Scheme of Work 2020-2021
Subject: Biology

Year Group: 13 Autumn term 1
Specification: AQA

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes

1 **3.5.1 Photosynthesis**	The light-dependent reaction of photosynthesis including: • chlorophyll and photoionisation • some of the energy from electrons released during photoionisation is conserved in the production of ATP and reduced NADP • the production of ATP involves electron transfer and the passage of protons	• Describe the structure of chloroplasts. • Explain where, specifically, the light-dependent reaction occurs. • Explain the role of light in photolysis and photoionisation. • Explain how photoexcited electrons move along the electron transfer chain, and how ATP and reduced NADP are produced. Explain chemiosmosis and the role of ATP synthase in producing ATP	**Learning activities:** • questioning to recall GCSE knowledge • teacher led explanation of the structure of a chloroplast • ask students to sketch a graph of how energised they felt throughout a typical day (most will show boosts every time they eat) • teacher explanation of process of light-dependent reaction of photosynthesis (using animations and videos). As an extension, students interpret energy level diagrams during electron transfer - linking energy level diagram to their graph to aid understanding • card sort – order the statements • exam questions. **Skills developed by learning activities:** • AO1/AO2 – development of understanding of the light dependent reactions of photosynthesis and application of knowledge to the context of exam questions • AO3 – interpret scientific ideas and information from energy level diagrams extended exam answers	**Past exam paper material:** BIOL4 Jan 2013 – Q8a BIOL4 Jan 2010 – Q8a	uic.edu/classes/bios/bios100/lectures/light_reaction.htm **Rich questions:** • What roles does light play in this process? • How is ATP produced? • How is reduced NADP produced? Explain the role of water in the light-dependent reaction **<u>Flipped learning opportunity</u>** PiXL Independence: Biology – Student Booklet KS5 – Photosynthesis and respiration	C1,C3,Sp2

	across chloroplast membranes (chemiosmotic theory) • photolysis of water produces protons, electrons and oxygen.					
2	The light-independent reaction including: • carbon dioxide reacts with RuBP to form two molecules of glycerate 3-phosphate (GP). This reaction is catalysed by the	• Explain where the light-independent reaction occurs. • Describe the Calvin cycle. • Explain the roles of reduced NADP and ATP. Interpret experimental data about the light independent reaction	**Learning activities:** • ask which parts of the photosynthesis equation remain unaccounted for • provide a synopsis of Calvin's lollipop experiment, along with results from the chromatograms as to which substances were present at different times. Ask pupils to suggest a reaction sequence • teacher explanation of process of light-independent reaction (using animations and videos). Link to role of ATP and reduced NADP • analysis of data eg varying carbon dioxide levels of the concentrations of RuBP and GP • exam questions. **Skills developed by learning activities:** • AO1/AO2 – development of understanding of the light-independent reaction	**Past exam paper material:** BIOL4 Jan 2013 – Q5 BIOL4 June 2012 – Q4 BIOL4 June 2013 – Q5 BIOL4 June 2010 – Q8a–8b BIOL4 June 2011 – Q8c BIOL4 June 2014 – Q8	uic.edu/classes/bios/bios100/lectures/calvin.htm wps.prenhall.com/wps/media/objects/1109/1135896/8_3.html **Rich questions:** • What role does reduced NADP play in this process? • What role does ATP play in this process? • How many carbon atoms do RuBP, GP and TP have? How is the chloroplast adapted to maximising	C1, Sp3,C3

	enzyme Rubisco • ATP and reduced NADP are used to reduce GP to triose phosphate (TP) some of the TP is		• AO2/AO3 – application of knowledge to exam questions and experimental data extended exam answers. Students could produce a video podcast to summarise the whole process of photosynthesis		the rate of photosynthesis in the stroma?	
3	**Required practical 7:** Use of chromatography to investigate the pigments isolated from leaves of different plants, eg leaves from shade-tolerant and shade-intolerant plants or leaves of different colours. .	• Explain how to extract photosynthetic pigments from leaves and separate them using chromatography. • Identify photosynthetic pigments found in leaves of different plants.	**Learning activities:** • questioning to recall the purpose of doing chromatography • students work through the chromatography practical • as extension work, students could then go on to calculate Rf values and compare them to published data to identify pigments • discussion and conclusions about the differences found in plant leaves of different colour and from different environments. **Skills developed by learning activities:** • AO1 – development of knowledge of a scientific technique • AO2 /AO3 – apply knowledge of scientific techniques and draw conclusions as to the pigments present • AT g and b	Students could undertake BIO6T P12 ISA	saps.org.uk/secondary/teaching-resources/181-student-sheet-10-thin-layer-chromatography-for-photosynthetic-pigments cleapss.org.uk **Rich question:** What is chromatography used for?	Sp7,Sp2

			• MS 1.9 – use an appropriate statistical test (eg to compare mean distances moved by different pigments) • PS 1.2 – apply scientific knowledge to practical contexts Practical competency – 8.4.2.1/8.4.2.2/8.4.2.3/8.4.2.4			
4	**Required practical 8:** Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts.	• Design an experiment to investigate the effect of a named factor on the rate of the reaction catalysed by dehydrogenase. • Process data to calculate rates. • Represent raw and processed data clearly using tables and graphs. • Explain why scientists carry out statistical tests. • Calculate an appropriate statistical test and interpret values in terms of probability and chance. • Apply knowledge to draw and explain conclusions. Evaluate the results conclusions.	**Learning activities:** Students design an experiment to investigate the effect of a named variable, eg temperature, on dehydrogenase activity in extracts of chloroplasts. This could include: • researching and designing a suitable method • risk assessment • carrying out (subject to teacher approval) • processing and presentation of data • selection and use of appropriate statistical tests • drawing conclusion and evaluating results. **Skills developed by learning activities:** • AO2 /AO3 – apply knowledge of scientific techniques and interpret data to draw conclusions • AT g and b • MS 1.9 – select (and use) an appropriate statistical test • MS 3.1 and MS 3.2 – transfer information between tables and graphs, and plot 2 variables on a graph • MS 3.5/MS 3.6 – calculate rate or work out rate from the slope of a tangent to a curve	BIO6T P11 ISA	cleapss.org.uk nuffieldfoundation.org/practical-biology/investigating-light-dependent-reaction-photosynthesis scribd.com/doc/6468471/Teaching-A2-Biology-Practical-Skills aqa.org.uk	Sp7,Sp2

			• PS 1.2 – apply scientific knowledge to practical contexts • PS 2.4 – consider key variables • PS 2.2/PS 3.1/MS 3.2/MS 1.3 – plot the experimental data in an appropriate format • PS 2.3/MS3.3 – evaluate data for errors and uncertainties, and consider margins of accuracy 8.4.2.1/8.4.2.2/8.4.2.3/8.4.2.4/8.4.2.5			
5	Light, temperature carbon dioxide (and mineral/ magnesium levels) can limit the rate of photosynthesis. Farmers seek to overcome limiting factors in order to increase the productivity of land and maximise profits.	• Explain what is meant by limiting factors. • Identify environmental factors that limit the rate of photosynthesis. • Interpret graphs showing the rate of photosynthesis and explain graphs in terms of which factors are rate limiting. • Explain how farmers seek to maximise crop growth through knowledge of rate limiting factors, and how this is a balance between cost vs profit. Evaluate data relating to common agricultural practices used to overcome the effect of these limiting factors	**Learning activities:** • students could undertake an investigation of a named factor on the rate of photosynthesis using algal beads, algae or an aquatic plant • jigsaw tasks: in groups of three, each student goes off to access information about one of the named factors and the trends in rate graphs • group feedback and completion of an explanation table • teacher assessment and teaching of areas of weakness • exam questions/past ISA paper • teacher led explanation of agricultural practices to maximise rate • data evaluation task relating to agriculture. **Skills developed by learning activities:** • AO1 – knowledge of rate limiting factors • AO2 /AO3 – apply knowledge to trends in scientific data to make judgements • AT a – devise and carry out experiments to investigate the effect of named variables on the rate of photosynthesis • MS 1.9 – use an appropriate statistical test	Students could undertake BIO6T P10, BIO6X 2013 or HBI6T P10 ISA **Specimen assessment material**: A-level Paper 2 (set 1) – Q8 **Past exam paper material:** BIOL4 Jan 2011 – Q5 BIOL4 June 2014 – Q3c BIO6X 2013 EMPA	nuffieldfoundation.org/practical-biology/investigating-factors-affecting-rate-photosynthesis nuffieldfoundation.org/practical-biology/investigating-photosynthesis-using-immobilised-algae cleapss.org.uk **Rich question:** Show graphs and ask students to explain what the limiting factors are.	C1,C3,Sp 2

			• MS 1.4 – understand simple probability • MS 3.4 – determine the compensation point in plants by reading off the intercept point • PS 1.2 – apply scientific knowledge to practical contexts 8.4.2.1/8.4.2.2/8.4.2.3/8.4.2.4			

6 **3.5.2 Respiration**	Respiration produces ATP. Aerobic respiration involves: • glycolysis • active transport of pyruvate into the mitochondrial matrix • oxidation of pyruvate to acetate • production of acetyl CoA • the Krebs cycle oxidative phosphorylation, associated with electron transfer and chemiosmosis, to synthesise ATP.	• Know where the different stages of aerobic respiration occur. • Explain the significance of the oxidation reactions involved in glycolysis, the link reaction and the Krebs cycle. • Explain the roles of coenzymes and reduced NAD in respiration. • Describe the process of electron transfer associated with oxidative phosphorylation. • Explain chemiosmosis and the role of ATP synthase in producing ATP. • Apply knowledge to explain trends in data.	**Learning activities:** • questioning to recall GCSE knowledge and AS knowledge of ATP • teacher led explanation of the stages involved in aerobic respiration (using animations and videos) • card sort – order the stages/molecules • exam questions. Include exam questions which focus on interpreting and explaining data. **Skills developed by learning activities:** • AO1/AO2 – development of understanding of aerobic respiration • AO2/AO3 – application of knowledge to exam questions • extended exam answers.	**Past exam paper material:** BIOL4 Jan 2012 – Q8b BIOL4 June 2013 – Q4 BIOL4 June 2010 – Q6 BIOL5 Jun 2014 – Q9	**Flipped learning opportunity** PiXL Independence: Biology – Student Booklet KS5 – Photosynthesis and respiration Research on the 4 processes of respiration 1. Glycolysis 2. Link reaction 3. Krebs Cycle 4. Electron Transport Chain sumanasinc.com/webcontent/animations/content/cellularrespiration.html highered.mheducation.com/sites/0072507470/student_view0/chapter25/animation__electron_transport_system_and_formation_of_atp__quiz_1_.html highered.mheducation.com/sites/0072507470/student_view0/chapter25/animation__how	C1,C3,Sp2

					_glycolysis_works.html highered.mheducation.com/sites/0072507470/student_view0/chapter25/animation__how_the_krebs_cycle_works__quiz_1_.html **Rich question:** Provide statements and ask students whether they apply to glycolysis, the Krebs cycle or oxidative phosphorylation (or more than one)	
7	Glycolysis is the first stage of anaerobic and aerobic respiration. If respiration is only anaerobic, pyruvate can be converted to ethanol or lactate using reduced NAD. The oxidised	• Describe the process of anaerobic respiration in animals and some microorganisms. • Explain the advantage of producing ethanol or lactate using reduced NAD. • Compare and contrast aerobic and anaerobic respiration. Interpret information/data about anaerobic respiration and apply knowledge.	**Learning activities:** • Teacher led explanation of the stages involved in anaerobic respiration (using animations and videos) and the benefit of oxidising reduced NAD to produce ethanol or lactate • students draw a table comparing and contrasting aerobic and anaerobic respiration eg maximum number of ATP molecules generated • exam questions. **Skills developed by learning activities:** • AO1/AO2 – development of understanding of anaerobic respiration	**Past exam paper material:** BIOL4 Jan 2013 – Q6 BIOL4 June 2011 – Q1 BIOL4 Jan 2010 – Q5.	**Flipped learning opportunities** **Research on Link reaction and Krebs cycle and complete the summary sheet provided.** **Include in your research:** **-An outline of the nature of the link reaction** **-Description of what happens during the Krebs cycle**	C1,C3,Sp2

	NAD produced in this way can be used in further glycolysis. Other respiratory substrates include the breakdown products of lipids and amino acids, which enter the Krebs cycle.		• AO2/AO3 – application of knowledge to exam questions.		**-The importance of the Krebs cycle.** **<u>Resources</u>: Text books, Revision guide** - **https://s-cool.co.uk/a-level/biology/biological-molecules-and-enzymes/revise-it/carbohydrates** sumanasinc.com/webcontent/animations/content/cellularrespiration.html highered.mheducation.com/sites/0072507470/student_view0/chapter25/animation__electron_transport_system_and_formation_of_atp__quiz_1_.html **Rich questions:** • Show students statements and ask them whether they apply to photosynthesis, anaerobic or aerobic respiration.	

					• How do aerobic and anaerobic respiration differ? Reduced NAD is used to produce lactate or ethanol from pyruvate. What is the advantage of this?	
8	**Required practical 9:** Investigation into the effect of a named variable on the rate of respiration of cultures of single-celled organisms.	• experiment to investigate the effect of a named factor on a culture of single-celled organisms. • Process data to calculate rates. • Represent raw and processed data clearly using tables and graphs. • Calculate an appropriate statistical test and interpret values in terms of probability and chance. • Apply knowledge to draw and explain conclusions. • Evaluate the results and conclusions.	**Learning activities:** Students design an experiment to investigate the effect of a named variable eg temperature on the rate of respiration of yeast/bacteria. This could include: • working through key aspects of experimental design eg key variables • carrying out (subject to teacher approval) • processing and presentation of data • selection and use of appropriate statistical tests (eg comparison of mean rates at two different temperatures • BIO6T Q12 ISA or HBI6T P11 ISA. **Skills developed by learning activities:** • ATb – use a redox indicator to investigate dehydrogenase activity • PS 1.2 – apply scientific knowledge to practical contexts • PS 2.2/PS 3.1/MS 3.2/MS 1.3 – plot the experimental data in an appropriate format • PS 2.3/MS3.3 – evaluate data for errors and uncertainties and consider margins of accuracy • AO1/AO2 – application of knowledge to explain trends	BIO6T Q12 ISA HBI6T P11 ISA HIBI6X 2013 EMPA	aqa.org.uk	Sp7,Sp2

			• AO3 – develop and refine practical design • MS 1.9 – use an appropriate statistical test • MS 1.4 – understand simple probability 8.4.2.1/8.4.2.2/8.4.2.3/8.4.2.4/8.4.2.5.			
9	**3.5.3 Energy and Ecosystems**	Plants synthesise organic compounds from carbon dioxide. Most of the sugars are used as respiratory substrates. The rest are used to make other biological molecules, which form the biomass of the plants. Biomass can be measured in terms of mass of carbon or dry mass of tissue per given area per given time. The chemical energy stored in dry biomass can be estimated using calorimetry.	• set students a diagnostic question eg 'where does an oak tree get the materials it needs to grow from?'. See if students relate glucose production from photosynthesis to biomass • comprehension exercise on the uses of sugars produced during photosynthesis. Get students to read this and produce a concept map • revisit diagnostic question • teacher led explanation of the measurement of biomass (including units) and how the energy within it can be estimated • exam questions. **Skills developed by learning activities:** • AO1 – knowledge of biomass • AO1/PS 4.1 – understand calorimetry • MS 0.1 – recognise and make use of appropriate units MS3.3 – consider margins of error/accuracy. Students could conduct calorimetry experiments by burning dried plant/food samples and calculating energy released. **Skills developed by learning activities:** • AT a - investigations to find the dry mass of plant samples or the energy released by samples of plant biomass 8.4.2.2/8.4.2.3 – use apparatus safely.	**Specimen assessment material**: A-level Paper 3 (set 1) – Q5.4 and 5.6 **Past exam paper material**: BIOL4 June 2014 – Q7ci	**Rich questions:** • Explain the relationship between photosynthesis, respiration and biomass. Explain how you could ensure that biomass was completely dry before weighing. Questions from the BIO6T Q13 ISA	So5,Sp2 M2

10	The concept of gross primary production and net primary production and their mathematical relationship ie *NPP = GPP – R* NPP is available for growth and reproduction and for other trophic levels. The net production of consumers, such as animals, can be calculated as: *N = I –(F + R)*	• Explain the concepts of gross primary production and net primary production. • Understand the mathematical relationship between the two and use it to calculate values when supplied with data. Explain the reduction	**Learning activities:** • provide food webs for students to interpret and ask questions for them to answer • introduce terminology eg trophic level • show energy/biomass losses along a food chain and how they occur. Teacher led explanation of the concepts of GPP and NPP and their mathematical relationship. Then discuss how net production is in energy/biomass along a food chain. • Explain the concept of net production in consumers, linked to how energy losses occur along food chains. • Apply knowledge to the context of exam questions. • calculated • provide data for students about food chains and ask them to calculate NPP from appropriate data. They could also calculate % efficiency of the food chains • exam questions. **Skills developed by learning activities:** • MS0.2 – convert and carry out calculations of energy transfer using numbers in standard and ordinary form • MS0.3 – calculation of percentage efficiency and percentage yield • MS 2.3/MS 2.4 – substitute numerical values into, and solve, algebraic equations using appropriate units extended exam answers.	**Past exam paper material:** BIOL4 Jan 2012 – Q2 BIOL4 Jan 2013 – Q8b BIOL4 June 2010 – Q4 BIOL4 June 2011 – Q2 BIOL4 Jan 2010 – Q8b	**Rich questions:** • What do the arrows in food chains represent? • Why do humans tend to rear herbivores as their source of meat? How is energy lost along a food chain?	So5,Sp2 M2

11	The ways in which production is affected by farming practices designed to increase the efficiency of energy transfer.	• Explain the ways in which production is affected by simplifying food webs. • Explain the ways in which farmers are reducing respiratory losses within a human food chain. • Interpret and calculate data on efficiency when provided with appropriate information. • Evaluate the ethics of some of these farming practices.	**Learning activities:** • Teacher led explanation of how farmers can improve production by simplifying food webs and reducing respiratory losses. Question students about why this would provide more food for us • debate: give students different viewpoints and ask them to debate whether it is ethical to use these farming practices • continuum – students place themselves on a continuum line based on their opinion from the debate • exam questions. **Skills developed by learning activities:** • MS0.2 – convert and carry out calculations of energy transfer using numbers in standard and ordinary form • MS0.3 – calculation of percentage efficiency essay writing skills.	**Past exam paper material:** BIOL4 Jun 2012 – Q8a BIOL4 Jun 2013 – Q8c BIOL4 Jan 2010 – Q8 BIOL5 June 2014 – Q10b	ciwf.org.uk/education **Rich questions:** • How could farmers improve efficiency? Evaluate the advantages and disadvantages of using these methods.	So5,Sp2 M2
12	**3.5.4 Nutrient cycles** Nutrients are recycled within natural ecosystems, exemplified by the phosphorous cycle, to include:	• Describe the stages of the phosphorus cycle, and the ions at each stage. • Explain the role of saprobionts and mycorrhizae in the phosphorus cycle. Interpret information/data about the phosphorus cycle and apply knowledge.	**Learning activities:** • introduce the importance of nutrient recycling within ecosystems • brainstorm why phosphorus is a useful element in nature eg in ATP, DNA, phospholipds etc • teacher led explanation of the phosphorus cycle using videos and animations • card sort of the stages • exam questions. **Skills developed by learning activities:**		**Flip learning: The phosphorous cycle** • a) Prepare a 5 min presentation on the phosphorous cycle. • b) Create your own worksheet and/or past exam style questions with mark scheme.	So5,Sp2 M2

	• the role of saprobionts in decomposition the role of mycorrhizae in facilitating the uptake of water and inorganic ions by plants.		AO1 – development of knowledge and understanding of the phosphorus cycle		**Nitrogen cycle** Construct a flow diagram of the nitrogen cycle in sufficient detail to illustrate the processes of ammonification, nitrification, nitrogen fixation and denitrification sumanasinc.com/webcontent/animations/content/phosphorouscycle.html **Rich questions:** • Explain the significance of phosphorus to living things. What role do saprobionts and mycorrhizae play?	
13	Nutrients are recycled within natural ecosystems, exemplified by the nitrogen cycle, to include: the role of bacteria in	• Describe the stages of the nitrogen cycle, and the ions/ molecules at each stage. • Explain the processes of saprobiotic nutrition, ammonification, nitrification, nitrogen fixation and denitrification within the nitrogen cycle.	**Learning activities:** • brainstorm how nitrogen is used eg in DNA, amino acids • students read comprehension on the nitrogen cycle • nitrogen cycle game – get students to model the movement of an atom of nitrogen • students generate questions they still have • teacher-led explanation of the nitrogen cycle, to address questions and reinforce • card sort of the stages	**Specimen assessment material**: A-level Paper 3 (set 1) – Q5 **Past exam paper material:** BIOL4 Jan 2013 – Q1 BIOL4 Jun 2012 – Q8b	tes.co.uk/teaching-resource/nitrogen-cycle-game-6079926 mhhe.com/biosci/genbio/tlw3/eBridge/Chp29/animations/ch29/1_nitrogen_cycle.swf **Rich questions:**	So5,Sp2 M2

	the nitrogen cycle in the processes of saprobiotic nutrition, ammonification, nitrification, nitrogen fixation and denitrification.	• Explain the role of saprobionts and mycorrhizae in the nitrogen cycle. Interpret information/data about the nitrogen cycle and apply knowledge.	• exam questions. **Skills developed by learning activities:** • AO1 – development of knowledge and understanding of the nitrogen cycle • AO2 – application of knowledge to the context set in exam questions extended exam answers. • Culture nitrogen-fixing bacteria from root nodules of leguminous plants. • 8.4.2.1/8.4.2.3 – follow instructions/work safely AT i/PS 4.1 – use aseptic techniques to culture bacteria on streak plates	BIOL4 June 2011 – Q8a BIOL4 June 2014 – Q2	• Explain the significance of nitrogen to living things. Write an equation for the conversions which occur during: ammonification; nitrogen fixation; denitrification; nitrification. nuffieldfoundation.org/practical-biology/nitrogen-fixing-bacteria-root-nodules-leguminous-plants	
14	The use of natural and artificial fertilisers to replace the nitrates and phosphates lost by harvesting plants and removing livestock. The environmental issues arising from the use of fertilisers including	• Explain why farmers utilise natural and artificial fertilisers. • Explain how eutrophication is caused, and what the impact is on the ecosystem in which it happens. • Interpret information/data about eutrophication and apply knowledge.	**Learning activities:** • introduce the rationale behind using fertilisers on agricultural land • DARTS task: provide students with a comprehension on leaching and eutrophication which they must convert into diagrams and present to the class • class peer evaluation of presentations • work through some exemplar data about leaching and eutrophication • discussion/debate: should farmers use fertilisers? Students argue the case from different perspectives • exam questions. **Skills developed by learning activities:**	**Past exam paper material:** BIOL4 Jan 2012 – Q6 BIOL4 June 2013 – Q8b BIOL4 Jan 2011 – Q3 BIOL4 June 2011 – Q3b.	nroc.mpls.k12.mn.us/Environmental%20Science/course%20files/multimedia/lesson78/animations/5a_Lake_Eutrophication.html **Rich questions:** • Explain how eutrophication occurs. Suggest steps that could be taken to reduce eutrophication from farmland.	So5,Sp2 M2

	leaching and eutrophication		• AO1 – development of understanding of eutrophication through the use of fertilisers AO2 – application of knowledge to the context set in exam questions.			
15	Extension: design an investigation into the effect of named mineral ions on plants	• Recall the key features of good experimental design. • Apply knowledge to design a valid experiment to test the effect of named mineral ions on plant growth.	**Learning activities:** • questioning about what constitutes good experimental design • provide students with an equipment list of available apparatus and chemicals • students write up a method for their proposed experiment. **Skills developed by learning activities:** • MS 1.9 – select an appropriate statistical test PS 1.1/1.2 – solve problems set in, and apply scientific knowledge to, practical contexts.	Marking of experimental plans.	nuffieldfoundation.org/practical-biology/investigating-effect-minerals-plant-growth **Rich questions:** What are the key features/principles of good experimental design?	Sp7,Sp2