**Assessment Schedule – Biology 2.4: Demonstrate understanding of life processes at the cellular level (AS 91156)**

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| **QUESTION ONE - Evidence**  | **Achievement** | **Merit** | **Excellence** |
| (a)Photosynthesis is the process in which plants use sunlight to produce nutrition for the plant in the form of glucose (sugar). This is converted and stored as starch. Plants convert solar energy into chemical potential energy, which is then available to other organisms. Basically, the plant takes 12 molecules of water and 6 molecules of carbon dioxide and converts them into one molecule of sugar, 6 molecules of oxygen and 6 molecules of water. light6CO2 +12 (or 6) H2O → C6H12O6 +6O2 + 6 (or not) H2O\* chlorophyll\* Candidates might not include water as a product, but should still get full credit.  | * Gives the reactants and products of photosynthesis / provides word equation.
* Describes the conversion of solar/radiant energy into chemical energy/glucose/nutrition for the plant.
* Identifies stroma and grana in structure of a chloroplast.
* Describes the absorption of sunlight by chlorophyll in the grana
 | * Explains how the double membrane (stroma and grana) relates to light dependent and independent reactions
* Explains the role of the inner membrane (thylakoid membrane) in providing a large surface area for enzyme catalysed reactions
* Explains how temperature affects the rate of photosynthesis by altering enzyme structure and efficiency.
* Explains how increasing substrate concentration (CO2 and water) increases the rate of photosynthesis.
* Explains enzyme inhibition by chemical herbicides slowing the rate of photosynthesis
 | Through discussion, links the rate of photosynthesis to the structure and function of enzymes* Discusses improvements in rate of photosynthesis by linking enzyme function to increasing temperature. Explains optimal temperature range for enzyme function and structural denaturation at temperatures above threshold.
* Discusses competitive inhibition of chemical herbicides preventing the binding of substrates to the active site of enzymes in the thylakoid membrane of chloroplasts. OR discusses hoe chemical herbicides bind to enzymes inducing a change in shape which prevents the active site from binding substrates.
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| (b)The chloroplast is the organelle where photosynthesis occurs. Chloroplasts have thin membranes / large surface area for absorption of light.The organelle is surrounded by a double membrane. Inside the inner membrane is a complex mix of enzymes and water called the stroma and is the site of the light-independent reactions.A complex network of stacked sacs called grana is formed through the folding of the thylakoid membrane. The large surface area created by the grana allows the maximum amount of light to be captured, and supports substrates reaching the enzymes efficiently. |
| (c)Enzymes are biological catalysts that speed up the rate of reactions or allow reactions to take place in conditions where it would not otherwise be possible.Enzymes are proteins.All enzymes have an optimum temperature. At very low temperatures the enzyme action is slow and at high temperatures the enzyme may become denatured which makes them inactive. The rate of photosynthesis is affected by **substrate concentration**: Substrate is the molecule on which an enzyme acts. Generally the more CO2 there is, the more efficiently glucose can be produced. Water availability can also influence the rate of photosynthesis. Plants can reach a maximum photosynthesis rate, at which point any increase in CO2 or H2O will not affect the plant further.**Temperature** affects the rate of photosynthesis. Because reactions are enzyme controlled, photosynthesis has an optimum temperature.The slight separation of the cells provides maximum absorption of carbon dioxide.**Chemical herbicides** can act as competitive inhibitors blocking or non-competitive inhibitors causing the active site of the enzymes involved in photosynthesis to be misshapen so that the enzyme catalysed reactions are slowed down.  |
| **N 0** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response or does not address the question. | An attempt but failure to give description or show understanding. | Provides ONE or TWO statements from Achievement. | Provides THREE statements from Achievement. | Provides FOUR statements from Achievement. | Provides THREE statements from Merit. | Provides FOUR statements from Merit. | Provides ONE statement from Excellence. | Provides TWO statements from Excellence. |

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| **QUESTION TWO - Evidence**  | **Achievement** | **Merit** | **Excellence** |
| **Cellular Respiration:*** The process of transforming chemical potential energy into the useable form (ATP) using oxygen
* Glucose + oxygen 🡪 carbon dioxide + water + energy (ATP).

**Diffusion:** * Movement of substances from a high concentration to a low concentration.
* Diffusion takes place along a concentration gradient.
* Passive movement.
* Eg: oxygen and glucose diffusing into the cell and carbon dioxide and water diffusing out of the cells.

**Osmosis:** * Movement of **water** from a high concentration of water to a low concentration of water through a semi-permeable (selectively permeable) membrane
* Passive movement.
* Eg. Diffusion of water out of the cells

**Active transport:** * Movement from a low concentration to a high concentration (or an increase in movement rate above that which occurs without energy input from the organism).
* Energy is required.
* Eg:Exocytosis of mucus by goblet cells
 | * In (a) Describes aerobic cellular respiration as the function of the mitochondria
* In (a) Gives the reactants and products of cellular respiration / equation. (#s not required)
* In (b) Gives the structure of a mitochondria (double membrane, matrix, cristae).
* In (b) Describes the distribution of mitochondria in each cell.
* Describes the process of oxygen diffusion into the cell or carbon dioxide out of the cell
* Describes the movement of waste water out of the cell by osmosis
* Describes active transport
 | * Explains passive diffusion (oxygen/glucose/carbon dioxide) or osmosis with respect to concentration gradient.
* Explains the need to use energy (ATP) to perform exocytosis to transport mucus, which is too large a molecule to diffuse through the cell membrane on its own/secreted quickly in large amounts against the concentration gradient.
* Explains the abundance of mitochondria is linked to energy need, more throughout the muscle cell to assist in contraction of muscle fibres.
* Explains how the distribution of mitochondria is linked to where in the cell energy is needed.
 | * Through discussion compares the energy use of each type of cell and links the ideas to the abundance of mitochondria in each cell type. Muscle cells require large amounts of energy on demand so they have a higher concentration of mitochondria. Fewer mitochondria are required to power the production of mucus and/or active transport of mucus. Mucus may be continually produced and secreted at a slower rate.
* Through discussion compares the energy use of each type of cell and links the ideas to the distribution of mitochondria in each cell type. Mitochondria are located throughout the muscle cell next to the muscle fibres to provide energy in the form of ATP for muscle contractions. In goblet cells, energy is required mainly at one end of the cell, near the nucleus, and storage vesicles fill the upper end of the cell.
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| **N0** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response or does not address the question. | Provides any ONE or TWO statements from Achievement. | Provides any THREE statements from Achievement. | Provides any FOUR statements from Achievement | Provides FIVE statements from Achievement | Provides THREE statements from Merit  | Provides FOUR statements from Merit | Provides ONE statement from Excellence. | Provides TWO statements from Excellence. |

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| **QUESTION THREE - Evidence**  | **Achievement** | **Merit**  | **Excellence** |
| (a) Mitosis is a type of cell division in which a somatic (diploid) cell divides to produce genetically identical daughter cells for growth and repair.  | * Describes the role of mitosis to produce new cells for growth of spring vines.
* Describes the purpose of mitosis to produce identical (diploid) daughter cells with a complete set of chromosomes to carry out all cellular functions.
* Describes the role of enzymes in semi-conservative DNA replication.
* Describes how seasons (temp) influence enzyme action.
* Describes more food/energy is available during warmer seasons with more light intensity
 | * Explains how the process of semi-conservative DNA replication maintains the genetic code (producing identical chromatids).
* Describes the role of enzymes in semi-conservative DNA replication (unwinding, unzipping, polymerising).
* Explains the role of enzymes in DNA replication being affected by seasonal temperatures. (Increased temperatures speeds up the rate of reactions)
* Explains dormancy being due to enzymes involved in replication/cell division becoming inactive at cooler temperatures.
* Relates the rate of growth of vines to amount of photosynthesis the plant can do to provide nutrition for other functions.
 | * Through discussion links enzyme action to DNA replication. Discussion includes how factor(s) affect enzyme action, and how this in turn affects the rate of replication of mitosis/growth. May discuss optimal temperature for enzyme catalysed steps in DNA replication/division. Increased light intensity provides more energy through photosynthesis to speed up growth.
* Relates differences in the rate of mitosis to differences in functions of parts of the plant. The trunk only provides stability and grows slowly. The new vines are needed for photosynthesis and reproduction (forms grapes). Without photosynthesis the plant would have no source of nutrition/energy for other life processes (such as the growth of the trunk).
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| (b) Semi-conservative replication preserves the genetic code while producing new somatic cells. Steps involved include:* Unwinding and unzipping of double stranded parent strands to produce two single template DNA strands.
* Complementary base-pairing ensures that the newly synthesised strand of each DNA molecule (chromosome) is identical to the original missing half of the double stranded chromosome.
* Semi-conservative refers to the fact that each new chromosome (chromatid) is made of one old template strand and one newly synthesised strand of DNA.
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| (c) Enzymes are biological catalysts that speed up the rate of reactions or allow reactions to take place in conditions where it would not otherwise be possible.Enzymes function in specific conditions. Outside of these conditions the enzymes will not function as well.All enzymes have an optimum temperature. At very low temperatures the enzyme action is slow and at high temperatures the enzyme may become denatured which makes them inactive. DNA replication would occur at the greatest rate at the optimal temperature.Enzymes are involved in each step of DNA replication and therefore the rate of mitosis (growth) is dependent on the factors affecting enzyme action.Growth is faster in spurs/shoots than in the trunk, thus the trunk is not pruned.Trunk provides support whereas vines produce nutrition (are involved in reproduction). |
| **N0** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response or does not address the question. | Provides ONE statement from Achievement | Provides TWO statements from Achievement. | Provides THREE statements from Achievement. | Provides FOUR statements from Achievement. | Provides THREE statements from Merit  | Provides FOUR statements from Merit | Provides ONE statement from Excellence. | Provides TWO statements from Excellence. |

# Judgement Statement

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|  | Not Achieved | Achievement | Achievement with Merit | Achievement with Excellence |
| Score range | 0 – 7 | 8 – 13 | 14 – 18 | 19 – 24 |