Assessment Schedule – 2022

Biology: Demonstrate understanding of life processes at the cellular level (91156)

Evidence Statement

Q	Expected Coverage	Achievement	Merit	Excellence
ONE (a)	The reactants required for photosynthesis are water and carbon dioxide. Water enters through the roots of the plant, and carbon dioxide enters through the stomata (on the underside of leaves). CO_2 enters via diffusion through the stomata. Water enters via osmosis through the roots.	• Describes both reactants (accept unbalanced symbol equation or mixture of word and symbol). • Describes how carbon dioxide and water enter the plant.		
(b)	Several possibilities: E.g.: Outer membranes are clear to let light into the grana / thylakoids so that light reaction can happen. Thylakoids are filled with chlorophyl, which captures the light for the light reaction. The light reaction breaks the water into H^+ and O_2, and the oxygen is released as a by-product of the reaction. The stacked grana provide a large surface area, which maximises light capture for the light reaction; this will maximise the amount of hydrogen provided and increase oxygen release. The light-dependent phase also produces ATP, which is used to drive the light-independent phase. The chloroplast is also built to aid the diffusion of CO_2, which is needed make the glucose. The semipermeable membranes allow CO_2 to diffuse easily into the liquid stroma. The liquid of the stroma also allows for easier diffusion of CO_2, which will increase the rate of the light independent reaction and glucose production.	• Describes function of one structure – e.g. thylakoid / grana carries out light reaction / captures light energy. • Describes the function of an additional part – e.g. stroma carries out dark reaction / captures CO_2. • Describes how one structure of the chloroplast is built– e.g. membranes clear.	• ONE structure is explained and linked to its function (2M points possible). - Clear membranes allow light to pass into chloroplast. - Large surface area of grana / thylakoid will maximise light capture for light dependent reaction. - Chlorophyll found in grana / thylakoid is the pigment that allows light reaction to proceed. - Stroma contains enzymes which catalyse reactions • Two structures / reactions are linked together in terms of photosynthesis (2M points possible). - The clear membranes / stroma allow light to pass through to the thylakoids / grana where the light reaction occurs. - The liquid stroma surrounds the thylakoids / grana to enable the light / dark reactions to be closely linked. - Semi permeable membrane allows CO_2 to easily pass through to the stroma for dark phase. • Specific products and reactants are linked (2M points possible). - Carbon dioxide from light independent reaction is used to produce the glucose. - Water is split in the light dependant reaction to release hydrogen / oxygen.	• A fully linked discussion between the structures, reactants and products. For example: - Grana and chlorophyl linked to light reaction, and ATP / H^+ production linked to driving the dark reaction to produce more glucose / release more oxygen. • A fully linked discussion of another structure, reactants, and products. For example: - Semi permeable membranes and liquid stroma aids diffusion for the transport and fixation of carbon dioxide in the light independent reaction, which will produce more glucose.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes any ONE statement from Achievement.	Describes any TWO statements from Achievement.	Describes any THREE statements from Achievement.	Describes any FOUR statements from Achievement.	Explains any THREE statements from Merit.	Explains any FOUR statements from Merit.	ONE discussion of structures, reactants and products.	TWO discussions of structures, reactants and products.

Q	Expected Coverage	Achievement	Merit	Excellence
TWO	Enzymes are biological catalysts that are built out of protein with an active site, which binds to the substrate. Co-factors are molecules / minerals / substances that bind with the enzyme to increase its activity, usually by allowing the active site to bind more effectively with the substrate / to further lower the activation energy needed for the reaction to take place. Without the cofactor, the enzyme won't be able to catalyse the reaction. Enzymes work at their highest rate only at their optimum pH. In this case, the optimum pH for *elodea* enzymes is between pH 6 and pH 9, with a peak rate at pH 8 where just over 200 reactions per second are happening. This is because at the optimum range, the enzyme's active site will fit best with the substrate to catalyse the reaction. As the pH moves below or above this pH range, the reactions slow down. This is because the enzymes are starting to denature. The low and high pH will disrupt the hydrogen bonds of the enzyme's protein and cause the active site to change shape. When this happens, the substrate no longer fits into the active site and the reaction cannot proceed. In this case, at pH 4, and at pH 10 the *Elodea* enzymes are completely denatured.	• Describes enzyme function. • Describes enzyme structure including active site. • Describes co factors as increasing / enhancing enzyme activity. • States that enzymes have an optimum pH / works best at pH 8 where their activity is at its highest / pH outside of optimum range will slow or stop enzyme activity. • States that high or low pH will denature the enzyme.	• Explains co factors are separate molecules / minerals that bind with the enzyme to increase its activity. • Explains that denaturing changes the shape of the active site / causes the substrate to no longer fit into the active site. • Explains that the enzyme's optimal activity is between pH 6-9 with a peak rate at pH 8. • Explains that enzymes denature below pH 4 / above pH 10.	• Full discussion of pH that links low AND high pH with changing the shape of the active site so that substrate no longer fits AND quotes optimum range and both high and low pH points at which denaturing happens. • Full discussion of co-factors that includes binding to enhance the fit between active site and substrate when co factors present, which increases the ability of the substrate and active site to form a complex effectively / further lowers the activation energy needed for the reaction to take place / links to context.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes any ONE statement from Achievement.	Describes any TWO statements from Achievement.	Describes any THREE statements from Achievement.	Describes any FOUR statements from Achievement.	Explains any TWO statements from Merit.	Explains any THREE statements from Merit.	Fully discusses pH and enzyme activity with reference to the graph.	Discusses both pH and co factors and fully references graph.

Q	Expected Coverage	Achievement	Merit	Excellence
THREE (a)	The purpose of cellular respiration is to make ATP for the cell / release energy from glucose.	• Describes purpose of cellular respiration.		
(b)	Aerobic word equation: glucose + oxygen → 36ATP + carbon dioxide + water (or unbalanced symbol equation) Anaerobic word equation: glucose → 2ATP + lactic acid + carbon dioxide (or unbalanced symbol equation) The process of aerobic respiration takes place in the mitochondria, and uses oxygen and glucose. It produces carbon dioxide and water as waste products and up to 38 ATP per glucose molecule. In contrast, anaerobic respiration does NOT use oxygen, and produces carbon dioxide and lactic acid / ethanol as waste products. In addition, anaerobic respiration produces only 2 ATP per glucose / much less ATP per glucose molecule. The reason the heart can beat faster (120 bpm) at 100% O_2 concentration, is that the aerobic respiration is supplying enough ATP to allow a fast heart rate. In addition, the waste products of aerobic respiration are easily removed from the cell, and are not toxic. Therefore, no damage will occur to the heart muscle. The observations above show that the heart beats much slower as the oxygen concentration decreases. This is because the lack of oxygen is slowing aerobic respiration. Once the oxygen level reaches 0%, the heart beats only 20 beats per minute because it is now using anaerobic respiration and there is not enough ATP produced to allow a faster heart rate. If the 0% oxygen was to continue for more than a few hours, it is likely the larva heart would stop beating completely, which could result in the death of the larva. Anaerobic respiration produces a harmful waste product of lactic acid, which could damage the heart muscle if it builds up in large quantities. In addition, the very low amount of ATP produced in anaerobic respiration may provide enough energy to sustain the heart beat for prolonged periods.	• Aerobic occurs in mitochondria AND anaerobic occurs in cytoplasm. • Description of aerobic respiration / materials / more ATP produced by aerobic respiration / correct word equation. • Description of anaerobic includes no oxygen needed / less ATP produced by anaerobic respiration / correct word equation. • States a trend from the data table – e.g. at low O_2, the heart rate is slower. • States that 0% O_2 for prolonged periods could result in death / serious harm.	• Aerobic respiration described AND linked to many more ATP being produced per glucose. • Anaerobic description linked to no oxygen needed AND toxic waste products / much less ATP produced per glucose. • Uses the data table to explain the results of one O_2 concentration. E.g. at 0% O_2, the heart rate is low because anaerobic respiration is happening. • Links 0% O_2 for prolonged periods could result in death due to lactic acid / low ATP production.	• Full discussion of the results linked to aerobic respiration. E.g. O_2 + more ATP produced + no toxic by-products + **numbers** quoted from the data table to support statements. • Full discussion of the results linked to anaerobic respiration. E.g. No O_2 + less ATP produced + toxic by-products + **numbers** quoted from the data table to support statements. • Prolonged exposure to 0% O_2 linked to: + lower ATP / energy + toxic by-products + damaging cell / heart muscle.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes any ONE statement from Achievement.	Describes any TWO statements from Achievement.	Describes any THREE statements from Achievement.	Describes any FOUR statements from Achievement.	Explains any TWO statements from Merit.	Explains any THREE statements from Merit.	Discusses ONE criterion for Excellence.	Discusses TWO criteria for Excellence. Can't get E8 without referring to specific data from table

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 18	19 – 24