George Stephenson High School Unit Overview

Unit: B1- Transport and Enzymes	Number of Lessons: 12
• Students must know the process of diffusion, osmosis and active transport • Students must be able to carry out and make conclusions from practical work on the principles of osmosis • Students must be able to predict outcomes of practical work on osmosis • Students must be able to calculate percentage change • Students must know the factors affecting the rate of diffusion • Students must know the uses of diffusion in humans and plants • Students must understand the concept of surface area to volume ratio and be able to calculate this • Students must know the adaptations that alveoli have in order to increase the rate of diffusion in the lungs • Students must know what an enzyme is and its function • Students must know how enzymes carry out their function using the terms 'substrate' and 'active site' • Students must know the names of basic enzymes used in human digestion • Students must know the factors affecting enzyme activity	**Progression** **Links to FUNDAMENTALS UNITS:** • Cells • Diffusion • Energy **Links to ESTABLISHING UNITS:** • Body systems (enzymes) • Body systems (digestive) • Photosynthesis and **respiration** • Reproduction and health **Future links and progression onto KS4 UNITS** • Cells (B)- cell membrane and diffusion • DNA and Genetic Engineering (B)- enzymes in DNA replication/GE/DNA extraction • Signalling and Control (B)- diffusion of hormones • Non-communicable diseases (B)- diseases affecting the lungs • Fuels and Hydrocarbons (C)- Catalysts

Possible Key Learning Points	Skills	Prerequisites
- Diffusion is particles moving from high to low concentration (osmosis is water) - Active transport is particles moving from low to high conc. and requires energy - Predict outcomes of practical work on osmosis - How to calculate percentage change - The factors affecting the rate of diffusion - Uses of diffusion in humans and plants - How to calculate surface area to volume ratio - Adaptations that alveoli have in order to increase the rate of diffusion in the lungs - What an enzyme is and its function - Enzymes action using the terms 'substrate' and 'active site' - The names of basic enzymes used in human digestion - The factors affecting enzyme activity	**Key Skills Developed:** - Literacy- to understand and be able to use new vocabulary effectively - Oracy- communicate with others effectively during group discussions - Oracy- use oracy skills to develop and explore new ideas - Numeracy- measuring lengths - Science/Numeracy- calculate percentage change - Science/Numeracy- calculate surface area to volume ratio - Science (practical)- compare the effects of different concentration solutions on osmosis - Science/Numeracy- predict where water will move using principles of concentration - Science (practical)- investigate the factors affecting enzyme action	**Students should already:** - Know that cells have a cell membrane that allows only certain molecules through - Know that diffusion is the "spreading out" of molecules rom high to low concentration - Know that the lungs have a large surface area - Understand that energy can be transferred - Know that the body has different systems- including digestive - Know that enzymes break substances down - Know some enzymes of the digestive system - Know the process of enzyme action and some of the factors affecting enzyme action - Hold basic numeracy skills- including interpreting a graph - Have key literacy skills such as suitable reading age - Be aware of the purpose of the curriculum and its links with Y8 Establishing and KS4 (progression)
Subject Specific Language	Pedagogical Notes	Make it Stick Activities

- Diffusion / osmosis / active transport - Concentration (gradient) - (partially permeable) membrane - Surface area / temperature - Kinetic energy - Alveoli / intestine / villi / adaptation - Surface area / volume / ratio - Diffusion distance - Respiration - Enzyme - Digestion - Active site / substrate / lock and key - Enzyme substrate complex - Carbohydrate / lipid / protein - Amino acid / glucose / fatty acid / glycerol - Amylase / lipase / protease - pH / temperature / denature	Students will have learned about cells (the cell membrane), energy and diffusion during ***FUNDAMENTALS*** and should have good knowledge of the language to use. Here there should be links drawn to the ***Cells*** topic- specifically the fact that cells have a cell membrane. There should be links made to the cell membrane and the diffusion of substances in/out of the cell. Students will likely need reminders about the key language to use when talking about diffusion and have not encountered the terms osmosis or active transport before. It should be highlighted that osmosis is a specific type of diffusion. Students will likely struggle during the osmosis core practical, there are a lot of steps to follow. Having 1 group conduct an experiment in each concentration solution may speed things up. The importance of calculating a percentage change should also be highlighted here. Links can be made to the ***Respiration and Photosynthesis*** topic; it should be highlighted that oxygen required for respiration diffuses into the blood in the lungs, and into the cells around the body and vice versa for carbon dioxide. The link to surface SA;Vol ratio should also be highlighted. This could also be linked to the ***Reproduction and Health***, referring to diseases affecting the lungs (also ***KS4- Non-Communicable Diseases***). The alveoli topic links all the information on increasing diffusion rates and SA:Vol ratio. In the ***Body systems*** topic from ***ESTABLISHING*** students will have covered the principles of enzymes (including structure, function and names of enzymes). This topic goes into much more detail, requiring students to know that enzymes are proteins (made from amino acids), the products of digestion and describe the process of denaturing. Students must also know the factors that can affect an enzyme's activity and describe enzymes as biological catalysts. Students will likely think that a lack of an enzyme will stop a reaction from taking place- it should be highlighted that a lack of an enzyme will lead to a slower reaction. Students will likely struggle with the vast terminology and key vocabulary in the lessons covering the immune system and phagocytosis- glossaries or working through definitions together may help with the stickability. This topic is essential for further KS4 topics. **<u>Assessments:</u>** - **Live marking of student work throughout unit** - Plenary's at the end of every lesson - Questioning- verbal and written - End of topic assessment: 30 Mark Total 1. Quizlet Flashcards (AO1) – PA 2. Seen Applications Questions (AO2/3) – PA 3. Unseen Application Questions (AO2/3) – TA	Tips for Teachers to Help Learning 'Stick' • Active learning methods: See suggested activities for detail • 'Desirable difficulties': Extension questions, questioning • Feedback: live-marking, questioning, home learning (SA FHL), EoT tests- SA/TA • Testing: AO1 questions as starters, questioning, plenary questions, plenary activities (**beat the teacher, conclusion making, redraft, "3,2,1", exam questions, gap fill, storyboard)** • Reflection/elaboration: class discussions, SA, DIRT • Interleave: cells. Body systems, diffusion, photosynthesis and respiration, reproduction and health

Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions

- What could this lesson be on? - What is diffusion / osmosis? - How are diffusion and osmosis similar / different? - What is different about active transport? - Why might we need to calculate % change rather than just look at the end size? - Why might the size and mass of the potato change? - What might cause diffusion to happen faster or slower? Why? - Why would "X" cause it to go faster? - Where in the body might diffusion take place? - Why does is having a large SA:Vol ratio be beneficial? - Why do larger organisms need lungs? - What adaptation might alveoli have to speeding up the rate of diffusion? - What is the function on an enzyme? - Why are enzymes useful? - What might happen if an enzyme no longer works? - What are enzymes made of? - Where does the reaction take place? - What do enzymes release at the end of a reaction? - How might enzymes be used in digestion? - Why do we need to digest food? - What factors might affect enzyme activity? - Why does denaturing lead to a slower reaction? - Would a reaction stop if the enzyme was denatured?	- ***Figuring out the topic*** from a video allows students to make their own links to prior learning. The ***rearrange the definition*** activity allows students to process the definition (that they should already know) more deeply; the same is true for predicting the definitions activity. ***Back to back*** ensures students are focussed when copying a diagram (deeper processing). ***Answering questions*** from a video promotes engagement. ***Beat the teacher*** allows both students and teacher to see any misunderstandings/misconceptions - ***Osmosis core practical*** allows students to practise the skills they may be questioned on in exams. Questions assess prior learning whilst the ***producing a*** model allows for the embedding of the principle of active transport. - ***Writing a method*** as a starter will allow students recall the previous lesson and practise the exam skill of method writing. ***Calculating the % change*** allows students to practise this skill and the analyse the results from the practical. ***Graph drawing*** will allow students to analyse how the concentration of solution affects osmosis. ***Concluding from the graphs*** practises the exam skill. - ***Definition writing*** as a starter ensures students are recovering/retaining their prior learning. ***Demonstration*** allows for students to see how different factors affect diffusion, without taking a full lesson. ***Redrafting*** allows students to practise writing an exam style answer whilst also gaining feedback. - ***Pictures into words*** enables students to write a definition for diffusion with support already given. ***Information gathering*** allows students to work together to understand a lot of complex information. ***Questions requiring linking of learning*** allows students to think about the adaptations of cells/organs to increasing the rate of diffusion. The ***3,2,1*** plenary then tests this. - ***Calculations*** ensures that students have the skills needed for this lesson. ***Teacher demonstration*** then gives students the opportunity to see how to calculate SA:Vol ratio, before attempting this themselves. This is then linked to the need for lungs in larger organisms through questioning. Plenary ***exam style questions*** allows students to test their learning from the lesson. - ***Calculation starter*** allows testing of the previous lesson. There is then an opportunity for students to ***annotate a diagram*** after answering questions. The ***video*** about alveoli allows students to see how the alveoli help oxygen/carbon dioxide diffusion. ***Teacher explanations and questioning*** following the ***video explanation*** allows students to correctly understand why alveoli are important before explaining it in an exam question. - The ***describe a diagram*** allows students to explain enzyme action withou the demand of using key words. ***Teacher explanation*** followed by ***ordering information*** allows students to explain the process of digestion by an enzyme. The ***gap fill*** allows students to test their own knowledge of enzymes. Going back to the ***starter*** allows students understand their progress- as they can now use key terminology. - ***Match up*** reintroduces the idea of specificity whilst the ***gap-fill*** assesses students' prior knowledge. ***Teacher explanation*** of enzyme action allows students to ***develop their own explanations*** for the lock and key model. ***Drawing the process of digestion*** allows for the quick testing of their understanding of enzyme action and specificity before a ***storyboard plenary*** allows for more details to be added. - ***Beat the teacher*** allows students to highlight common misconceptions. ***Teacher explanation*** enables students to demonstrate the products of digestion by ***cutting up larger molecules and labelling the products. Exam questions*** tests student knowledge from the lesson. - ***Enzyme and pH core practical*** allows students to practise the skills they may be questioned on in exams. Whilst waiting during the practical, ***writing a method*** will allow students to practise the exam skill of method writing; ***analysing data*** is included for the same reason. - The ***rearrange the words*** activity allows students to begin to develop and understanding of the results from the practical. The ***group discussion*** gives students an opportunity to reason with peers as to the factors affecting enzyme action. **Teacher explanation** enables students to understand why an enzyme may not work as well but the ***information finding*** activity allows students to understand WHY this occurs for themselves.	- Osmosis is not diffusion - Movement of particles stop at equillibrium - Diffusion requires energy - All organisms have lungs - Enzymes die when they denature - Without enzymes, a reaction stops - "Enzymes break down food which is used in digestion" as opposed to breaking down = digestion

George Stephenson High School Unit Overview

Unit: KS4 Y10 B3 Biology Combined Science: DNA & Genetic Engineering	**Number of Lessons:** 13
Key Principles 3.4 Describe DNA as a polymer made up of: a two strands coiled to form a double helix b strands linked by a series of complementary base pairs joined together by weak hydrogen bonds 3.5 Describe the genome as the entire DNA of an organism and a gene as a section of a DNA molecule that codes for a specific protein 3.6 Explain how DNA can be extracted from fruit 3.12 Explain why there are differences in the inherited characteristics as a results of alleles 3.13 Explain the terms chromosome, gene, allele, dominant, recessive, homoxygous, heterozygous, genotype, phenotype, gamete and zygote 3.14 Explain monohybrid inheritance using genetic diagrams, Punnett squares and family pedigrees 3.15 Describe how the sex of offpsiring is determined at fertilisation using genetic diagrams 3.16 Calculate and analyse outcomes (using probabilities, ratios and percentages) from monohybrid crosses and pedigree analysis for dominant and recessive traits 3.19 State that most pheotypic features are the result of multiple genes rather than single gene inheritance 3.21 Discuss the outcomes of the human genome project and its potential applications within medicine 4.10 Describe genetic engineering as a process which involves modifying the genome of an organism to introduce desirable characterisitcs	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** - Recall that humans and animals have offspring which grow into adults - Recognize that living things all produce offspring of the same kind, but normally offspring vary and are not identical to their parents **At KS3 Pupils should already have been taught to:** - **Y7 Fundamentals Cells** - Recall the main organelles of plant and animal cells and recognise that the nucleus controls the cell and stores its genetic information (DNA) - **Y8 Establishing Reproduction and Health** - Understand that sexual reproduction involves the passing on of genes via gametes onto offspring during fertilisation - **Y9 Establishing Evolution and Genetics** - Complete monohybrid inheritance Punnett squares - Recall that the role of DNA is to code for proteins - Describe the basic structure of DNA - Relate DNA to genes and chromosomes - Understand that variation arises through mutation, - Can relate the role of mutations to natural selection and extinction - Recall the two types of variation: continuous and discontinuous

4.11 HIGHER TIER **Describe the main stages of genetic engineering including the use of:** **a restriction enzymes** **b ligase** **c sticky ends** **d vectors** 4.14 Evaluate the benefits and risks of genetic engineering and selective breeding in modern agriculture and medicine, including practical and ethical implications	**Future links and progression onto other KS4 UNITS** - **B1 Transport and Enzymes** - Enzymes in Genetic Engineering - **B2 – Cells** - Cell Structure and Specialized Cells (Gametes) - Stem Cells and Ethics - Growth in Plants and Animals - **B4 – Cell Cycle and Variation** - Mitosis and Meiosis - Genetic Variation, Cancer and Mutation - Evolution and Natural Selection - Selective Breeding - Genetic Analysis and Classification - **B7 Signaling and Control / B5 Non-Communicable Diseases** - Hormones and Diabetes - **C5 Acids** - Solubility and Precipitation **Progression onto KS5 Biology requires an in-depth understanding of Mathematics, Cell Biology, Gene Technologies and Genetics**

Possible Key Learning Points	**Skills**	**Prerequisites**
Key Learning Principles - Outline the general structure of DNA - Describe the complementary base pairing rules of DNA - Understand the relationship between the genome, chromosomes, genes and DNA - Describe practically how DNA could be extracted for fruit	**Key Skills Learnt** - Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Draw tables of results and produce suitable graphs to display data - Formulate conclusions based on evidence collected	**Students should already:** - Be aware of basic laboratory safety - Hold basic numeracy skills such as negative numbers, ratios, percentages, probabilities, using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply) - Have key literacy skills such as suitable reading age

- Explain how inheritance works using homo/heterozygous alleles - Understand how genotype and phenotype are determined via dominant and recessive alleles - Use Punnett squares and family pedigree charts to calculate probabilities with inheritance - Describe how sex is determined using Punnett square analysis - Outline the common types of genetic disorders and their inheritance including the role of carriers - Describe how the Human Genome project has caused advances in gene technologies - Describe how genetic engineering works **with reference to the enzymes involved** - Outline the role of medical ethics in genetic engineering - Begin to explore careers in genetics and biotechnology **Interleaving:** Y7 Fundamentals Cells Y8 Establishing Reproduction and Health Y9 Establishing Evolution and Genetics KS4 B2 Cells KS4 B4 Cell Cycle and Variation C5 Acids	- Numeracy: use and calculate probabilities, percentages and ratios - Develop fine motor skills and practical safety when using lab equipment - Improved logic and problem-solving skills - Teamwork and communication in practical work - Independent learning during research-based home learning - Begin to reflect on the issues arising from medical ethics and research	- Be aware of the purpose of the curriculum and its links with Y7 Fundamentals, Y8/9 Establishing and KS4 - Recall the main organelles of plant and animal cells and their function - Understand that sexual reproduction involves the passing on of genes via gametes onto offspring during fertilisation - Complete simple monohybrid inheritance Punnett squares - Be able to relate DNA to protein production - Describe the basic structure of DNA - Relate DNA to genes and chromosomes - Understand that variation arises through mutation - Can relate the role of mutations to natural selection and extinction linking to Darwin's Finches - Recall the two types of variation: continuous and discontinuous and give examples

Subject Specific Language	Pedagogical Notes	Make it Stick Activities
DNA (Deoxyribonucleic Acid) Nucleus Cell Chromosome Base / Nucleotide Gene Genotype Phenotype Double Helix Hydrogen Bonds A T C G Phosphate Complementary Base Pairing RNA (Ribonucleic Acid) Amino Acid Ribosome Protein Extraction Punnett Square Extraction Buffer Ethanol Filtration Precipitation Inheritance Alleles Heterozygous / Homozygous Carrier Dominant / Recessive Monohybrid Gamete Zygote Genome X and Y Chromosomes Family Pedigree Charts Genetic Disorder Cystic Fibrosis Polydactyly	Following on from Y9 Establishing Evolution and Genetics students will arrive at GCSE with a good foundation the key terminology used in this topic; however this will need further development and reinforcing throughout the topic. Students generally find genetics quite a simple topic to "understand"; however, often answer exam questions poorly, regularly using incorrect terminology and making simple errors. It is also a frequent examiner choice for evaluation questions especially surrounding medical ethics which will need much practice and debate. Genetics can be a difficult topic at first due to the overwhelming array of complex terminology and definitions which can be easily confused (e.g. heterozygous and homozygous); therefore I encourage regular use of mini-quizzes and terminology / definitions tests (see 'make it stick' activities). I find students enjoy completing Punnett Squares meaning it is a good way to increase pupil's confidence with "Biology Maths". This module contains one practical's extracting DNA from fruit. I find Strawberry or Kiwi works best. Make it very clear regarding the CLEAPPs safety surrounding Ethanol and encourage pupils to do this step very slowly at a 45 degree angle for the best results. Interleave solubility, precipitation and separation techniques here.	Tips for Teachers to Help Learning 'Stick' • Modeling of DNA • Flipped Home Learning • Quick Quizzes • Mini-Plenaries • DNA → RNA → Proteins Drama Activity • 6 Mark Question Practice / KATs • DNA Extraction Practical • Cartoon Caption Making • Plus Minus Interesting • Key Word Bingo • Give one Get one • Flash Card Making • SA/PA • IPads Sole Activity • Doctor Role Play • BUSK Technique for 6 Markers • True or False • Marketplace Genetic Engineering • 5Ws 1H • Storyboarding • Debating • Opinion Line • Chili Challenge

Human Genome Project Genetic Engineering GMO & GM Crop Hybridization Diabetes / Insulin Restriction Enzymes Ligase Sticky Ends Recombinant Plasmid Ethics	As mentioned previously it is greatly beneficial to spend a good amount of time developing pupil's opinions with medical ethics via debates. I recommend trying the DNA modelling lesson as this seems to be something pupils remember easily as it is tangible. **<u>Assessments:</u>** **Frequency in-class Live Marking throughout Unit** **Key Assessed Task** Three options: - Lesson 1/2: Describe the structure of a molecule of DNA - Lesson 7: Evaluate the medical applications of the human genome project - Lesson 9 [Recommended Formal KAT]: Student Choice Chili Challenge 1) Extra Hot: Compare and contrast selective breeding and genetic engineering 2) Hot: Evaluate the use of genetic engineering 3) Mild: Describe how genetic engineering is used to mass produce human insulin I recommend doing all 3 at some point during the scheme but reserving the differentiated KAT during lesson 9 and using the others as a SA/PA exam questions. The TA KAT is to be marked *via* coded-marking and feedback to be completed by students in green pen. This assessment is vital in ensuring all pupils understand the key learning outlined at KS3/4.	

	End of Topic Assessment Lesson 10 35 Mark Total - Section 1: Quizlet Flashcards (AO1) – 15 Marks (PA) - Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) - Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA)	
Reasoning opportunities and probing questions	Suggested Practical Activities	Possible Misconceptions
How is genetic engineering different / similar to selective breeding What is the percentage change of a parent have a boy with [_____] trait? Evaluate the HGP Evaluate the use of GMOs / GM Crops in society Would you screen your child for genetic disorders if it was free? What would you decide to do if? Do you agree with the idea of creating 'designer babies'? Why do you think DNA is shaped in a double helix? Are all mutations bad? Why not? How much of your personality (or appearance) is determined by nature vs. nurture? Why do siblings / twins not look identical? Should clones be produced? Why is it useful for genealogist to study ancestral family pedigree charts? How many different combinations of bases can be formed by one triplet? A typical gene is 300 amino acids in length? How many bases does it likely contain?	- DNA Extraction from Fruit - DNA Modeling - Solubility and Filtration Review (e.g. KI and PbNO3 demo)	Genes are responsible for all traits All traits are the product of a single gene Dominant traits are always the most common All mutations are bad If a couple has a 25% of giving birth to a child with a genetic disorder and the 1st born expresses this genotype then the next 3 children are born "risk free" DNA & only applies to humans not plants and other living things Clones will look 100% identical (no environmental factors) A gene and an allele are the same The 'X' and 'Y' chromosome are X and Y shapes The genes decoded in the HGP are from one person Brothers and sisters inherit the same genes as they have the same parents You have 25% of your grandparents genes.

If there are 20 different amino acids in the human genome. How many possible different polypeptides could be formed from a gene containing 18 bases?		

George Stephenson High School Unit Overview

Unit: KS4 Y10 B4 Biology Combined Science: Cell Cycle and Variation	**Number of Lessons:** 14
Key Principles 2.1 Describe mitosis as part of the cell cycle, including the stages: interphase, prophase, metaphase, anaphase, telophase and cytokinesis 2.2 Describe the importance of mitosis in growth, repair and asexual reproduction 2.3 Describe the division of a cell by mitosis as the production of two daughter cells each with identical sets of chromosomes in the nucleus to the parent cell and that this results in the formation of two genetically identical diploid body cells 3.3 Explain the role of meiotic cell division, including the production of four daughter cells each with half the numer of chromosomes and that this results in the formation of genetically different haploid gametes [*the stages of meiosis are not required*] 3.4 Describe cancer as the result of changes in cells that lead to uncontrolled cell division 3.22 State that there is usually extensive genetic variation within a population of a species and that these arise through mutations 3.23 State that most genetic mutations have no effect on the phenotype, some mutations have a small effect on the phenotype and, rarely, a single mutation will significantly affect the phenotype 4.2 Explain Darwins theory of evolution by natural selection 4.3 Explain how the emergence of resistant organisms supports Darwins theory of evolution including antibitic resistance in bacteria 4.4 Describe the evidence for human evolution, based on fossils, including: a Ardi from 4.4 million years ago	**The Big Picture (Progression): At KS2 pupils should already have been taught to:** - Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals - Explore and compare the differences between living things and categorize these based on their common observable similarities and differences with reasons - Identify that most living things live in habitats to which they are suited - Notice that animals have offspring which grow into adults - Explore and use classification keys to help group, identify and name a variety of living things - Recognize that environments can change and this can pose dangers to living things - Recognize that living things have changes over time and that fossils provide information about living things that inhabited Earth millions of years ago - Recognize that living tings produce offspring of the same kind, but normally offspring vary and are not identical to their parents - Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution

b Lucy from 3.2 million years ago c Leakey's discovery of the Turkana Boy from 1.6 Million years ago 4.5 Describe the evidence for human evolution based on stone tools, including: a the development of stone tools over time b how these can be dated from their environment 4.7 Describe how genetic analysis has led to the suggestion of the three domains rather than the five kingdoms clasification method 4.8 Explain selective breeding and its impact on food plants and domesticated animals	**At KS3 Pupils should already have been taught to:** - **Y7 Fundamentals Cells** - Recall the main organelles of plant and animal cells and recognise that the nucleus controls the cell and stores its genetic information (DNA) - **Y7 Fundamentals Environmental Biology** - Define adaptation and explain how different organisms are adapted to different environments to help them survive - Understand the process of extinction due to changes in the environment - Understand that organisms of the same species and between species display variation - Compare and identify examples of continuous and discontinuous variation - Compare and identify examples of genetic and environmental variation - Recognise that variation is the result of genetic mutations - Describe and explain Darwin's Theory of Evolution by Natural Selection through examples such as Darwin's Finches and Peppered Moths - **Y8 Establishing Reproduction and Health** - Understand that sexual reproduction involves the passing on of genes via gametes onto offspring during fertilisation in both plants and animals - Recognise that cross-breeding and hybridisation sometimes occurs

	- **Y9 Establishing Microbiology** - Recognise that bacteria resistance to antibiotics can occur - **Y9 Establishing Evolution and Genetics** - Complete monohybrid inheritance Punnett squares - Recall that the role of DNA is to code for proteins - Describe the basic structure of DNA - Relate DNA to genes and chromosomes - Understand that variation arises through mutation, - Can relate the role of mutations to natural selection and extinction - Recall the two types of variation: continuous and discontinuous **Future links and progression onto other KS4 UNITS** - **B2 – Cells** - Cell Structure and Specialized Cells (Gametes) - Stem Cells and Ethics - Growth in Plants and Animals - **B3 – DNA & Genetic Engineering** - DNA Structure - Inheritance - Sex Determination - Human Genome Project - Genetic Engineering - **B5 Non-Communicable Diseases** - Non-Communicable Diseases and Cancer - **B6 Communicable Disease** - Investigating Antibiotics and Resistance - **B7 Signaling and Control** - Ethics and Stem Cells

	- **B9 Ecosystems and Material Cycles** - Ecosystem Theory Niches and Adaption - Human Impact and Biodiversity - **C4 Fuels an Hydrocarbons** - Fossil Fuel Formation **Progression onto KS5 Biology requires an in-depth understanding of Mathematics, Cell Biology, Evolution, Gene Technologies and Genetics**

Possible Key Learning Points	**Skills**	**Prerequisites**
Key Learning Principles - Outline the stages of the cell cycle including the stages of mitosis - To understand how cancer and its treatment relate to the cell cycle - Describe meiosis and the role of gametes - Compare mitosis and meiosis - Describe the different types of variation (genetic / environment vs. continuous / discontinuous) - Understand the role of mutations in genetics - Explore some of the factors which cause mutation and variation - Describe and explain Darwin's Theory of Evolution by Natural	**Key Skills Learnt** - Literacy / Oracy: To understand and use new unit specific vocabulary effectively - Draw tables of results and produce suitable graphs to display data - Formulate conclusions based on evidence collected - Compare and contrast different scientific processes - Basic Latin used in classification - Numeracy: use of dates - Improved logic and problem-solving skills - Teamwork and communication	**Students should already:** - Be aware of basic laboratory safety - Hold basic numeracy skills such as negative numbers, ratios, percentages, probabilities, using a calculator and competency with simple mathematical processes (add, subtract, divide, multiply) - Have key literacy skills such as suitable reading age - Be aware of the purpose of the curriculum and its links with Y7 Fundamentals, Y8/9 Establishing and KS4 - Recall the main organelles of plant and animal cells and recognise that the nucleus controls the cell and stores its genetic information (DNA) - Define adaptation and explain how different organisms are adapted to different environments

Selection and the evidence behind it - Compare Darwin's theory to opposing theory's such as Lamarck's - Give evidence to support Darwin's theory of evolution including antibiotic resistance, tools and fossils - Outline the different classification systems used throughout history including the binomial method for naming organisms - Describe the process of selective breeding and its impact of agricultural crops, livestock and domesticated animals **Interleaving:** Y7 Fundamentals Cells Y7 Fundamentals Environmental Biology Y8 Establishing Reproduction and Health Y9 Establishing Evolution and Genetics Y9 Establishing Microbiology KS4 B2 Cells KS4 B3 DNA and Genetic Engineering KS4 B5 Non-Communicable Diseases KS4 B6 Communicable Diseases KS4 Signally and Control KS4 B9 Ecosystems and Material Cycles KS4 C4 Fuels and Hydrocarbons	- Independent learning during research-based home learning - Begin to reflect on the issues arising from medical ethics of selective breeding - Awareness of poor lifestyle choices and its impact on long term health	to help them survive - Describe and explain Darwin's Theory of Evolution by Natural Selection through examples such as Darwin's Finches and Peppered Moths - Understand that sexual reproduction involves the passing on of genes via gametes onto offspring during fertilisation in both plants and animals - Recognise that cross-breeding and hybridisation sometimes occurs - Recognise that bacteria resistance to antibiotics can occur - Complete monohybrid inheritance Punnett squares - Recall that the role of DNA is to code for proteins - Describe the basic structure of DNA - Relate DNA to genes and chromosomes - Understand that organisms of the same species and between species display variation which arises through mutation giving examples of genetic and environmental variation as well as continuous and discontinuous variation - Can relate the role of the environment and mutations to natural selection and extinction

Subject Specific Language	Pedagogical Notes	Make it Stick Activities
Mitosis Division Cell Cycle Interphase Prophase Metaphase Anaphase Telophase Cytokinesis Growth Haploid Diploid Gametes Nucleus Chromosomes DNA Genes Allele Zygote Daughter Cells Meiosis Homologous Crossing-Over Centromere Codon Amino Acid Protein Cancer Mutation Tumor Darwin Natural Selection Survival of the Fittest Lamark Species Common Ancestor Acquired Characteristics	Following on from Y9 Establishing Evolution and Genetics students will arrive at GCSE with a good foundation the key terminology used in this topic; however this will need further development and reinforcing throughout the topic. Students generally find genetics and evolution quite a simple topic to "understand"; however, often answer exam questions poorly, regularly using incorrect terminology and making simple errors. It is also a frequent examiner choice for 6 mark which will need much practice. Spend some time focusing on comparing mitosis and meiosis which is a frequent stumbling block for students. As well as real world examples of natural selection and evolution. Genetics can be a difficult topic at first due to the overwhelming array of complex terminology and definitions which can be easily confused (e.g. mitosis and meiosis); therefore I encourage regular use of mini-quizzes and terminology / definitions tests (see 'make it stick' activities). Students may arrive into some lessons with a number of misconceptions which often need to be addressed (especially in evolution – see misconceptions). This often results in poor superficial response to exam questions. Therefore continue to practice these throughout. The reason this module contains selective breeding is to allow for simple comparison between this artificial form of selection and	Tips for Teachers to Help Learning 'Stick' • Flipped Home Learning • Card Sorts • Oracy Activities • Sticky Note Challenge • Think Pair Share • 3 Wise Monkeys • Storyboard • Venn Diagrams • Words to Pictures • Graph Drawing for Variation • Bingo • Plus Minus Interesting • Pens in Pots • IPads Research • Letter to Parliament • Marketplace • Double Bubble • Evolution Chopsticks Game • Google Your Brain • What animal am I? Game • Challenge Wall (Actor, Philosopher, Fortune-Teller) •

Adaption Variation Competition Predator / Prey Offspring Fossils Lucy / Ardi / Turkana Boy Decay Hominid *Homo sapian* Evolution Stratigraphy Carbon Dating Antibiotic Resistance MRSA Classification Binomial Phylogeny Taxonomy / Taxonomist Domain / Kingdom / Phylum / Class / Order / Family / Genus / Species Eukarya / Archaea / Eubacteria Prokaryotes / Protists / Fungi Vertebrate / Invertebrate Mammal / Bird / Fish / Reptile / Amphibian Selective Breeding Domestication Artificial Selection Desirable Characteristics Generation Cross-Breeding	the natural selection of Darwinism. Potential for a high level 6MQ here? Rely on acronyms such as IPMAT-C for the cell cycle and PMAT-C for mitosis. This module contains required practical work; however, some interesting practical's can be included such as the evolution chopsticks game (see DJN for details). **<u>Assessments:</u>** **Frequency in-class Live Marking throughout Unit** **Key Assessed Task** Four options in Natural Selection Lesson 2 – Self Differentiated: - <u>Extra Hot Challenge</u>: Flamingos feed on organisms that live in mud at the bottom of lakes. Leopards prey on flamingos. Flamingos find it difficult to fly away from predators if their feathers get wet so consequently Flamingos have evolved very long legs. - Compare the theories of Darwin and Lamarck and explain the evolution of these long legs (6 marks) - <u>Hot Challenge:</u> Using Charles Darwin's theory of evolution predict how a change in the weather *could* alter the shape of finch beaks over successive generations and explain why this change would occur (6 marks) - <u>Mild Challenge:</u> Using Charles Darwin's	

	theory of evolution explain why on an island populated with mostly hard shelled nuts and fruits, finches with wide, sharp, round beaks were more often found (6 marks) - <u>Extra Mild Challenge</u>: Using Charles Darwin's theory of evolution explain why following many periods of very cold icy winters Highland Cattle (cows) gained longer and longer fur (6 marks) I recommend doing all 3 at some point during the scheme but reserving the differentiated KAT during lesson 9 and using the others as a SA/PA exam questions. The TA KAT is to be marked *via* coded-marking and feedback to be completed by students in green pen. This assessment is vital in ensuring all pupils understand the key learning outlined at KS3/4. **End of Topic Assessment Lesson 10** 35 Mark Total - Section 1: Quizlet Flashcards (AO1) – 15 Marks (PA) - Section 2: Seen Applications Questions (AO2/3) – 10 Marks (PA) - Section 3: Unseen Application Questions (AO2/3) – 10 Marks (TA)	

Reasoning opportunities and probing questions	Suggested Practical Activities	Possible Misconceptions
What are the stages of the cell cycle? What does IPMAT-C stand for? Compare mitosis and meiosis Evaluate mutations in living things What evidence do we have for human evolution? Why did it take such a long time for the process of evolution by natural selection to be accepted by the scientific community? How is it possible for a scientist to believe natural selection but also be religious? How is selective breeding similar to evolution by natural selection? Evaluate the current model of classification? Where would you place the Platypus in the current model for classification? Why? How do you explain the evolution of the [_____] to have [_____]? (e.g. Zebras & stripes) Does the influenza virus provide evidence for or against evolution as it is classified as non-living? Why is variation among a species and between difference species important for an ecosystem? Without competition would evolution occur? In 10,000 years how do you think human beings will look / act? If a deadly disease or natural disaster hit the human population predict how would Evolution by Natural Selection change us in the short term and long term?	- **Evolution Chopsticks/Forceps Game** See PowerPoint for details - **Find the Smarties Game** How to Play: Take your students onto the field and throw 20 smarties into quadrat – count number and colours found in 60s. Discuss camouflage. Repeat by letting smarties "breed" by adding additional smarties of camouflaged colours (desirable traits) based on discussion. Repeat and discuss your results.	Genes are responsible for all traits All traits are the product of a single gene All mutations are bad A gene and an allele are the same Evolution is a theory about the origin of life Humans evolved directly from Apes Evolution only occurs slowly (….bacteria) Humans are not currently evolving Natural selection occurs as animals are 'trying' to adapt Natural selection always gives animals what the need 'Survival of the fittest' meaning those animals which are fittest in the literal sense Evolution is 'just' a theory Darwin invented evolution Evolution and religion are incompatible Evolution can only explain simple organisms If evolution as true why do Monkeys still roam the Earth The 2nd Law of Thermodynamics disproves evolution GMOs and GM Crops are bad Selective Breeding is always good All mammals walk on land Cancer is totally random and cannot be predicted Confusion between mitosis and meiosis Interphase is part of mitosis Interphase is a "resting phrase" All cells can do meiosis Mitosis will always produce genetically identical cells (mutations….) Meiosis daughter cells are genetically identical

Unit: KS4 B5 Non-Communicable Diseases	**Number of Lessons:** 10
Key Principles Students should begin the topic with a solid foundation of knowledge on humans as multicellular organisms introduced in KS3. Students should begin to conceptualise the phenomenon of the pathology of non-communicable diseases. Students should finish this unit competent in their knowledge of the definition and examples of non-communicable diseases, as well as the structure and function of the cardiovascular system and ultimately the pathology of diabetes and cardiovascular disease. Students should be able to apply numeracy skills to calculate cardiac output. Students should be able to apply scientific methodology to investigate the rate of respiration Introduction to careers surrounding diagnosis of disease.	**The Big Picture (Progression): At KS3 pupils should already have been taught to:** - Describe the structure and function of specialised cells, tissues, organs and organ systems - Describe and explain the process of circulation - Describe and explain the process of digestion - Recognise health as a state of being free from illness or injury - Recognise disease as a disorder of structure or function - Recognise pathogens as disease-causing microorganisms - Describe the transmission of communicable disease - Describe respiration as an exothermic chemical reaction - Compare aerobic and anaerobic respiration - **Links to other Combined Science Units** - **Biology:** - B1 – Transport and enzymes core principles - B2 – Cells - B3 – DNA and gnetic engineering - B4 – Cell cycle and variation - B6 – Communicable Diseases - B7 – Signaling and Control - **Chemistry:** - C1 Key concepts: chemical reactions - C2 Key concepts: chemical reactions - C9 Rates and equilibrium - C10 Chemical energy changes - **Physics:** - P5 Energy - **At KS5 students should go on to learn:** - Biological molecules - [Glycogen as a polymer of glucose, ATP as currency of energy, ATP uses] - Cells and microscopy - [Cell structure and specialization, magnification, transport across membranes, absorption] - Exchange - [Exchange in humans, pulmonary disease, haemoglobin, oxygen dissociation, heart and vessel structure, cardiac cycle, enzymes and digestion] - Genetic information and classification - [Genetic variation, mutation, adaptation, human activity, quantitative investigation] - Respiration and photosynthesis - [Respiration chemical process, respirometers and application] - Environmental Biology - [Energy transfer, environmental issues]

	- Survival and response - [Nervous coordination, neurological disorders, skeletal muscle contraction, homeostasis, diabetes] - Inheritance - [Codominance, sex-linkage, population genetics, natural selection] - Control of gene expression - [mutations, stem cells, DNA technology and treatment]

Possible Key Learning Points	**Skills**	**Prerequisites**
Key Learning Principles - Define health - Define disease - Define non-communicable disease - State examples of non-communicable diseases - Describe the components of blood - Describe the structure of blood vessels - Explain the structure of blood vessels - Describe the heart structure - Describe the double-circulatory system - Calculate cardiac output - Describe pathology of CVD - Explain effects of CVD on body - Suggest treatments for CVD - Define respiration - Compare aerobic and anaerobic respiration - Describe the changes in the human body during exercise - Explain the changes in the human body during exercise - Core practical: investigate temperature effect on rate of respiration **Interleaving:** • Y7 Energy • Y7 Cells • Y7 Diffusion • Y8 Body Systems • Y8 Reproduction and Health • Y9 Evolution and Genetics • B1 Transport and Enzymes	**Key Skills Learnt** - Literacy / Oracy: To understand, use and define new specific vocabulary effectively - Use and recall key units correctly - Use and convert between units accurately - Understand how to describe examples of disease as non-communicable - Describe and explain the structure and function of the circulatory system - Explain the pathology of cardiovascular disease with reference to respiration - Develop fine motor skills, practical safety and ethical considerations when dissecting and using living organisms - Develop practical methodology when investigating respiration - Teamwork and verbal literacy in collaborative activities such as pens in pots - Creativity when modeling - Draw tables of results and produce suitable graphs/charts to display data - Formulate conclusions based on evidence collected - Evaluation of positives and negatives to draw personal opinions - Calculate cardiac output as stroke volume x heart rate - Calculate rate as change/time - Draw bell-shaped curves of heart and breathing rate - Substitution of values to calculate and rearrange formula - Independent learning during research- based home learning	**Students should already:** - Be able to accurately describe the basic gross structure and function of human anatomy, including specialised cells, tissues and organ systems, including digestive, circulatory, muscular and skeletal - Be able to describe the gross structure and function of the double circulatory system and its vessels - Be able to recognise disease as disorder of structure and function - Be able to describe health as the absence of illness or injury - Be able to identify some microorganisms as pathogenic and disease-causing - Be able to compare the structure of animal, plant and bacterial cells - Be able to describe the transmission of communicable disease as spread of pathogens - Be able to recognise that not all diseases are caused by pathogens - Be able to recognise respiration as a chemical reaction which releases energy within most animal and plant cells - Be able to compare the similarities and differences between aerobic and anaerobic respiration - Be able to use key literacy skills to accurately and fluently apply KS3 scientific terminology - Hold developed numeracy skills and competency with more advanced mathematical processes, such as percentages, ratio, standard form, unit conversion, data analysis (mean, mode, median), probability - Be able to present data scientifically in results

• B2 Cells • B4 Cell Cycle and Variation • C1 Key concepts: chemical reactions • C2 Key concepts: chemical reactions • P5 Energy		tables and correct use of graphs and charts - Be able to interpret numerical data to describe relationships and draw conclusions - Be aware of the purpose of the curriculum and its links with KS3 and KS5 - Be aware of the links between KS4 and careers beyond KS4 and KS5
Subject Specific Language	Pedagogical Notes	Make it Stick Activities
Health Disease Communicable Non-communicable Transmit Atrium Ventricle Vena cava Pulmonary artery Pulmonary vein Aorta Tricuspid valve Bicuspid valve Pulmonary valve Aortic valve Vessel Vein Artery Capillary Plasma Platelet Red blood cell White blood cell Cardiovascular system Stents Bypass Statin Atherosclerosis Atheroma	Non-communicable diseases is a topic which relies heavily on prior understanding of gross anatomy and body systems beginning in KS2 and expanding through Y8 Body systems. Disease is a concept that students are innately aware of but have not studied the pathology of. It is highly recommended to revisit disease through contextual and career-based scenarios, extending throughout this scheme and subsequent schemes. A significant focus of the topic is on cardiovascular disease as a non-communicable disease, therefore building in deeper understanding of circulatory system structure and function from Y8 Body Systems. In contrast to KS3, students are now expected to be able to accurately and fluently use anatomical terms to describe structure and function of the cardiovascular system and its pathology. It is essential to continually reinforce accurate use of key terms and sizes through frequent low stakes assessment e.g. 6 AO1 starters and visual learning through modeling and dissection. Students may have emotional connections to this topic so bear this in mind. As the topic incorporates a lot of gross human anatomy, students tend to show a greater interest in what is happening in their own body when it is visible to the naked eye. We recommend using visual learning such as vessel modeling, heart dissections, reinforced with real life visuals and active learning throughout the scheme e.g. students measuring their own heart/breathing rate. Non-communicable diseases as a topic also includes lots of opportunities to develop 'good habits' as skills in Science, such as the difference between describing and explaining data, evaluating	Tips for Teachers to Help Learning 'Stick' • Short AO1 fact recall 'flashcard' questions throughout e.g. starter • Continuous interleaving of class targets/core principles into AO1 fact recall questions e.g. define 'non-communicable disease' • Focus on visual learning methods such as the heart dissection • Embed visual learning through use of device modeling • Continuous live-marking for immediate personal feedback, including stretch and challenge where appropriate • Create 'desirable difficulties' such as describing and explaining change in heart rate • Incorporate frequent, low stakes testing throughout, such as 'pens in pots' and 'hot seat' • Encourage collaboration and responsibility through strategies such as 'pens in pots' and 'hot seat' • Provide opportunities for elaboration, reflection after KAT and DIRT lesson after assessment • Explain to students how to troubleshoot their own problems. Don't do it for them – "Have you tried X?"

Arteriosclerosis Blood clot Cholesterol Plaque Respiration Aerobic Anaerobic Oxygen debt Lactic acid Respirometer Potassium Hydroxide Limestone Air pressure Rate	opinions or comparing, which has shown to be a downfall in previous examiner reports. We therefore recommend revisiting these skills habitually when possible e.g. describe breathing rate change, explain increase in respiration, evaluate CVD treatment, always make direct comparisons when comparing aerobic and anaerobic respiration. Students will likely struggle with the different curve gradients showing both an increase and decrease on the same curve. We recommend reinforcing routine, small steps when describing and explaining data e.g. include both variables, describe the entire curve, back up with data as seen in Y8 Body Systems. Although students will have experienced this at KS3, students will be ethically challenged to handle organs with focus and respect. We recommend following a provided method whilst focusing on small, achievable goals to promote progress and student engagement e.g. labels. As some students will not be mentally or physically capable of engaging with gross anatomy, it is highly recommended to prepare alternative work for elsewhere within the classroom. Non-communicable disease expands greatly on the concept of respiration as a chemical reaction, introduced in Y8 Respiration and Photosynthesis. This scheme focuses on factors which affect it and how it can be measured as a rate, which students may find challenging. We highly recommend incorporating a model of the respirometer for visual learning with frequent challenging of preconceived misconceptions through use of low-stake assessment e.g. Hot seat – explain why respiration is not breathing. **<u>Assessments:</u>** Continuous live-marking throughout, prioritizing key students. **Literacy Key Assessed Task possibilities:** Describe/explain the change in breathing/heart rate. This is a key area for assessment as the skills of describing and explaining data is fundamental to linking the circulatory system structure and function to respiration. It is a key skill and concept to understand, so repeat exposure should help secure learning for GCSE assessment.KAT can be marked with coded marking or whole class feedback and feedback by students completed in green pen **End of unit assessment** 20 flash cards to learn via quizlet/paper copies Seen application question used in class to ensure students understand concepts and to demonstrate modeling and decoding of the question (metacognition)	

	Final Assessment (30 marks) Section 1 – flash cards 10 marks (AO1) - PA Section 2 – seen application question 10 marks (AO2/3) - PA Section 3 – unseen application question (KAT to assess understanding of unit as a whole) 10 marks (AO2/3) - TA	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is a cell? What is a tissue? What is an organ? What is an organ system? Why do we need a circulatory system? Why do we need different types of valves? Why do arteries have thick walls? Why do veins have valves? Why are capillaries 1 cell thick? Do all organisms need blood? Why is the left side of the heart thicker? Why is the heart described as an organ? Why are humans considered to have a double-circulatory system? Why is blood made from more than just red blood cells? How do we separate the components of blood? Why might a person feel fatigued with anaemia or low red blood cell count? What causes CVD? Why are there different types of CVD? How might you treat CVD? What are the risks of treating CVD? What is respiration? Why do bacteria not have mitochondira? What is the difference between respiration and breathing? Why does your heart beat faster during exercise? Why do you breathe faster during exercise? Why do you continue breathing heavy after exercise? What type of respiration is needed for power lifting?	- 6 AO1 fact recall questions to start each lesson - Research into meaning of health and disease, as well as careers - Modeling blood components - Modelling of blood vessels - Modelling of circulatory system with post-it stepping stones - Paired evaluation arguments for and against treatments - Heart dissection with accurate use of labels - Investigation into effect of exercise on heart rate and breathing rate - Investigation into rate of respiration and effect of temperature	Communicable diseases must spread through the air All blood vessels are the same All organisms have blood All organisms have a heart Deoxygenated blood is blue Blood is just made from red blood cells Cardiovascular disease is inside the heart Respiration is breathing The woodlice such the fluid Faster breathing causes faster respiration All cells have mitochondira, including bacteria All cholesterol is bad Cholesterol can only come from food Disease is always physical Health is always physical

What type of respiration is needed for a marathon? How do you calculate rate? Why might temperature increase rate of respiration? How might you improve the investigation of respiration?		

Unit: KS4 B6 Communicable Diseases	**Number of Lessons:** 11
Key Principles Students should begin the topic with a solid foundation of knowledge on humans as multicellular organisms and pathogens as disease-causing microorganisms introduced in KS3. Students should also begin the topic with an understanding of health and disease from B6 – Non-Communicable Diseases. In this topic, students begin to conceptualise the phenomenon of the transmission, pathology and response to communicable diseases, including both the immune response and drug design. Students should finish this unit competent in their knowledge of the definition and examples of communicable diseases, as well as the sequence of events in leukocyte response and drug design to treat such communicable diseases. Students should develop scientific method and aseptic technique to investigate effectiveness of antibiotics on bacterial growth. Numeracy skills – calculating zones of inhibition areas Introduction to careers surrounding transmission and treatment of communicable disease.	**The Big Picture (Progression): At KS3 pupils should already have been taught to:** - Describe the structure and function of specialised cells, tissues, organs and organ systems - State the different types of pathogens - Recognise pathogens as disease-causing microorganisms - Recognise microorganisms as microscopic organisms - Describe basic transmission of communicable disease - Recognise health as a state of being free from illness or injury - Recognise disease as a disorder of structure or function - Recognise pathogens as disease-causing microorganisms - Recognise some drugs as treatment of disease - **Links to other Combined Science Units** - **Biology:** - B1 – Transport and enzymes core principles - B2 – Cells - B3 – DNA and genetic engineering - B4 – Cell cycle and variation - B5 – Non-communicable Diseases - B7 – Signaling and control - **Chemistry:** - C1 Key concepts: chemical reactions - C2 Key concepts: chemical reactions - C9 Rates and equilibrium - C10 Chemical energy changes - **Physics:** - P5 Energy - **At KS5 students should go on to learn:** - Biological molecules - [Glycogen as a polymer of glucose, ATP as currency of energy, ATP uses] - Cells and microscopy - [Cell structure and specialization, magnification, transport across membranes, absorption] - Exchange - [Exchange in humans, pulmonary disease, haemoglobin, oxygen dissociation, heart and vessel structure, cardiac cycle, enzymes and digestion] - Genetic information and classification - [Genetic variation, mutation, adaptation, human activity, quantitative investigation] - Respiration and photosynthesis - [Respiration chemical process, respirometers and application] - Environmental Biology - [Energy transfer, environmental issues]

	- Survival and response - [Nervous coordination, neurological disorders, skeletal muscle contraction, homeostasis, diabetes] - Inheritance - [Codominance, sex-linkage, population genetics, natural selection] - Control of gene expression - [mutations, stem cells, DNA technology and treatment]

Possible Key Learning Points	**Skills**	**Prerequisites**
Key Learning Principles - Define health - Define disease - Define communicable disease - State examples of communicable diseases - Describe the spread of pathogens - Explain how to prevent spread of pathogens - Describe the lifecycle of a virus - Define sexually transmitted infection - Describe how to prevent spread of sexually transmitted infections - Describe physical and chemical defences in plants - Describe the process of phagocytosis - Explain how white blood cells defend against infection - Describe the process of vaccination - Explain how vaccines make people immune to future infection - Describe how new medicines are developed - Explain the function of each step in designed medicines - Describe aseptic technique - Describe how to investigate antibiotic effectiveness **Interleaving:** • Y7 Energy • Y7 Cells • Y7 Diffusion • Y8 Body Systems	**Key Skills Learnt** - Literacy / Oracy: To understand, use and define new specific vocabulary effectively - Use and recall key units correctly - Use and convert between units accurately - Understand how to describe examples of disease as communicable - State examples of communicable diseases - Develop fine motor skills, practical safety and aseptic technique when investigating antibiotics - Numeracy skills when calculating zones of inhibition - Recognise why certain organisms/regions are more susceptible to communicable diseases - Recognise physical and chemical defences in specific organisms - Select specific treatments for specific communicable diseases - Teamwork and verbal literacy in collaborative activities such as pens in pots - Creativity when modeling scientific processes e.g. phagocytosis, antibody production, vaccination - Draw tables of results and produce suitable graphs/charts to display data - Formulate conclusions based on evidence collected - Evaluation of positives and negatives to draw personal opinions on vaccinations - Draw bell-shaped curves of antibody response to primary and secondary infection - Independent learning during research- based home learning	**Students should already:** - Be able to accurately describe the basic gross structure and function of human anatomy, including specialised cells, tissues and organ systems, including digestive, circulatory, muscular and skeletal - Be able to recognise disease as disorder of structure and function - Be able to describe health as the absence of illness or injury - Be able to identify some microorganisms as pathogenic and disease-causing - Be able to recognise microorganisms as living, microscopic, single-celled organisms - Be able to compare the structure of animal, plant and bacterial cells - Be able to describe the transmission of communicable disease as spread of pathogens - Be able to recognise that not all diseases are caused by pathogens - Be able to recognise organisms respond to infections with defences - Be able to recognise vaccinations as injections to keep us safe from infection - Be able to recognise methods to prevent spread of infection e.g. hand-washing - Be able to recognise some medications used for treating infections e.g. antibiotics - Be able to use key literacy skills to accurately and fluently apply KS3 scientific terminology - Hold developed numeracy skills and competency with more advanced mathematical processes, such as percentages, ratio, standard form, unit conversion, data analysis (mean, mode, median),

• Y8 Reproduction and Health • Y9 Evolution and Genetics • B1 Transport and Enzymes • B2 Cells • B4 Cell Cycle and Variation • C1 Key concepts: chemical reactions • C2 Key concepts: chemical reactions • P5 Energy		probability - Be able to present data scientifically in results tables and correct use of graphs and charts - Be able to interpret numerical data to describe relationships and draw conclusions - Be aware of the purpose of the curriculum and its links with KS3 and KS5 - Be aware of the links between KS4 and careers beyond KS4 and KS5
Subject Specific Language	Pedagogical Notes	Make it Stick Activities
Health Disease Communicable Non-communicable Pathogen Virus Bacteria Fungi Protist Lytic Lysogenic DNA RNA Transmission STI Phagocyte Phagocytosis Lysozyme Vesicle Antigen Leukocyte Lymphocyte Memory lymphocyte Antiody Antitoxin	Communicable diseases is a topic which relies heavily on prior understanding of gross anatomy and body systems beginning in KS2 and expanding through Y8 Body systems.Similarly, this understanding draws upon the deeper learning throughout B5 Non-communicable Diseases, where students begin to question the pathology of disease.. It is highly recommended to revisit disease through contextual and career-based scenarios, extending from B5 Non-communicable Diseases into this scheme. A significant focus of the topic is on providing examples of the pathogens responsible for communicable diseases, building upon the understanding of disease as a disorder of structure or function, developed in B5. In contrast to KS3, students are now expected to be able to accurately and fluently use immunological terms to describe and explain the immune response, both cellular and humoral. It is essential to continually reinforce accurate use of key terms and sizes through frequent low stakes assessment e.g. 6 AO1 starters and visual learning through modeling and investigation. Students may have emotional connections to this topic so bear this in mind. As the topic incorporates a lot of microscopic human anatomy, students tend to show a greater interest in what is happening in their own body, similarly to B5 and Body Systems in Y8. We recommend using visual learning such as immunity modeling, role playing as researchers and doctors, using aseptic technique to investigate	Tips for Teachers to Help Learning 'Stick' • Short AO1 fact recall 'flashcard' questions throughout e.g. starter • Continuous interleaving of class targets/core principles into AO1 fact recall questions e.g. define 'communicable disease' • Focus on visual learning methods such as modeling, stop motion animation or growing bacterial cultures • Embed visual learning through use of device modeling • Continuous live-marking for immediate personal feedback, including stretch and challenge where appropriate • Create 'desirable difficulties' such as describing and explaining antibody response • Incorporate frequent, low stakes testing throughout, such as 'pens in pots' and 'hot seat' • Encourage collaboration and responsibility through strategies such as 'pens in pots' and 'hot seat' • Provide opportunities for elaboration, reflection after KAT and DIRT lesson after assessment • Explain to students how to troubleshoot their own problems. Don't do it for them – "Have you tried

Toxin Neutralise Attenduated Vaccination Immunity Herd immunity Primary/secondary response Antibiotic One of inhibition Control Variable	antibiotics, reinforced with real life visuals and active learning throughout the scheme e.g. students selecting appropriate drugs for patient treatment. Communicable diseases as a topic also includes lots of opportunities to develop 'good habits' as skills in Science, such as the difference between describing and explaining or evaluating opinions on vaccination. We therefore recommend revisiting these skills habitually when possible e.g. describe how white blood cells protect against infection or explain why a vaccination against HIV does not protect against an ebola infection. Students will likely struggle with the different curve gradients showing both an increase and decrease on the same curve. We recommend reinforcing routine, small steps when describing and explaining data e.g. include both variables, describe the entire curve, back up with data as seen in B5 and Y8 Body Systems. Although students may have experienced this at KS3, students will be challenged to grow microorganisms aseptically without contamination. We recommend following a strict, concrete aseptic method to promote aseptic technique and student engagement e.g. Bunsen burner always on to remove airborne contaminants. Communicable disease deepens greatly on the detail of pathogenic infection and immune response, introduced in KS3. This scheme focuses on applying this understanding to describing and explaining vaccinations and immunity, which students may find challenging. We highly recommend incorporating modelling for visual learning with frequent challenging of preconceived misconceptions through use of low-stake assessment e.g. Hot seat – explain why pathogens must be attenuated. **<u>Assessments:</u>** Continuous live-marking throughout, prioritizing key students. **Literacy Key Assessed Task possibilities:** Describe/explain how vaccinations provide immunity. This is a key area for assessment as the skills of describing and explaining are fundamental to linking all the content from pathogens and immune response. It is a key skill and concept to understand, so repeat exposure should help secure learning for GCSE assessment.KAT can be marked with coded marking or whole class feedback and feedback by students completed in green pen **End of unit assessment** 20 flash cards to learn via quizlet/paper copies Seen application question used in class to ensure students understand	X?"

	concepts and to demonstrate modeling and decoding of the question (metacognition) Final Assessment (30 marks) Section 1 – flash cards 10 marks (AO1) - PA Section 2 – seen application question 10 marks (AO2/3) - PA Section 3 – unseen application question (KAT to assess understanding of unit as a whole) 10 marks (AO2/3) - TA	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is a cell? What is a tissue? What is an organ? Why do bacteria not have mitochondria? How can you reduce transmission? Why are specific pathogens more prevalent in certain regions? Which viral lifecycle is more dangerous between lytic and lysogenic? Are viruses living organisms? Why are antibiotics ineffected against viruses and fungi? How might antivirals work? If someone is immunocompromised, how might that lead to further diseases? How is HIV fatal? Why do you need specific vaccinations? What might happen if we do not have enough white blood cells? Why is phagocytosis before antibody production? What might happen if the pathogen antigen is different? How might pathogens become resistant? How might the ultimate plant be able to defend itself against pathogens? Why can some pathogens only infect plants/animals? How does a vaccination protect us years later? Why must the pathogen in a vaccination be attenuated? Why are condoms more beneficial contraceptives than hormonal tablets? How do you know the medications you are taking	- 6 AO1 fact recall questions to start each lesson to embed retention of difficult key terms - Research into meaning of health and disease, as well as careers - Modeling/stop motion animation of spreading disease - Modeling/stop motion animation phagocytosis - Modeling/stop motion animation of antibody/antitoxin production - Modeling/stop motion animation of vaccination - Evaluation arguments for and against vaccinations - Investigating antibiotics practical with calculation of zones of inhibition - Role playing – doctors selecting medication for patients - Role playing – scientists diagnosing STI infection - Jigsaw matching antibodies and antigens - Carton labeling of key terms e.g. antigen, antibody	Communicable diseases must spread through the air Diseases must be communicable Disease is always physical Health is always physical All antibiotics kill all bacteria All pathogens are the same All microorganisms cause disease Plants can not suffer from disease Antibiotics destroy all microorganisms All white blood cells are the same Immune system responds the same way for all pathogens Viruses are living Humans have no microorganisms living in/on them Symptoms show immediately following infection Vaccination cause autism There can be no new pathogens or diseases There is no need for new vaccines One vaccination protects against all pathogens You can stop taking antibiotics once symptoms cease

are safe? Why is each step needed for designing drugs? What is the difference betweena primary and secondary infection? Why ar some people against vaccinations? Do you agree/disagree? How do you know which antibiotic is most effective? Can you prove this mathematically?		

George Stephenson High School Unit Overview

Unit: KS4 B7 Signalling and Control	**Number of Lessons:** 14
Key Principles Students should begin the topic with a solid foundation of knowledge on humans as multicellular organisms introduced in KS3, who exhibit disease as a disorder of structure or function. Students should begin to build upon the concept of intercellular signalling through hormones and nervous impulses with specific examples and pathologies, introduced in B5 – Non-Communicable Disease Students should finish this unit competent in their knowledge of the definition and examples of homeostatic mechanisms, including thermoregulation, osmoregulation, Glucoregulation and the menstrual cycle. This is then compared to nervous control, through reflex actions and electrical impulse signalling. Students should be able to apply numeracy skills to calculate BMI. Students may be stretched to apply numeracy skills to calculate speed of impulse transmission. Introduction to careers surrounding controlling fertility in medical contexts.	**The Big Picture (Progression): At KS3 pupils should already have been taught to:** - Describe the structure and function of specialised cells, tissues, organs and organ systems - Describe and explain the process of circulation - Recognise health as a state of being free from illness or injury - Recognise disease as a disorder of structure or function - Recognise hormones as internal chemicals - Recognise a high volume of fat as being a state of poor health - Recognise menstruation as a cycle - Recognise the menstrual cycle as a female cycle necessary for producing offspring - Recognise the nervous system as the system responsible for responding to the environment - Recognise reflex responses as fast and involuntary - **Links to other Combined Science Units** - **Biology:** - B1 – Transport and enzymes core principles - B2 – Cells - B3 – DNA and gnetic engineering - B4 – Cell cycle and variation - B5 – Non-Communicable Diseases - B6 – Communicable Diseases - **Chemistry:** - C1 Key concepts: chemical reactions - C2 Key concepts: chemical reactions - C9 Rates and equilibrium - C10 Chemical energy changes - **Physics:** - P5 Energy - **At KS5 students should go on to learn:** - Biological molecules - [Glycogen as a polymer of glucose, ATP as currency of energy, ATP uses] - Cells and microscopy - [Cell structure and specialization, magnification, transport across membranes, absorption] - Exchange - [Exchange in humans, pulmonary disease, haemoglobin, oxygen dissociation, heart and vessel structure, cardiac cycle, enzymes and digestion] - Genetic information and classification - [Genetic variation, mutation, adaptation, human activity, quantitative investigation] - Respiration and photosynthesis - [Respiration chemical process, respirometers and application] - Environmental Biology

	- [Energy transfer, environmental issues] - Survival and response - [Nervous coordination, neurological disorders, skeletal muscle contraction, homeostasis, diabetes] - Inheritance - [Codominance, sex-linkage, population genetics, natural selection] - Control of gene expression - [mutations, stem cells, DNA technology and treatment]

Possible Key Learning Points	**Skills**	**Prerequisites**
Key Learning Principles - Define hormone - State examples of hormones, glands, target organs and effects - Describe the function of adrenaline - Describe the function of thyroxine - Define homeostasis - Explain the importance of homeostasis - Describe the process of thermoregulation - Describe the process of osmoregulation - Describe the process of glucoregulation - Describe how disorders of glucoregulation results in diabetes - Compare type I and type II diabetes - State how to calculate BMI - Describe the menstrual cycle - Explain how fertility treatments work - Explain how contraceptives work - Describe the nervous system - Describe the reflex arc - State the 5 senses and their sensory organs - Compare adult and embryonic stem cells - Describe the process of stem cell therapy - Explain the importance of stem cells - Explain how stem cells can treat certain disorders **Interleaving:** • Y7 Energy • Y7 Cells • Y7 Diffusion • Y8 Body Systems	**Key Skills Learnt** - Literacy / Oracy: To understand, use and define new specific vocabulary effectively - Use and recall key units correctly - Use and convert between units accurately - Explain physiological consequences of lack of hormonal control - Explain physiological consequences of lack of nervous control - Explain the diagnosis and symptoms of diabetes - Explain the treatment of diabetes - Explain the function of physical and oral contraceptives - Evaluate the use of specific physical and oral contraceptives for specific patients - Evaluate the use of stem cell therapy to form personal opinion - Teamwork and verbal literacy in collaborative activities such as pens in pots - Creativity when drawing or modeling - Draw tables of results and produce suitable graphs/charts to display data - Formulate conclusions based on evidence - Evaluation of positives and negatives to draw personal opinions - Calculate BMI as mass (kg) / height squared - Calculate speed of nervous impulse transmission - Substitution of values to calculate and rearrange formula - Independent learning during research- based home learning	**Students should already:** - Be able to accurately describe the basic gross structure and function of human anatomy, including specialised cells, tissues and organ systems, including digestive, circulatory, muscular and skeletal - Be able to describe the gross structure and function of the double circulatory system and its vessels - Be able to recognise disease as disorder of structure and function - Be able to describe health as the absence of illness or injury - Be able to compare the structure of animal, plant and bacterial cells - Be able to recognise that not all diseases are caused by pathogens - Be able to state examples of non-communicable diseases - Describe the menstrual cycle - State examples of contraception - Describe neurons as cells which carry nervous impulses - Be able to use key literacy skills to accurately and fluently apply KS3 scientific terminology - Hold developed numeracy skills and competency with more advanced mathematical processes, such as percentages, ratio, standard form, unit conversion, data analysis (mean, mode, median), probability - Be able to present data scientifically in results tables and correct use of graphs and charts - Be able to interpret numerical data to describe

• Y8 Reproduction and Health • Y9 Evolution and Genetics • B1 Transport and Enzymes • B2 Cells • B4 Cell Cycle and Variation • B5 Non-Communicable Diseases • B6 Communicable Diseases • C1 Key concepts: chemical reactions • C2 Key concepts: chemical reactions • P5 Energy		relationships and draw conclusions - Be aware of the purpose of the curriculum and its links with KS3 and KS5 - Be aware of the links between KS4 and careers beyond KS4 and KS5
Subject Specific Language	Pedagogical Notes	Make it Stick Activities
Health Disease Communicable Non-communicable Transmit Hormone Pituitary gland Adrenal gland Brain Ovaries Testes Pineal gland Hyothalamus Pancreas Thymus Thyroid Folicle stimulating horone Oestrogen Leutinising hormone Progesterone Pacinian corpuscle Menstrual cycle Uterus lining	Signalling and Control is a topic which relies on priorunderstanding of gross anatomy and body systems beginning in KS2 and expanding through B5 Non-Communicable Diseases and B6 Communicable Diseases. Intercellular signalling and control is a concept that students are innately aware of but have not studied explicitly. It is highly recommended to revisit signalling and control through contextual and career-based scenarios, building upon prior schemes and extending throughout this scheme. Signalling and Control as a topic contains some challenging semantics with umbrella terms and 'Matryoshka' words e.g. glucose, glycogen. This can introduce misapplication of key terms and structure. It is essential to continually reinforce accurate use of key terms through frequent low stakes assessment e.g. 6 AO1 starters and visual learning through modeling and role play. Similarly to Y8 Body Systems, Signalling and Control contains a significant focus on microscopic structures which are not visible to the naked eye and therefore may appear more abstract to some students. Similarly, this mindset may also be hindered by availability of scientific equipment at KS2 e.g. microscopes. It is therefore recommended to use not only modeling to reinforce visual learning, but also real life visuals and role playing to deepen the retention of content.	Tips for Teachers to Help Learning 'Stick' • Short AO1 fact recall 'flashcard' questions throughout e.g. starter • Continuous interleaving of class targets/core principles into AO1 fact recall questions e.g. define 'homeostasis • Focus on visual learning methods such as testing senses • Embed visual learning through use of modeling • Continuous live-marking for immediate personal feedback, including stretch and challenge where appropriate • Create 'desirable difficulties' such as describing and explaining change in blood glucose • Incorporate frequent, low stakes testing throughout, such as 'pens in pots' and 'hot seat' • Encourage collaboration and responsibility through strategies such as 'pens in pots' and 'hot seat' • Provide opportunities for elaboration, reflection after KAT and DIRT lesson after assessment • Explain to students how to troubleshoot their own problems. Don't do it for them – "Have you tried

Adrenaline Thyroxine Glucagon Glycogen Insulin Glucoregulation Osmoregulation Kidney Antidiuretic hormone Thermoregulation Receptor Neurone Sensory Relay Motor Effector Simulus Neurotransmitter Synapse Homeostasis Stem cell Differentiation Specialised Embryonic stem cell Adult stem cell	Incorporating such pedagogy throughout encourages a higher level understanding of the relationships between structures and functions, providing a foundation to stretch into the pathology of such structures and functions. A significant focus of the topic is on diabetes as a disorder of signalling and control, therefore building in deeper understanding of no-communicable disease from B5 as well as the circulatory system structure and function from Y8 Body Systems. In contrast to KS3, students are now expected to be able to accurately and fluently use anatomical terms to describe structure and function of the endocrine system and its pathology. It is essential to continually reinforce accurate use of key terms through frequent low stakes assessment e.g. 6 AO1 starters and visual learning through modeling and dissection. Students may have emotional connections to this topic so bear this in mind. Similarly to B5 and B6, the topic incorporates a lot of human anatomy, students tend to show a greater interest in what is happening in their own body when it is visible to the naked eye. We recommend using visual learning such as neurone modeling, BMI calculations, sensory testing reinforced with real life visuals and active learning throughout the scheme e.g. students deciding the most appropriate use of fertility treatment. Non-communicable diseases as a topic also includes lots of opportunities to develop 'good habits' as skills in Science, such as evaluating opinions, which has shown to be a downfall in previous examiner reports. We therefore recommend revisiting these skills habitually when possible e.g. evaluate the use of hormonal therapy, evaluate the use of stem cell therapy. Students will likely struggle with the different curve gradients in homeostasis showing both an increase and decrease on the same curve. We recommend reinforcing routine, small steps when describing and explaining data e.g. include both variables, describe the entire curve, back up with data as seen in B5 and B6. Although students will have experienced this, students will be ethically challenged to form mature, scientifically and morally informed opinions with respect. We recommend following a provided oracy structure promote progress and student engagement e.g. speaker, prober. As some students will not be mentally or physically capable of engaging with potentially personal issues e.g. Diabetes, BMI, it is highly recommended to consider these barriers and potentially prepare alternative work for elsewhere within the classroom. **<u>Assessments:</u>** Continuous live-marking throughout, prioritizing key students.	X?"

	Literacy Key Assessed Task possibilities: Describe the process of glucoregulation. Evaluate the use of stem cell therpy. These are key areas for assessment as the skills of describing relies heavily on key term retention, whulst evaluating is fundamental to linking scientific content to arguments for and against to produce a personal opinion. It is a key skill and concept to understand, so repeat exposure should help secure learning for GCSE assessment. KAT can be marked with coded marking or whole class feedback and feedback by students completed in green pen **End of unit assessment** 20 flash cards to learn via quizlet/paper copies Seen application question used in class to ensure students understand concepts and to demonstrate modeling and decoding of the question (metacognition) Final Assessment (30 marks) Section 1 – flash cards 10 marks (AO1) - PA Section 2 – seen application question 10 marks (AO2/3) - PA Section 3 – unseen application question (KAT to assess understanding of unit as a whole) 10 marks (AO2/3) - TA	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
What is a cell? What is a tissue? What is an organ? What is an organ system? Why do we need a circulatory system? Why do we need a nervous system? Why do we need an endocrine (hormonal) system? Do all organisms need blood? Why is blood made from more than just red blood cells? What causes diabetes? How does insulin link to diabetes? Why are there different types of diabetes? How might you treat diabetes? What are the risks of treating diabetes? Why is BMI not an accurate measurement of health? What is homeostasis? What happens if we lose homeostasis? How does our body col down internally?	- 6 AO1 fact recall questions to start each lesson - Research into meaning of health and disease, as well as careers - Career role playing treatment of patients for active learning - Modelling/drawing of neurons - Modelling of Glucoregulation with cut outs to describe the process - Map from memory for retention of vast volume of key terms e.g. glands, hormones, target organs - Card sort for retention of vast volume of key terms e.g. glands, hormones, target organs - Testing of senses for active learning - Calculating own BMI for active learning - Testing own reflexes for active learning - Back to back for visual learning of reflex arc - WIP/PIW for homeostatic mechanisms - Paired evaluation arguments for and against stem cell therapy	Communicable diseases must spread through the air All blood vessels are the same All organisms have blood All organisms have a heart Deoxygenated blood is blue Blood is just made from red blood cells Disease is always physical Health is always physical Hormones affect all cells Hormones come from one gland Males and females have the same levels of hormones Females do not produce testosterone Males do not produce oestrogen Hormones cannot be affected by the environment e.g. diet, performance enhancing drugs Hormones disappear once they reach their target organ Hormones cannot interact with each other Only elderly have hormonal abnormalities There is a ‘normal’ level of hormone The brain only controls nervous control

How does our body heat up internally? How do we retain water? How do we lose more water? Where does glucose go? How might you improve the calculation of BMI? Why do you shiver? Why do people urinate more in the winter? How might sweet urine show diabetes? How does hyperglycaemia show diabetes? Why might a diabetic need to carefully monitor their diet? What is the difference between type I and type II diabetes? Why might diabetics lose weight quicker? Why might diabetics be at increased risk of losing limbs? Why do oral contraceptives contain oestrogen or progesterone? Why are condoms considered more affective forms of contraception? How does FSH therapy increase fertility? Why does the uterus lining shed? How does an underactive thyroid increase weight gain? Why is alcohol considered a diuretic drug? How might drugs increase or decrease the speed of nervous impulse transmission? What might the effects be? What happens if you block a synapse? What happens if you increase the amount of neurotransmitter? What happens if you prevent the re-uptake of neurotransmitter? Are you for or against stem cell therapy? Why might somebody else be for/against stem cell therapy? How does stem cell therapy treat a disorder? How does motor neurone disease cause muscular atrophy? How does motor neurone disease cause tremors? How does a lumbar injury cause paralysis? What might happen if the myelin sheath degenerates?		An imbalance in homeostasis affects only the heart Only an underactive thyroid causes weight gain BMI is an accurate measure of health Adult stem cells can be taken from anyone Only condoms are a form of contraception Oral pills are only used as contraception, not fertility treatment Stem cell therapy is illegal Stem cell therapy is unsafe Stem cell therapy cures everything We have a finite number of neurons in our lives We only use 10% of our brains Bigger brains means smarter people Adults have more neurons than infants

George Stephenson High School SCIENCE KS4 Y11 Biology PLANT STRUCTURES AND FUNCTIONS Unit Overview

Unit:Y11 B8 Plant structures and their functions	Number of Lessons: 9

TOPIC 8 PLANT STRUCTURES AND FUNCTIONS (FROM SPEC)

Topic 6 – Plant structures and their functions

Students should:		Maths skills
6.1	Describe photosynthetic organisms as the main producers of food and therefore biomass	
6.2	Describe photosynthesis in plants and algae as an endothermic reaction that uses light energy to react carbon dioxide and water to produce glucose and oxygen	
6.3	Explain the effect of temperature, light intensity and carbon dioxide concentration as limiting factors on the rate of photosynthesis	2c, 2d, 2g 4a, 4c
6.4	**Explain the interactions of temperature, light intensity and carbon dioxide concentration in limiting the rate of photosynthesis**	4b, 4c, 4d
6.5	*Core Practical: Investigate the effect of light intensity on the rate of photosynthesis*	2c, 2f, 2g 4a, 4c
6.6	**Explain how the rate of photosynthesis is directly proportional to light intensity and inversely proportional to the distance from a light source, including the use of the inverse square law calculation**	2g 3a 4a, 4b, 4c, 4d
6.7	Explain how the structure of the root hair cells is adapted to absorb water and mineral ions	
6.8	Explain how the structures of the xylem and phloem are adapted to their function in the plant, including: a lignified dead cells in xylem transporting water and minerals through the plant b living cells in phloem using energy to transport sucrose around the plant	
6.9	Explain how water and mineral ions are transported through the plant by transpiration, including the structure and function of the stomata	
6.10	Describe how sucrose is transported around the plant by translocation	
6.12	Explain the effect of environmental factors on the rate of water uptake by a plant, to include light intensity, air movement and temperature	1a, 1c 2b, 2c 4a, 4b, 4c, 4d
6.13	Demonstrate an understanding of rate calculations for transpiration	1a, 1c 2b, 2c 4a, 4b, 4c, 4d

Specification points 6.11, 6.14, 6.15 and 6.16 are in the GCSE in Biology only.

The Big Picture (Progression):

At KS2 pupils should already know:

Describe how plants need water, light and a suitable temperature to grow and stay healthy

At KS3 students should already know:

Word equation for photosynthesis, identifying reactants and products.

How root hair cells and palisade cells are adapted for their function.

The structure and function of stomata

Future links and progression onto other KS4 units:

B1 Transport and enzymes

B2 Cells

B9 Ecosystems and cycles

Possible Key Learning Points	Skills	Prerequisites
Formulating the balanced symbol equation for photosynthesis Interpreting graphs for limiting factors Core practical investigating the effect of light intensity on the rate of photosynthesis Calculating rates Understanding and using the inverse square calculation (Higher only) Exam practice focusing on command words, how to answer describe or explain questions using limiting factors data. How to answer describe or compare questions using translocation and transpiration as examples. **Interleaving:** Cell structure Diffusion Osmosis Active transport Balancing equations Enzymes	Literacy/Oracy accurate use of key words during class Q and A sessions and within written answers Literacy – describing and explain graphs Accurate spelling of key words Numeracy: Calculating light intensity using $I_{(new)} = \frac{1}{d^2_{(new)}}$ Plot, draw and interpret limiting factors graphs Understand and use inverse proportion (Higher only) Carry out rate calculations Core Practical: Investigating how light intensity affects the rate of photosynthesis. Interpersonal: Team-work and communication skills during core practical	Students should already know: The reactants and products of photosynthesis. How to construct the word equation for photosynthesis Students should be familiar with the structure and function specialised cells. How substances are transported via osmosis, diffusion and active transport. The structure of a leaf including adaptations for photosynthesis.
Subject Specific Language	Pedagogical Notes	Make it Stick /GREENZONE Activities

Biomass Endothermic Glucose Carbon dioxide Oxygen Chloroplast Chlorophyll Light intensity Limiting factors Directly proportional Inversely proportional Root hairs cells Diffusion Osmosis Active transport Xylem Phloem Lignin Sieve tubes Companion cells Transpiration Translocation	As with most science topics, the amount of new terminology can be tricky. Students struggle to distinguish accurately Revisiting and correcting use of key terminology is essential throughout the unit. Focusing how to answer questions asking to describe graphs/data and explaining trends in data. Students often misinterpret what to do in an explain question and often simply describe a pattern or trend using data from the graph/ table as evidence. Students must be shown how to approach explain questions using scientific principles. There are two good opportunities in this unit when looking at limiting factors and again later during translocation and transpiration. Using translocation and transpiration to practice writing to compare and contrast (This has appeared on an examination paper as a 6 mark question) **<u>Assessments:</u>** Regular in class live marking throughout the unit **End of unit assessment** 15 flash cards to learn via quizlet/paper copies Seen application question used in class to ensure students understand concepts and to demonstrate modeling and decoding of the question (metacognition) Final Assessment (30 marks) Section 1 – flash cards 10 marks (AO1) - PA Section 2 – seen application question 6 marks (AO2/3) - PA	Starter for 5 (recall questions) Interleave particles topic Desirable difficulties including a variety of challenge options - ‘chilli challenge’ KAT and DIRT opportunities Metacognitive mediators to plan, monitor and evaluate own thinking processes Low stakes assessment through recall and interleaving approaches 5/3 and similar challenge tasks using the range of questions

	Section 3 – unseen application question (KAT to assess understanding of unit as a whole) 5 marks (AO2/3) - TA	
Reasoning opportunities and probing questions	Suggested Activities	Possible Misconceptions
Do plants need to respire? When does respiration and photosynthesis occur in plants? Explain what causes a limiting factor graph to plateau. Relate your knowledge of enzymes to a graph for rate of photosynthesis and temperature Compare the structure of root hair cells and palisade cells, giving reasons for any differences. Explain why cells of the xylem are dead and cells of the phloem living. Why are companion cells required? Which organelle would you expect to be in large numbers in companion cells and why?	Words to pictures Look cover check Difference between describing and explaining graphs Quick quizzes Core practical – light intensity and photosynthesis Spot the link Exam question practice Change reduce change	• Plants obtain their energy directly from the sun. • Plants feed by absorbing food through their roots. • Carbon dioxide, water, and minerals are food. • Plants use heat from the sun as a source of energy for photosynthesis • Sunlight is a food • Sunlight is composed of molecules. • Plants absorb water through their leaves. • Plants produce oxygen for our benefit. • Plants require an abundant supply of water under sunlight because a large amount of water is used up during photosynthesis. • Photosynthesis is made up of a light reaction and a dark reaction.

		• Only green plants can carry out photosynthesis. • Chlorophyll absorbs green light in sunlight for photosynthesis. • The role of chloroplasts in photosynthesis is to absorb light energy. • During photosynthesis, water provides the hydrogen and oxygen for the synthesis of carbohydrate. • Green plants carry out photosynthesis in daytime and respiration at night-time. • In green plants, carbohydrate formed in photosynthesis combines with atmospheric nitrogen to form proteins.