecting metabolism.	that photosynthesis is the process by which plants make food called glucose. that photosynthesis is an endothermic reaction.	carbon dioxide, oxygen, water, light, chlorophyll, glucose, exothermic, endothermic, chloroplasts.	a) Subject specific skills Practical skills (RP5) – investigate the effect of light intensity on the rate of photosynthesis of an aquatic organism e.g. pondweed. TRILOGY Practical skills - measuring the body's response to exercise. b) Numeracy Use data to relate limiting factors to the cost effectiveness e.g. of adding heat, light or carbon dioxide to greenhouses. Plot and draw appropriate graphs of the rate of photosynthesis against light intensity selecting appropriate scales for axes. Use of inverse proportion – the inverse square law and light intensity in the context of photosynthesis. Use data to assess the energy production in aerobic and anaerobic exercise. Calculation of heart rate from graphs. c) Literacy d) Reading
		that limiting factors are those in short supply. that the rate photosynthesis is affected by a variety of factors which interact.	limiting factor, light, temperature, carbon dioxide, rate, interact, crops, economical, yield.	
		how to measure the rate of photosynthesis. how to process data, describe trends and draw conclusions.	pondweed, rate, photosynthesis, aquatic, light, inverse square law.	
		that glucose produced in photosynthesis can be converted to different substances or stored.	respiration, starch, insoluble, fat, oil, cellulose, amino acids, proteins, nitrate ions.	
		that respiration is an exothermic reaction which releases energy from glucose. that the energy released from respiration has various uses.	respiration, oxygen, glucose, aerobic, chemical reactions, movement, aerobically, energy transfer, synthesis, larger molecules, movement, keeping warm.	
		that anaerobic respiration takes place without oxygen that the products of anaerobic respiration in animals and plants differ.	anaerobic, animals, plants, lactic acid, ethanol, carbon dioxide, fermentation, bread, alcohol.	

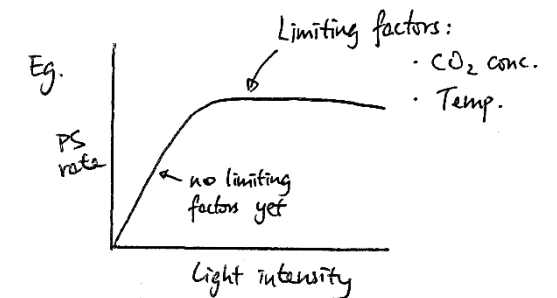
oxygen to oxidise food in a process called aerobic respiration which transfers the energy that the organism needs to perform its functions. Conversely, anaerobic respiration does not require oxygen to transfer energy.	KS5 ladders to work on: the stages of respiration and photosynthesis, biochemical pathways and how ATP production is linked to electron transfer.	that during exercise heart rate, breathing rate and breath volume increase. that changes during exercise supply muscles with more oxygen and glucose.	heart rate, breathing rate, breath volume, oxygen, glucose, muscle contraction, energy release.	Etymology of photosynthesis. Photo - light, synthesis. Etymology of the word “respiration”. Reading – making the best use of photosynthesis. How plant growers manipulate conditions/limiting factors to obtain high yields. Page 130-131 AQA Biology text. e) Cultural capital links What happens to your body when you start exercising? https://ed.ted.com/best_of_web/WaARd3SV The importance of fermentation in bread and alcohol production. https://www.youtube.com/watch?v=y5XEwTDIriE <i>Respiration – respiration is not produced/created or made! It is only released or transferred.</i> <i>Breathing <u>is not</u> the same as respiration. Breathing is the process of drawing air into and out of the lungs using the diaphragm, intercostal muscles, and ribs. Respiration is an exothermic chemical reaction. It occurs in all cells using glucose and releases energy or transfers energy to a chemical energy store – ATP the energy currency of the cell.</i> <i>Plants only photosynthesise – incorrect plants are living organisms so carry out the process of photosynthesis and respiration. Plants respire all the time not just at night when they have finished photosynthesising.</i>
		that anaerobic respiration in muscle results in an oxygen debt.	lactic acid, carbon dioxide, oxygen debt, accumulated, contracting, react.	
		that metabolism is the sum of all reactions that occur in the body. that metabolism includes a variety of different reactions such as respiration/lipid formation.	starch, glucose, lipids, fatty acids, glucose, nitrate, amino acids, respiration, proteins, excess proteins, respiration, enzymes, conversion.	

Mitochondria – release or transfer energy in the cell. Energy cannot be created nor destroyed so do not write about energy being made.

https://www.saps.org.uk/animations/plant_biology/

Animation from SAPS tackling the common misconception that respiration in plants does not take place at the same time as photosynthesis, when actually it does!

Limiting factors – these are not factors 'affecting photosynthesis rate' they are factors which stop the rate of photosynthesis increasing further. Graphical representation can assist with learning.



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Topic 4.1	Rationale (layering, why this why now?)	Knowledge goals: <i>You need to know that how to</i>	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
Cell Biology Cells are the basic unit of all forms of life, studying cells will give us a clearer understanding of how organisms function. 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	 KS2 how animals and plants grow. KS3 NC links to structure and function of living organisms: cells and organisation  KS4 ladders to work on: Specialised cells Cell differentiation Microscopes Cell transport Diffusion Osmosis Active transport Cell cycle cell division (mitosis).	that prokaryotic cells are bacteria. that eukaryotic cells are plant and animal cells.	eukaryotic, prokaryotic, plasmid, nucleus, DNA bacteria, animals, plants.	a) Subject specific skills Practical skills - using microscopes. Practical skills (RP1) – use a light microscope to observe, draw and label a plant cells. TRILOGY Practical skills (RP2) – investigate the effect of a range of sugar or salt concentrations on the mass of plant tissue. TRILOGY b) Numeracy Using the formula triangles to rearrange magnification equation conversion of units (mm into μm) Expression of answers/numbers in standard form. Calculating surface area: volume ratios. Calculating rates of water uptake/% change. Present observations as tables, graphs, or drawings. Use estimations to judge the relative size or area of sub-cellular structures. c) Literacy and d) Reading Ethical impacts of stem cells and their use in science. How do they work? Page 32+33 AQA Biology text. Literacy skills evaluation of pros and cons of stem cell use from embryos/bone marrow when provided with information.
		that plant and animal cells have differences and similarities in their cellular structures. that sub-cellular structures carry out particular functions	cell membrane, cell wall, cytoplasm, nucleus, chloroplast, vacuole, ribosomes, mitochondria, chloroplasts, vacuole.	
		how to calculate magnification, image size and actual size. how to convert between units.	millimetre, micrometer, magnification, actual size, real size.	
		that cells can be specialised to carry out different functions.	sperm, neurone, muscle, epithelial, palisade, root hair.	
		that cells differentiate or specialise to carry out different functions. that plant cells retain the ability to differentiate throughout their life.	differentiation, specialisation, stem cells, differentiate, cell division. meristem, embryo, bone marrow.	
		that magnification and resolution are properties of microscopes. that electron microscopes have high resolution/magnification.	electron microscope, light microscope, sub-cellular structure, magnification, resolution.	
		how to use a microscope. how to make an observational drawing from a microscope	microscope, focus, light, electron, sub- cellular, magnification	
		that cells divide in a series of stages called the cell cycle.	DNA, chromosomes, ribosomes, mitochondria, mitosis, growth, cell cycle. division, cell cycle,	

to grow, cells must divide by mitosis producing two new identical cells.	KS5 ladders to work on: Complex cellular structure animals, plants, fungi. Cellular processes respiration, photosynthesis, control of blood glucose. Cell division. Stem cell types – pluripotent, multipotent, totipotent.	that diffusion is the spreading out of particles. how to explain the effect of different factors on the rate of diffusion.	diffusion, concentration gradient, passive, temperature, surface area, SA:vol ratio particles, rate, single celled, multicellular.	Similarities and differences between optical and electron microscopes – page 4+5 AQA Biology text. e) Cultural capital links Therapeutic cloning https://www.bbc.co.uk/bitesize/guides/zs8y4qt/revision Stem cell and bone marrow transplants https://www.nhs.uk/conditions/stem-cell-transplant/ Use of isotonic drinks in sport https://www.britishsoftdrinks.com/Sports-Drinks f) Common misconceptions Nucleus, it <u>is not</u> 'the brain of the cell'. Don't write this in exams! The nucleus controls the cells activities as it contains the genetic code (DNA) to make the cells proteins. Mitochondria – <u>release or transfer energy</u> in the cell. Energy cannot be created nor destroyed so do not write about energy being made. Differentiation – is <u>not</u> cell division. Cell division means cells specialising because of different genes being expressed. Cell division means cells splitting in half. Stem cells – they are <u>not</u> the cells found the stems of plants. In plants they are found in meristems and can differentiate into any cell type. Plants have stem cells throughout their entire lives. Distinguishing between the terms osmosis, diffusion and active transport and direction of movement. Specific teaching of this tier 3 vocabulary needed. Diffusion → movement down a concentration gradient passively. Osmosis → diffusion/movement of water
		that water moves across a partially permeable membrane by osmosis.	osmosis, partially permeable membrane, dilute, concentrated, rate, % change in mass.	
		how to investigate the effect of a range of sugar concentrations on the mass of plant tissue.		
		that active transport moves substances against a concentration gradient. that active transport requires energy from aerobic respiration.	energy, respiration, dilute, concentrated, release, mineral ions, nitrate ions magnesium ions.	

				from a dilute to more concentrated solution passively via a semi or partially permeable membrane. Active transport → movement against a concentration gradient, it requires ATP.
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Topic 4.7	Rationale (layering, why this why now?)	Knowledge goals: You need to know that how to	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
4.7 Ecology The study of ecology will allow us to develop a clearer understanding of how organisms are interdependent on one another and why cycling of elements like Carbon and compounds like as water are essential to life. The Sun is a source of energy that passes through ecosystems. Materials including carbon and water are continually recycled by the living world,	 KS3 NC: links to interactions and interdependence: Relationships in an ecosystem.  KS4 ladders to work on: Abiotic and biotic factors. Adaptations of organisms. Extremophiles. Feeding relationships. Quadrats and transects. Carbon and water cycles. Environmental change. Biodiversity. Deforestation. Global warming.	that communities are populations of different species. that competition occurs between plants and animals in communities.	ecosystem, organisms, interdependence, competition community, habitats.	a) Subject specific skills Practical skills (RP7) - measuring the population size of a common species in a habitat. TRILOGY Interpret diagrams of the carbon and water cycle. Interpret graphs used to model predator prey cycles. b) Numeracy Calculate values for mean, median and mode. Translate information between graphical and numerical forms. Plot and draw appropriate graphs selecting scales for the axes. Calculate population sizes of plants or other sessile organisms. c) Literacy and d) Reading Reading – how deforestation and global warming have an impact on biodiversity. Page 292, 293 and 295 AQA Biology text.
		that abiotic and biotic factors affect the distribution of organisms.	abiotic, biotic, temperature, pH, predators, pathogens.	
		that adaptations are features of organisms that allow survival. that adaptations can be structural, functional or behavioural.	environment, adaptation, feature, structural, functional, behavioural, extremophiles, bacteria.	
		that feeding relationships are shown by a food chain. that a predator-prey cycle is a biotic interaction.	consumers, herbivores, carnivores, omnivores, primary, secondary, tertiary, predator, prey.	
		how to use quadrats to estimate population size of a common species in a habitat.	Quadrat, mean, area, representative,	
		that transects show the distribution of a species.	line of study, distribution, abundance, ecosystem	
		that the carbon cycle returns carbon from organisms to the atmosphere as CO ₂ .	carbon cycle, water cycle, respiration, photosynthesis, evaporation, precipitation, infiltration,	

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	KS5 ladders to work on: abiotic and biotic interactions, succession and cycling of elements such as nitrogen. Detailed study of sampling techniques e.g. MRR and the use of quadrats for carrying belt transects, % cover and estimating population size. Use of statistical analyses to determine significance.	that the water cycle provides fresh water for plants and animals.	surface runoff, transpiration.	e) Cultural capital links Air pollution https://www.youtube.com/watch?v=e6rglsLy1Ys Environmental implications of deforestation. https://www.youtube.com/watch?v=lc-J6hcSKa8 Global warming https://www.youtube.com/watch?v=oJAbATJCugs f) Common misconceptions <i>Quadrats/sampling – quadrats are <u>not</u> thrown. Quadrats are placed randomly using a random number generator.</i> <i>Quadrat uses – learners often confuse quantitative sampling and transect sampling. Quantitative sampling is used to estimate population sizes, transect sampling is used to show distribution of a species.</i>
		that environmental change affects the distribution of a species in an ecosystem.	Temperature, water, composition, atmospheric gases.	
		that biodiversity is the variety of all the different species of organisms. that biodiversity can be maintained by using different strategies.	ecosystem, biodiversity, breeding programmes, rare habitats, field margins, deforestation, recycling.	
		that humans pollute the air, water and reduce land available. that pollution kills plants and animals reducing biodiversity.	sewage, fertiliser, toxic chemicals, smoke, acidic gases, landfill, biodiversity.	
		that deforestation occurs to provide land for cattle and to grow crops. that deforestation has environmental implications.	deforestation, biofuels, carbon dioxide, methane, sequestration.	
		that CO ₂ and CH ₄ are contribute to global warming. that global warming has biological consequences.	greenhouse gases, climate change, carbon dioxide, methane, extreme weather, habitat destruction.	

provide essential services that support human life and continued development.				<i>Food chains – arrows indicate the direction of energy transfer. The arrows do not show what has been eaten, which would make them go in the opposite direction.</i> <i>Biomass does <u>not</u> accumulate along the food chain, there are biomass losses. Needs clear exemplification to students. A human who has just eaten a cheeseburger does not gain all the biomass of the cow and the grass it fed on! There is minimal biomass left over after all the energy transfers in that food chain have occurred.</i> <i>Abiotic and biotic factors – terms are often misused by learners/poorly understood. Specific teaching of tier 3 vocabulary needed e.g. abiotic non-living, biotic living.</i> <i>Decomposers specific teaching of this term – organisms that breakdown dead organic matter e.g. bacteria / fungi <u>using</u> enzymes. Learners often fail to mention the role of enzymes in decomposition.</i>
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Topic 4.5	Rationale (layering, why this why now?)	Knowledge goals: <i>You need to know that how to</i>	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
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 and how organisms use feedback mechanisms to control conditions in the body. Hormones are chemical messengers produced by glands. Hormonal coordination is particularly important in reproduction as it	 KS3 NC: links to structure and function of living organisms: reproduction  KS4 ladders to work on: Homeostasis. Nervous system. Reflex actions. Hormones and the endocrine system. Control of blood glucose. Diabetes. Contraception. Control of fertility Negative feedback. Thyroxine and Adrenaline.	that homeostasis is regulation of the bodies internal conditions. that blood glucose, body temperature and water levels need to be controlled.	homeostasis, optimal conditions, blood glucose, temperature, water levels, control systems.	a) Subject specific skills Practical skills (RP6) - measuring reaction time using ruler drop test. TRILOGY Planning investigations – identification of independent, dependent and control variables. Interpret and explain simple diagrams of negative feedback control. b) Numeracy Calculation of reaction times and conversion of units e.g., seconds to milliseconds. Calculating arithmetic means. Extract and interpret data from graphs e.g., showing hormone levels in the menstrual cycle. Translate information about reaction times between numerical and graphical forms. c) Literacy d) Reading Evaluate information around the relationship between obesity and diabetes, and make recommendations taking into account social and ethical issues. Page 164+165 AQA Biology text.
		that nervous system allows humans to react to their surroundings and coordinate behaviour. that nervous pathways involve S>R>C>E>R.	nervous system, receptors, neurones, CNS, stimulus, receptor, coordinator, effector, response.	
		that reflex actions are automatic, rapid responses to stimuli which do not involve the brain. that synapses are junctions between neurones.	stimulus, receptor, sensory, relay, motor, neurone, synapse, diffuse, electrical, chemical.	
		how to measure reaction time using a ruler drop test.	reaction time, seconds, milliseconds, mean, mode.	
		that the endocrine system is made up of glands. how to identify the main endocrine glands in the body.	glands, oestrogen, testosterone, bloodstream, pituitary gland, pancreas, thyroid, adrenal, ovary, testes.	
		that blood glucose is controlled by the pancreas by negative feedback. that the pancreas produces the hormones insulin and glucagon.	pancreas, insulin, glucagon, hormone, pancreas, liver, muscle, negative feedback, bloodstream.	
		that diabetes is a disorder characterised by uncontrolled blood glucose concentration.	type I, type II, diabetes, obesity, risk factor, uncontrolled high blood	

controls the menstrual cycle. Understanding the role of hormones in reproduction has allowed scientists to develop not only contraceptive drugs but also drugs which can increase fertility. Cells in the body can only survive within narrow physical and chemical limits. They 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	KS5 ladders to work on: detailed understanding homeostatic control mechanisms: blood glucose, kidney roles of hormones as second messengers and protein molecules affecting permeability of phospholipid bilayers.	how to compare the causes and treatments for type I/II diabetes	glucose concentration, injections.	e) Cultural capital links The discovery of insulin https://www.youtube.com/watch?v=Gk1D4VgM8jY f) Common misconceptions <i>Learners often state impulses move across synapses, this is <u>incorrect</u>. Neurotransmitters diffuse across the synapse.</i> <i>Control of blood glucose – insulin raises blood glucose concentration, this is <u>incorrect</u>. Insulin acts to lower blood glucose concentration by causing glucose to move from blood into cells.</i> <i>Confusion and use of the terms glycogen, glucagon, glucose and glycerol! Needs explicit teaching that glycogen is in effect a store of glucose, glucagon is a hormone which acts to raise blood glucose. Glucose is sugar and glycerol a molecule that makes up parts of lipids. Explicitly teach this tier 3 vocabulary.</i> <i>(HT) Vasoconstriction and vasodilation – learners often get these terms confused. Constrict narrower, dilate wider this needs reinforced again through teaching of tier 3 vocabulary.</i> <i>Capillaries cannot dilate/constrict – this is <u>incorrect</u>, they have <u>no</u> muscles. Blood vessels <u>do not</u> ‘move up’ to the surface of the skin! Blood vessels which supply the surface capillaries dilate.</i> <i><u>Urea</u> and <u>urine</u> are different! Urea is nitrogenous waste from the breakdown of amino acids, made in</i>
		that the menstrual cycle is controlled by hormones. that hormones interact via stimulation or inhibition.	menstruation, oestrogen, LH, FSH, progesterone, negative feedback, stimulate, inhibit, interaction.	
		HT ONLY that fertility can be controlled by hormonal and non-hormonal forms of contraception.	FSH, LH, hormonal, non-hormonal, contraceptive pull, IUD, condom.	
		HT ONLY that negative restores any changes that occur in the body to norm. that thyroxine levels are controlled by negative feedback	thyroxine, thyroid gland, adrenaline, adrenal gland, negative feedback.	

tissues.

the liver. Urine is a liquid containing excreted urea, excess water and mineral ions – made in the kidney.

Auxin – misunderstanding of role, both promote and inhibit elongation of cells.

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Topic 4.3	Rationale (layering, why this why now?)	Knowledge goals: <i>You need to know that how to</i>	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
Infection and response Studying 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. When at risk from unusual or dangerous diseases our body's natural system can be enhanced by the	 KS2 living things have characteristics essential for keeping them alive and healthy. KS3 NC: links to structure and function of living organisms: nutrition and digestion, health.  KS4 ladders to work on: Bacterial disease. Fungal disease. Viral disease. Non-specific defence. Specific defence – white blood cells. Vaccination.	that communicable diseases can be spread. that pathogens can cause communicable disease. that salmonella is a bacterial disease spread by bacteria in food. that gonorrhoea is a sexually transmitted disease. that rose black spot is fungal disease of plants. that TMV is a viral infection of plants e.g., tomatoes. that protists are pathogens that cause malaria. that malaria can be treated by preventing vectors reproducing and using nets. that humans have non-specific defence mechanisms (barriers). that specific defence mechanisms involve white blood cells/immune system. that phagocytosis, antibody, and antitoxin production help to defend against pathogens. that immunity is the ability to resist disease.	communicable, pathogen, spread, viruses, fungi, bacteria, toxins reproduction. salmonella, food poisoning, toxins, spread, diarrhoea, vomiting, gonorrhoea, STD. rose black spot (RBS), tobacco mosaic virus (TMV), fungicide, mosaic pattern of discolouration, photosynthesis. malaria, vector, mosquito, fever, breeding, life cycle, recurrent. skin, nose, trachea, bronchi, stomach, non-specific defence. white blood cell, phagocytosis, antibody, antitoxin, immune system. inactive/dead pathogen, white blood cells,	a) Subject specific skills Development of hypotheses about the effectiveness of antibiotics or antiseptics used. b) Numeracy Calculating rates of infection/number of cases of a given disease e.g. from graphs or tables of data. Calculation of % increase or decrease in the number of confirmed cases of a disease e.g. measles. c) Literacy skills d) Reading Vaccination – preventing and treating disease page 98+99 AQA Biology text e) Cultural capital How antibiotics were discovered. https://www.bbc.co.uk/bitesize/guides/zt8t3k7/revision/1 Antibiotic resistant bacteria Ted-Ed https://www.youtube.com/watch?v=znnp-lvj2ek The importance and dangers of antibiotic resistance

use of vaccination and the use of antibiotics developed in the 1940s.	Testing and development of drugs.	that vaccination induces immunity and can help to prevent illness.	antibodies, specific, herd immunity, proportion, population, herd immunity.	https://www.bbc.co.uk/bitesize/guides/z8fkmsg/revision/4 f) Common misconceptions <i>Antibiotics can be used to treat all pathogens – bacteria, viruses, and fungi - <u>this is incorrect</u>. Antibiotics are only effective against bacteria, and damage bacterial cell walls or stop protein synthesis at ribosomes. Most antibiotics are made by fungi.</i> <i>When antibiotics no longer work bacteria <u>are not</u> 'immune' they have developed resistance to the antibiotics.</i> <i>Viruses are made from cells, <u>this is incorrect</u>. Viruses are acellular and reproduce inside cells. Antibiotics cannot kill viruses as the virus is inaccessible to the antibiotics.</i> <i>Communicable diseases – are diseases which are spread but students often do not appreciate the different <u>modes of transmission</u>. Pathogens can be spread via direct contact, contaminated food, sexual contact, or droplet infections. Students need this exemplified through specific examples.</i> <i>Distinguishing between the terms antigen, antibody and antibiotic. Specific teaching of this tier 3 vocabulary. Antibodies → Y shaped protein made by WBC, they kill pathogens, Antigen → cell surface protein for self/foreign recognition, antibiotic → chemical produced by fungi which kills bacteria.</i> <i>Misunderstanding of the reason of the maximum temperature allowed in schools and colleges to grow microbes. This is 25°C but not because it denatures enzymes and kills bacteria! It reduces the risk of developing harmful pathogens.</i>
		that antibiotics can be used to treat bacterial disease. that bacteria can develop resistance to antibiotics.	antibiotic, painkiller, penicillin, infective, viral, resistant strains, MRSA.	
	KS5 ladders to work on: Detailed bacterial and structure. Idea of viruses being acellular and their detailed structure/HIV. Bacterial replication and use of bacteria in determining DNA replication methods.	that drugs are tested and developed in a series of stages. that drugs are sourced from animals, plants, and microorganisms.	drug, placebo, clinical, digitalis, aspirin, penicillin, pre-clinical, double blind.	

				<i>Malaria – is <u>not</u> caused by bacteria/fungi, it is caused by a protest.</i>
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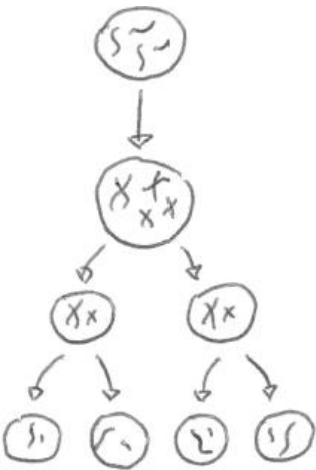
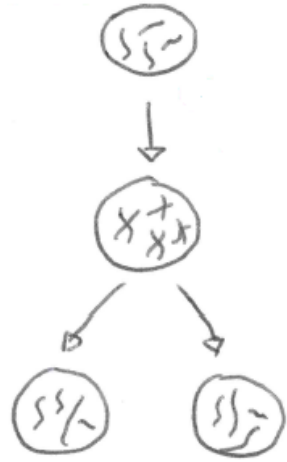
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Topic 4.6	Rationale (layering, why this why now?)	Knowledge goals: <i>You need to know that how to</i>	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
Inheritance, Variation & Evolution The study of inheritance will allow us to understand how genetic material is passed from one generation to the next and how we can use knowledge of DNA to benefit humans. DNA is the cells genetic material retained in the nucleus and arranged into chromosomes. The number of chromosomes is halved during meiosis and then	 KS3 NC: links to genetics and evolution: Inheritance, chromosomes, DNA and genes.  KS4 ladders to work on: Reproduction. DNA structure. Genetic inheritance. Sex determination. Inherited disorders. Variation Evolution. Resistant bacteria. Selective breeding. Fossils. Extinction.	that sexual reproduction involves gametes fusing. that asexual reproduction involves one parent and no fusion of gametes.	sexual, asexual, sperm, egg, pollen, ova, clones, mitosis, fusion.	a) Subject specific skills Modelling the behaviour of chromosomes during meiosis.
		that meiosis is a type of cell division that halves the number of chromosomes. that meiosis involves two cell divisions.	meiosis, gametes, single set, restore, embryo, differentiate, fertilisation, variation, fertilisation.	b) Numeracy Interpreting pedigree charts and determining the %, ratio or fraction of offspring with inherited disorders. Extract and interpret information from graphs and charts.
		that DNA is a polymer arranged in a double helix. that a small section of DNA is called a gene	DNA, double helix, polymer, gene, codes , genome, human genome project.	c) Literacy and d) reading skills Evaluation and summary of the pros/cons of genetic engineering of plants for use by humans e.g. those resistant to Bt toxin. Page 230-231 AQA Biology text
		how to carry out genetic crosses for inherited disorders. how to calculate probability, percentages, and ratios from genetic crosses/experiments.	gamete, chromosome, gene, allele, dominant, recessive, homozygous, heterozygous, genotype, phenotype, probability, percentage, ratio.	Evaluation and summary of the pros/cons of screening embryos for genetic disorders. Page 214-215 AQA biology text.
		that cystic fibrosis and polydactyly are genetic disorders. that embryos can be screened for genetic disorders.	cystic fibrosis, polydactyly, embryo screening, alleles, ethnical.	Evaluation of the potential benefits and risks of cloning in agriculture/medicine and that people have ethical objections.

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 an animal or plant. Very rarely a new mutation can be beneficial and consequently, lead to increased fitness in the individual. Variation generated by mutation and sexual reproduction is the basis for natural selection; this is how species evolve.	Classification methods. KS5 ladders to work on: protein synthesis, transcription and translation. Detailed understanding of the processes of cell division and gene expression. Epigenetic control of gene expression.	that the 23 rd pair determines a person's sex. how to carry out genetic crosses to show sex inheritance.	chromosomes, XX, XY, females, males, pairs, characteristics, gametes, homozygous, heterozygous.	e) Cultural capital links Why is the fossil record incomplete? https://www.bbc.co.uk/bitesize/guides/zthcwmn/revision/2 Darwin's theory of Evolution by Natural Selection. Development of this idea and rejection by some. https://www.youtube.com/watch?v=JOOk_0mUT_JU Genetic engineering of bacteria. https://www.bbc.co.uk/bitesize/guides/zqqs2nb/video https://www.bbc.co.uk/bitesize/guides/zqqs2nb/test f) Common misconceptions <i>Plants only reproduce asexually, this is <u>incorrect</u>. Plants reproduce sexually and asexually.</i> <i>Avoid – 'inheriting a characteristic' better to say 'inherit a specific gene/allele that codes for specific characteristics'.</i> <i>Natural selection – organisms cannot <u>choose</u> to adapt to their environment. A random mutation or pre-existing genetic variation leads to natural selection. Idea that natural selection is a theory to explain the process of evolution.</i> <i>Genes, DNA and chromosomes - specific teaching of this vocabulary and the correct hierarchy which is regularly confused by learners.</i>
		that variation is the differences in the characteristics of a population. that variation has genetic and environmental causes.	variation, genetic, environmental, mutations, phenotype, genes, environment, mutations.	
		that evolution is the change in the characteristics of a population over time. that evolution occurs by natural selection.	evolution, inherited, change, characteristics, species, phenotypes, variants.	
		that selective breeding involves choosing and mating animals or cross breeding plants for particular characteristics.	desired characteristics, breed, mate, generations, artificial selection.	
		that genetic engineering involves modifying an organisms genome.	Genome, genes, vectors, GM crops, diabetes, insulin, characteristic.	
		that fossils are the remains of organisms found in rocks. that fossilisation can occur by different methods.	fossils, extinct, remains, mineralisation, decay, preserved traces, footprints.	
		that extinction is permanent loss of all members of a species.	extinct, predators, climate change, disease, environmental change, catastrophic events.	
		that MRSA is a type of bacteria resistant to antibiotics. that different strategies can be used to reduce antibiotic resistance.	mutations, pathogens, reproduce, DNA, immune, resistant strain, MRSA, emergence, evolve.	

Through selective breeding scientists have produced 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. Genes can be taken from one species and then introduced into the genome of another species by the process of genetic engineering.		that Linnaeus classified organisms into three groups based structural characteristics. that Carl Woese classified organisms into domains based on DNA/RNA evidence.	Linnaeus, Woese, kingdom, phylum, class, order, family, genus, species, archaea, bacteria, eukaryota, evolutionary tree.	<i>Gene → DNA → Chromosome</i> <i>DNA – chemical that carries genetic information. Gene – section of DNA that codes for a protein/which determines characteristics. Chromosomes – supercoiled DNA molecule/thread like structure, contains genes/found in the nucleus.</i> <i>Cell division – misunderstanding of terms diploid and haploid, specific teaching of this vocabulary. Haploid cells contain ½ genetic information or one set of chromosomes/no-pairs and vice versa.</i> <i>Cell division processes – mitosis/meiosis diagrams often mis-drawn/misinterpreted by learners. Chromosomes drawn initially as single strands then 'X' shape after DNA replication – i.e. chromosomes appear double stranded. Then one cell division (mitosis) or two (meiosis).</i> <i>For meiosis</i>  <i>For mitosis</i>  <i>Important scientists, learners often confuse their work.</i> <i>Mendel – characteristics determined and passed on in 'units'. Lamarck – changes that occur during an</i>
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				<i>organism's lifetime are passed on. (we now know this is wrong)! Darwin – natural selection, survival of the fittest. Wallace – used Darwin's work to develop speciation theory. Linnaeus – developed the classification system – K,P,C,O,F,G,S. Woese – 3 domain system based on DNA/RNA.</i> Reading – evolution of the horse/fossil record. Page 244 AQA Biology text.
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Year 11 GCSE Trilogy Biology topics

In Year 11 Biology we teach the following topics (4.1 – 4.7). We deliver these topics in line with schools in the MAT and in preparation for external exams. We recap topics 4.5 – 4.7 (September → December) followed by another paper 2 mock. We recap topics 4.1 – 4.4 (January → May) followed by another paper 1 mock exam. We have found this approach helpful in preparing the students for their external GCSE exams.

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 4.2	Rationale (layering, why this why now?)	Knowledge goals: <i>You need to know that how to</i>	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
Organisation Understanding how organisms are built will give a clearer understanding of process that occur in living organisms. Organisation from cell to complex organ systems is fundamental to all multicellular organisms. The human digestive system provides the body with nutrients and the respiratory system provides it with oxygen and removes carbon dioxide. In each case they provide dissolved materials that	 KS2 describe ways in which nutrients and water are transported within animals. KS3 NC: links to structure and function of living organisms: nutrition and digestion, gas exchange systems.  KS4 ladders to work on: Enzymes. Digestive enzymes. Liver and the role of bile. Enzyme based experiments. Transport in animals. Heart and blood vessel structure. Transport in plants. Non-communicable diseases. Effect of lifestyle on development of disease. Cancer and risk factors. Transpiration and factors affecting.	that cells are organised into tissues, tissues in organs and organs into organ systems that tissues in the plant leaf include epidermal, palisade, mesophyll, xylem, and phloem. that enzymes catalyse specific reactions in cells. that enzyme models can be used to explain enzyme action. that digestive enzymes convert food into small soluble molecules which can be absorbed into the blood. how to investigate the effect of pH on enzyme reactions. how to carry out qualitative food tests for carbohydrate, lipid and protein. that bile is made in the liver and stored in the gall bladder that bile assists with fat digestion and neutralises stomach acid. that the heart pumps blood around the body in a double circulatory system.	cell, tissue, aggregation, organ, organ system, organism. epidermal, palisade, mesophyll, xylem and phloem, root, stem, stomata. lock & key theory, enzyme, catalysts substrate, active site, complex, temperature, pH. small, soluble, molecule, carbohydrases, proteases, lipases, active site, catalyst, enzyme-substrate complex. pH, amylase, rate, digest, starch, enzyme, substrate. iodine, biuret solution, benedict's solution, ethanol, qualitative test. bile, alkaline, liver, emulsify, droplets, surface area, rat, lipase. atria, ventricles, aorta, pulmonary artery, vena cava, pulmonary vein, pacemaker,	a) Subject specific skills Practical skills (RP3) – use of qualitative reagents to test for carbohydrates, lipids and proteins. TRILOGY Practical skills (RP4) – investigate the effect of a pH on the rate of reaction of amylase enzyme. TRILOGY Recognising the different types of blood cell from photographs. Practical skills- observing and drawing stomata or blood cells under a microscope. b) Numeracy Understanding of size and scale of in relation to cells, tissues, organs, and systems. Calculating rates from enzyme reactions. Expressing data in standard form. Interpret data relating to risk factors for specific diseases. c) Literacy and d) Reading

need to be moved quickly around the body in the blood by the circulatory system. In plants the 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.	KS5 ladders to work on: Detailed heart structure and how it beats in a coordinated manner. Transport in plants cohesion/tension. Tissue fluid formation in organisms. Cancer and the effect of epigenetic factors and genes on development of cancer.	that the heart contains 4 chambers, 4 vessels and valves.	double circulatory system/pump.	Using stimulus material to evaluate the use of heart valves from biological and mechanical sources. Reading – artificial hearts page 59 AQA Biology text. e) Cultural capital links Dr William Beaumont discovery and importance of digestive enzymes https://bit.ly/2VI2Wif Importance of maintaining a healthy lifestyle in relation to developing non-communicable diseases. https://www.nhs.uk/live-well/ https://www.nhs.uk/conditions/coronary-heart-disease/ Cancer causes and risk factors. https://www.macmillan.org.uk/cancer-information-and-support f) Graph reading skills Graphical analysis of data, frequency tables, bar charts and histograms. Plot graphs using appropriate scales for axes.
		that blood is a tissue composed of red and white cells and platelets suspended in plasma.	red blood cells, white blood cells, platelet, plasma, oxygenated, deoxygenated, exchange.	
		that the body contains three types of blood vessel.	artery, vein, capillary, oxygen, carbon dioxide, muscle, lumen,	
		that coronary heart disease is a non-communicable disease. that stenting and statins can be used to treat CHD.	coronary artery, fatty material, stents, statins, heart valves, biological, mechanical.	
		that heart valves can become faulty (leak/don't open). that artificial hearts are used to keep people alive while they are waiting for a heart transplant.	heart valve, stent, donor heart, artificial value, mechanical value, effectiveness, efficacy, heart transplant.	
		that risk factors are linked to an increased rate of disease. that diet, stress and life situations can affect health and well-being.	health, disease, interact, communicable, asthma, skin rashes, depression, cancer lifestyle diseases, obesity, alcohol, smoking, carcinogens, diabetes, risk factor, cardiovascular disease.	
		that cancer is uncontrolled cell division. that tumours can be benign or malignant.	malignant, benign, uncontrolled, cell division, secondary tumour, risk factors.	
		that transpiration is loss of water from plant leaves via the stomata. that transpiration is affected by various factors.	transpiration, temperature, humidity, light intensity, root hair cell, xylem vessel, stomata, stomatal density, water uptake, potometer, guard cells.	

		that roots, stems and leaves form the plant organ system. that xylem and phloem are adapted for transport.	xylem, phloem, water, mineral ions, glucose, translocation, transpiration, guard cells, root hair cells.	g) common misconceptions <i>Enzymes <u>are not alive</u>! so, they cannot die, they can only be denatured. Enzymes are protein molecules that are found within cells, they are denatured by extreme pH or temperature. This leads to a change in the shape of the active site.</i> <i>Deoxygenated blood is blue – <u>this is incorrect</u>, enforced by the idea of 'blue blood' in textbooks. Blood is deep red, but our veins look blue due to the scattering of light by the skin.</i> <i>Heart – right side of the heart pumps blood a greater distance around the body, <u>this is incorrect</u>. The right ventricle contains a smaller proportion of muscle so only pumps blood to the lungs. The left side with a greater proportion of muscle pumps blood to the body. The heart is a double pump.</i> <i>Plants obtain water from their leaves <u>this is incorrect</u>. Plants obtain water from their roots via their root hair cells. In fact, most plant leaves are adapted to direct water to the ground e.g., drip tips in rainforest plants. Leaves have stomata to allow exchange of gases.</i> <i>Plants are living! this is a fact. Unlike animals' plants do <u>not eat</u>. Carbon dioxide, water and minerals <u>are not</u> the plants food. Plants produce food during photosynthesis (a chemical reaction) this is why they are called producers.</i>
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