

Topic 4.7	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.
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, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis.	 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. Decomposition Anaerobic decay and biogas production. Measuring the rate of decay. Environmental change. Biodiversity. Trophic levels and biomass pyramids. Factory farming. Sustainable food production.	that communities are populations of different species. that competition occurs between plants and animals in communities. that abiotic and biotic factors affect the distribution of organisms. that adaptations are features of organisms that allow survival. that adaptations can be structural, functional or behavioural. that feeding relationships are shown by a food chain. that a predator-prey cycle is a biotic interaction. how to use quadrats to estimate population size of a common species in a habitat. that transects show the distribution of a species. that the carbon cycle returns carbon from organisms to the atmosphere as CO ₂ . that the water cycle provides fresh water for plants and animals. that decomposition is the breakdown of substances by microorganisms. that oxygen, temperature and moisture affect the rate of decomposition. BIOL ONLY	ecosystem, organisms, interdependence, competition community, habitats abiotic, biotic, temperature, pH, predators, pathogens. environment, adaptation, feature, structural, functional, behavioural, extremophiles, bacteria, deep sea vents consumers, herbivores, carnivores, omnivores, primary, secondary, tertiary, predator, prey. Quadrat, mean, area, representative, line of study, distribution, abundance, ecosystem carbon cycle, water cycle, respiration, photosynthesis, evaporation, precipitation, infiltration, surface runoff, transpiration. decay, decomposition, decomposers, fungi, bacteria, enzymes, temperature, moisture, oxygen concentration, biological material.	a) Subject specific skills Practical skills (RP9) - measuring the population size of a common species in a habitat. Practical skills (RP10) – measuring the rate of decay of fresh milk at different temperatures using pH change. BIOL ONLY 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. Construct pyramids of biomass using data and plot graphically/or draw to give an expected shape/pattern. Calculate population sizes of plants or other sessile organisms. Using formula: population size = field area/quadrat area x mean Calculating rates of decay of biological material. Calculating % of biomass lost between trophic levels. c) Literacy and d) Reading Evaluate and summarise the advantages and disadvantages of modern farming techniques.

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.	Food security. Deforestation. Global warming, Mycoprotein production. 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.	how to measure the rate of decay of fresh milk at different temperatures. BIOL ONLY	sodium carbonate, cresol red, lipase, milk, rate, thermometer	Reading – how deforestation and global warming have an impact on biodiversity. Page 292, 293 and 295 AQA Biology text. e) Cultural capital links The importance of decay https://www.youtube.com/watch?v=FVrOIMmmBQE Pros and Cons of factory farming (snaprevise) https://www.youtube.com/watch?v=olDdPZ1yRC0 What is food security (fuse school) https://www.youtube.com/watch?v=lsT246lrNxg Discovery of Quorn/Protein pioneer (Quorn foods) https://www.youtube.com/watch?v=UhXsyLTDoSk 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> <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>
		that anaerobic decay produces methane gas. that biogas is produced by anaerobic decay. BIOL ONLY	decay, decomposition, biogas, methane, carbon dioxide, anaerobic, bacteria, biogas generator, slurry, mineral ions.	
		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 trophic levels are feeding levels within a food chain. that pyramids of biomass can be used to represent the biomass at each trophic level. BIOL ONLY	plants, algae, herbivores, carnivores, decomposers, biomass, trophic level, ingested, faeces, respiration, carbon dioxide, water, urine.	
		that factory farming techniques increase the efficiency of food production. that sustainable fishing is important to maintain fish stocks. BIOL ONLY	Protein, restricting, energy loss, biomass, breeding, net size, fishing quotas, sustainable.	
		that food security is having enough food to feed a population. that various factors affect food security of countries BIOL ONLY	food security, birth rate, pathogens, pests, famine, agricultural inputs, conflict.	
		that CO₂ and CH₄ are contribute to global warming. that global warming has biological consequences.	greenhouse gases, climate change, carbon dioxide, methane, extreme weather, habitat destruction	

		that deforestation occurs to provide land for cattle and to grow crops. that deforestation has environmental implications.	deforestation, biofuels, carbon dioxide, methane, sequestration.	<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>
		that the fungus Fusarium can be used to produce mycoprotein, that mycoprotein is a low fat, high fibre protein rich food. BIOL ONLY	mycoprotein, Quorn, fungus, oxygen, aerobic, vegetarians, agriculture, biotechnology.	<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>

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 controls the menstrual cycle.	← Linking KS3 NC: links to structure and function of living organisms: reproduction Looking → KS4 ladders to work on: Nervous system. Reflex actions. Brain. Eye. Temperature regulation. Hormones and the endocrine system. Control of blood glucose. Diabetes. Contraception. Control of fertility. Kidneys and urine formation. Kidney disease. Plant tropisms. Uses of plant hormones.	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 (RP7) - measuring reaction time using ruler drop test. Practical skills (RP8) – investigating the effect light on the growth of newly germinated seedlings. BIOL ONLY Interpreting diagrams showing negative feedback. Interpreting evolutionary trees. 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. c) Literacy d) Reading Evaluation skills: comparing the relative advantages and disadvantages of kidney transplants to dialysis treatments. Page 188-191 AQA Biology text. Reading – uses of hormones in plants. Page 178-179 AQA Biology text. Evaluate the benefits and risks of procedures used to analyse brain function. Page 153 AQA Biology text. e) Cultural capital links Homeostasis – water/nitrogen balance podcast
		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 brain controls complex behaviour. BIOL ONLY that brain function/damage can be investigated in different ways.	brain, cerebral cortex, medulla, cerebellum, MRI scan, neuroscientists, complexity.	
		that the eye is a complex sense organ with different structures and functions. how to identify key structures in the eye. BIOL ONLY	retina, optic nerve, sclera, cornea, iris, ciliary muscle, suspensory ligaments, adaptation, circular muscle, radial muscle, dilate, constrict.	
		that accommodation is changing the lens shape to focus on near or distant objects. BIOL ONLY	accommodation, myopia, hyperopia, ciliary muscles, suspensory ligaments, lens, thicker, thinner, defects,	

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 tissues. These control systems include receptors which sense changes and effectors that bring about changes.	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.	that common eye defects include myopia and hyperopia.	myopia, hyperopia, laser eye surgery, spectacle lenses.	https://www.bbc.co.uk/bitesize/guides/zc8qdxs/revision/2 The discovery of insulin https://www.youtube.com/watch?v=Gk1D4VgM8jY How do the kidneys work (TED-ed) https://www.youtube.com/watch?v=FN3MFhYPWWo Kidney disease and dialysis (Fuse school)/ https://www.youtube.com/watch?v=9KZHowze7lq Plant tropisms https://www.youtube.com/watch?v=pCFstSMvAMl 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>Eye – mislabelling/identification of pupil and iris. Pupil is a hole that lets light in it is not coloured. Iris is coloured and contains circular and radial muscles. Cornea and</i>
		that body temperature is controlled by the thermoregulatory centre in the brain. BIOL ONLY that vasoconstriction/dilation are control mechanisms.	thermoregulatory centre, vasodilation, vasoconstriction, sweating, shivering, skeletal muscles.	
		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. how to compare the causes and treatments for type I/II diabetes.	type I, type II, diabetes, obesity, risk factor, uncontrolled high blood glucose concentration, injections.	
		that thyroxine from the thyroid gland stimulates basal metabolic rate. that thyroxine levels are controlled by –ive feedback.	Thyroxine, adrenaline, negative feedback, basal metabolic rate, adrenaline, oxygen, glucose, fight or flight.	
		that the kidneys maintain the water balance of the body. that the kidneys produce urine by filtration of the blood. BIOL ONLY	kidney, water, ions, glucose, urea, reabsorption, osmosis, urinary system, tubules.	
		that ADH is a hormone produced by the pituitary gland.	ADH, pituitary gland, kidney, permeability, tubules, dilute, concentrated, reabsorbed, negative feedback.	

	that ADH affects the permeability of the kidney tubules. BIOL ONLY		lens <u>both</u> refract light and lens also has a job of focussing light. Refraction is not confined to the cornea.
	that kidney failure can be treated with transplants or kidney dialysis. BIOL ONLY	dialysis, partially permeable, transplant, immunosuppressant's.	Vasoconstriction and vasodilation – learners often get these terms confused. Constrict narrower, dilate wider this needs reinforced again through teaching of tier 3 vocabulary.
	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.	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.
	that fertility can be controlled by hormonal and non-hormonal forms of contraception.	FSH, LH, hormonal, non-hormonal, contraceptive pill, IUD, condom.	<u>Urea and urine</u> are different! Urea is nitrogenous waste from the breakdown of amino acids, made in the liver. Urine is a liquid containing excreted urea, excess water and mineral ions – made in the kidney.
	that plants produce hormones to coordinate and control growth. that phototropism is response to light and gravi(geo) tropism is response to gravity.	phototropism, geotropism, gravitropism, auxin, gibberellin, unequal distribution, positive, negative.	Kidney function, needs to be clearly explained to learners that kidneys function to <u>filter substances</u> from the <u>blood</u> AND maintain water balance, <u>both</u> aspects are important. Learners often do not appreciate that kidneys act as part of a homeostatic mechanism to control water balance as a result of ADH release. If dehydrated there is an increase in ADH, if hydrated there is a decrease in ADH. Negative feedback loops aid understanding.
	how to investigate the effect of light on the growth of newly germinating seedlings. BIOL ONLY	maize, cress, seedlings, ruler, phototropism, mean, anomalous, chlorophyll.	
	that plant hormones have uses in agriculture and horticulture. that plant hormones include auxin, ethene and gibberellin. BIOL ONLY	weedkiller, rooting powder, germination, dormancy, flowering, auxin, ethene, and gibberellin.	Auxin – misunderstanding of role, both promote and inhibit elongation of cells.

Year 10 GCSE Biology topics (separates).

In Year 10 Biology we teach the following topics (4.2, 4.3, 4.5, 4.6 and 4.7) all topics (including 4.1 and 4.4) are then revisited again in Year 11. We start with topics 4.3, 4.2 (September → December) then teach 4.5, 4.6 and 4.7 (Jan → May) in preparation for the paper 2 mock exam after May half term. 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 4.3	Rationale (layering, why this why now?)	Knowledge goals: You need to know <i>that</i> <i>how to</i>	Key Tier 3 vocabulary	Core skills and enrichment opportunities.
Infection and response Studying infection and response will allows 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. Culturing microbes. Defence mechanisms. Vaccination. Monoclonal antibodies and medicine.	that communicable diseases can be spread. that pathogens can cause communicable disease.	communicable, pathogen, spread, viruses, fungi, bacteria, toxins reproduction.	a) Subject specific skills Practical skills – streak plating sterile water, growing microbes, looking at the effect of disinfectants on microbial growth using agar plates and paper discs. Development of hypotheses about the effectiveness of antibiotics or antiseptics used. b) Numeracy Calculation of clear zones/cross sectional areas using TTr^2 . Calculating numbers of bacteria given the mean division time. Expressing processed data in standard form. 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. Evaluation skills - uses of monoclonal antibodies in medicine pages 108+99 AQA Biology text.
		that salmonella is a bacterial disease spread by bacteria in food. that gonorrhoea is a sexually transmitted disease.	salmonella, food poisoning, toxins, spread, diarrhoea, vomiting, gonorrhoea, STD.	
		that rose black spot is fungal disease of plants. that TMV is a viral infection of plants e.g., tomatoes.	rose black spot (RBS), tobacco mosaic virus (TMV), fungicide, mosaic pattern of discolouration, photosynthesis.	
		that protists are pathogens that cause malaria. that malaria can be treated by preventing vectors reproducing and using nets.	malaria, vector, mosquito, fever, breeding, life cycle, recurrent.	
		how to grow uncontaminated cultures of microorganism by streaking/aseptic methods. BIOL ONLY	petri dish, inoculating loop, sterilised, flame, transfer, microorganisms.	
		that plant disease can be detected by different methods. BIOL ONLY that ion deficiency in plants leads deficiency diseases.	stunted, spots, decay, growths, malformed, pests' discolouration, nitrate stunted growth, magnesium, chlorosis, website, manual.	

use of vaccination and the use of antibiotics developed in the 1940s.	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 plants have defence mechanisms to prevent infection from pathogens and herbivores. BIOL ONLY	physical, chemical, mechanical, antibacterial chemicals, poisons, thorns, leaves, cellulose. mimicry, deter.	e) Cultural capital How antibiotics were discovered (Fleming). https://www.youtube.com/watch?v=ZAGY36JYQlg Understanding the importance and dangers of antibiotic resistance https://www.bbc.co.uk/bitesize/guides/z8fkmsg/revision/4 Monoclonal antibodies production and uses https://www.bbc.co.uk/bitesize/guides/zt8t3k7/revision/1 Antibiotic resistant bacteria Ted-Ed https://www.youtube.com/watch?v=znnp-lvj2ek 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>
		resistant strains of bacteria cannot be killed by killed. MRSA is a type of resistant bacteria. (Links to 4.6.3.4).	resistance, antibiotic, mutations, MRSA, immune	
		that humans have non-specific defence mechanisms (barriers).	skin, nose, trachea, bronchi, stomach, non-specific defence.	
		that specific defence mechanisms involve white blood cells/immune system. that phagocytosis, antibody, and antitoxin production help to defend against pathogens.	white blood cell, phagocytosis, antibody, antitoxin, immune system.	
		that immunity is the ability to resist disease. that vaccination induces immunity and can help to prevent illness.	inactive/dead pathogen, white blood cells, antibodies, specific, herd immunity, proportion, population, herd immunity.	
		that drugs are tested and developed in a series of stages. that drugs are sourced from animals, plants, and microorganisms.	drug, placebo, clinical, trial, digitalis, aspirin, penicillin, pre-clinical, double blind.	

		that monoclonal antibodies are identical and produced in a lab using lymphocytes and cancer cells. that monoclonal antibodies have uses in medicine, diagnosis, and disease treatment. BIOL ONLY	lymphocyte, cancer, tumour, hybridoma, pregnancy test, diagnosis, cancer treatment, research.	<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> <i>Malaria – is <u>not</u> caused by bacteria/fungi, it is caused by a protest.</i> <i>Monoclonal antibodies – understanding of what a 'hybridoma' is. They do not exist naturally and are made by fusion of a <u>B-lymphocyte</u> (must use this term) and a <u>tumour cell</u>.</i>
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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 combined with new genes from the sexual partner to produce unique offspring.	 KS3 NC: links to genetics and evolution: Inheritance, chromosomes, DNA and genes.  KS4 ladders to work on: Reproduction. DNA structure. Protein synthesis. Genetic inheritance. Sex determination. Inherited disorders. History of genetics. Variation Evolution. Theories of evolution: Darwin and Lamarck. Speciation. Selective breeding. Cloning of animals. Cloning of plants. Fossils. Extinction. Classification methods.	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. b) Numeracy Interpreting pedigree charts Determining the %, ratio or fraction of offspring with inherited disorders. Calculation of the length of DNA in a cell using numerical data. Converting between mm, µm and nm. Extract and interpret information from graphs and charts. 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. Evaluation and summary of the pros/cons of screening embryos for genetic disorders. Page 214-215 AQA biology text. Evaluation of the potential benefits and risks of cloning in agriculture/medicine and that people have ethical objections. Page 229 AQA Biology text. Reading - Gregor Mendel's discoveries about monohybrid inheritance, reading/comprehension p 234-235 AQA Biology text.
		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.	
		that sexual and asexual forms of reproduction have advantages/disadvantages. BIOL ONLY	sexual, asexual, natural section, parent, time, energy efficient.	
		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,	
		that DNA contains 4 bases A, T C and G. that proteins are synthesised at ribosomes, according to a template. BIOL ONLY	DNA, bases, nucleotide, phosphate, common sugar, amino acids, proteins, repeating units, protein synthesis	
		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.	
		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.	
		that Gregor Mendel developed the understanding of inheritance through experiments with pea plants.	Gregor Mendel, chromosomes, units of inheritance, gene function, descendants, gene theory.	

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. 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	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 importance of Mendel's work was not recognised until after his death. BIOL ONLY		e) Cultural capital links Darwin's theory of Evolution by Natural Selection. Development of this idea and rejection by some. https://www.youtube.com/watch?v=JOk_0mUT_JU Formation of new species. https://www.youtube.com/watch?v=HPQF9BQnw2A 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> <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>
		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 different theories of evolution were proposed by Darwin and Lamarck. that Darwin's theory was gradually accepted. BIOL ONLY	evolution, natural selection, acquired characteristics, mechanism, Jean-Baptiste Lamarck, Charles Darwin, variation.	
		that speciation is the formation of a new species. that speciation occurs through geographic isolation. BIOL ONLY	speciation, genetic variation, biotic factor, abiotic factor, natural selection, evolution, gene pools, fertile offspring.	
		that selective breeding involves choosing and mating animals or cross breeding plants for particular characteristics.	desired characteristics, breed, mate, generations, artificial selection.	
		that animals can be cloned by embryo splitting or adult cell cloning. that cloning of animals has implications. BIOL ONLY	cloning, genetically identical, adult cell cloning, embryo splitting, nucleus, genes, specialised, host mother, electric shock.	
		that plants can be cloned by tissue culture and cuttings. BIOL ONLY	cells, plant, identical, preserving, rare, economical, nurseries.	

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 fossils are the remains of organisms found in rocks. that fossilisation can occur by different methods.	fossils, extinct, remains, mineralisation, decay, preserved traces, footprints.	<i>Cell division – misunderstanding of terms diploid and haploid, specific teaching of this vocabulary. Haploid cells contain $\frac{1}{2}$ genetic information or one set of chromosomes/no-pairs and vice versa.</i>
		that extinction is permanent loss of all members of a species.	extinct, predators, climate change, disease, environmental change, catastrophic events	<i>Cell division processes – mitosis/meiosis diagrams often mis-drawn/misinterpreted by learners.</i>
		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>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> For meiosis For mitosis <i>Important scientists, learners often confuse their work.</i> <i>Mendel – characteristics determined and passed on in 'units'. Lamarck – changes that occur during an 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>

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 need to be moved quickly around the body in the blood by	 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	cell, tissue, aggregation, organ, organ system, organism.	a) Subject specific skills Practical skills (RP5) – enzymes effect of a known variable on enzyme activity e.g., pH/temperature. Recognising the different types of blood cell from photographs. Practical skills- observing and drawing stomata or blood cells under a microscope. Practical skills (RP4) – qualitative food tests. b) Numeracy Calculating rates from enzyme reactions. Expressing data in standard form Understanding of size and scale of in relation to cells, tissues, organs, and systems. Interpret data relating to risk factors for specific diseases. c) Literacy and d) Reading Using stimulus material to evaluate the use of heart valves from biological and mechanical sources. Reading – artificial hearts page 59 AQA Biology text. d) Cultural capital links Dr William Beaumont discovery and importance of digestive enzymes. https://bit.ly/2VI2Wlf
		that tissues in the plant leaf include epidermal, palisade, mesophyll, xylem, and phloem.	epidermal, palisade, mesophyll, xylem and phloem, root, stem, stomata.	
		that enzymes catalyse specific reactions in cells. that enzyme models can be used to explain enzyme action.	lock & key theory, enzyme, catalysts substrate, active site, complex, temperature, pH.	
		that digestive enzymes convert food into small soluble molecules which can be absorbed into the blood.	small, soluble, molecule, carbohydrases, proteases, lipases, active site, catalyst, enzyme-substrate complex.	
		how to investigate the effect of pH on enzyme reactions.	pH, amylase, rate, digest, starch, enzyme, substrate.	
		how to carry out qualitative food tests for carbohydrate, fat and protein.	iodine, biuret solution, benedict's solution, ethanol, qualitative test.	
		that bile is made in the liver and stored in the gall bladder that bile assists with fat digestion and neutralises stomach acid.	bile, alkaline, liver, emulsify, droplets, surface area, rat, lipase.	
		that the heart pumps blood around the body in a double circulatory system.	atria, ventricles, aorta, pulmonary artery, vena cava, pulmonary vein, pacemaker, double	

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 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.	circulatory system/pump.	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 https://www.bbc.co.uk/bitesize/guides/z372ng8/revision/2 e) Graph reading skills Graphical analysis of data, frequency tables, bar charts and histograms. Plot graphs using appropriate scales for axes. f) 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</i>
		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 valve, mechanical valve, 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.	<i>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>
		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.	<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>