Assessment Schedule – 2021

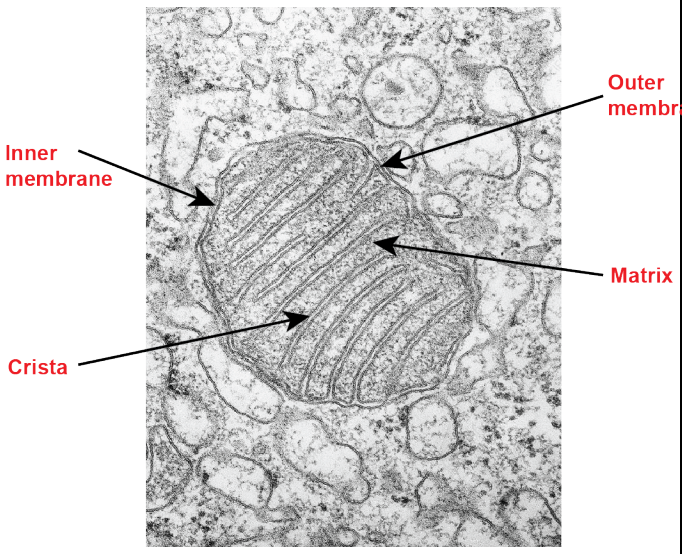
Biology: Demonstrate understanding of life processes at the cellular level (91156)

Evidence Statement

Q	Expected Coverage	Achievement	Merit	Excellence
ONE (a)	Photosynthesis is the process in which plants use sunlight, water, and carbon dioxide to produce glucose and oxygen. $\text{carbon dioxide} + \text{water} \xrightarrow{\text{light}} \text{glucose} + \text{oxygen}$ (Accept non-balanced symbol equation / mixture of symbol and word equation.)	• Describes the process of photosynthesis / provides correct word equation / provides unbalanced symbol equation.		
(b)	Water in the soil enters the root of a plant. Water enters via osmosis. Osmosis is the diffusion of water across a semi-permeable membrane from an area of higher water concentration to an area of lower water concentration. Osmosis requires no energy. Water in the soil enters (capillary action) through tiny root hairs. The soil must have a high concentration of water to move into the root cell semi-permeable membrane and into the root cell, which would have a low water concentration. Water is transported to a chloroplast within a leaf cell. In the chloroplasts, thylakoid membrane light energy is absorbed by the pigment chlorophyll. This light energy splits the water molecule into oxygen and hydrogen. Hydrogen 'goes to the' light independent (next phases) process, while oxygen is excreted as a waste product (via stomata on leaves). The hydrogen from the water molecule is used to help (combines with carbon) make the glucose molecule.	• Describes how water enters the plant through the roots. • Describes osmosis as the movement of water from high water conc to low water conc. • Describes light-dependent reaction. Light energy splits the water molecule into oxygen and hydrogen. • Describes hydrogen contributing to the production of glucose molecules. • Describes oxygen being excreted as waste. • Describes light-dependent reaction occurring in the chloroplast / grana / thylakoid membrane.	• Explains how osmosis occurs in **root cells** / correct full definition and mentions where high and low concentration / solute occurs. • Explains light dependent reaction and where it occurs. Light energy absorbed by chlorophyll and splits water molecule into oxygen and hydrogen. Occurs in grana / thylakoid membrane.	

(c)	Oxygen is derived from the water absorbed by the plant's roots. Oxygen is produced by the light dependent reaction, which requires sunlight to split the water molecule. Therefore, more oxygen is produced at midday when sunlight is highest, and lowest at midnight when there is no sunlight. More oxygen is produced at 6 p.m. than 6 a.m. because even though they have the same light intensity, the temperature is higher at 6 p.m. Warmer temperatures are better than cooler temperatures for photosynthesis. This means enzymes can collide more with substrates and more chemical reactions can occur. However, if the temperature increases too much, the enzyme may denature, resulting in the active site changing shape (no longer fitting the substrate), in which case the chemical reactions would stop, and oxygen production / photosynthesis rate decrease / stop. Other factors that affect the rate are; water availability, wave length of light, amount of chlorophyll / chloroplast number, enzyme concentration, nutrients / CO_2 concentration. Examples, but could discuss other factors: • The amount of water available to the plant will affect the production of oxygen / rate of photosynthesis, because if there is not enough water, the plant will be deprived of hydrogen, so will be unable to construct a glucose molecule, and thus lower the photosynthesis rate. • Different wavelengths / colours of light provide different amounts of energy / photons. Least energy from green light (as it is reflected) which means less water is split, less hydrogen to combine to construct glucose thus lowering the photosynthetic rate. • The concentration of carbon dioxide will affect the rate of photosynthesis (not oxygen production) because carbon dioxide is combined with oxygen (in the light-independent reaction) to form glucose, the final product of photosynthesis. • Plant nutrient exposure will affect the production of enzymes. As amino acids are required for enzyme construction / protein synthesis, if essential amino acids are not taken up by the plant, the plant may not be able to construct the enzymes necessary for photosynthesis to occur (thus decreasing the plant's rate of photosynthesis). As well as this, the amount of nutrients, such as potassium and nitrates, also affects the rate of photosynthesis. These nutrients could be used by enzymes as co-factors. If the co-factors / nutrients are limited, this would limit chemical reactions and the rate of photosynthesis. • The rate of photosynthesis will always correspond to the factor which is in least supply. When the other factors necessary for photosynthesis, such as light, become "limiting factors"; that is, those other factors also need to increase to bring about a further increase in the rate.	• Describes oxygen is made by the light dependent reaction so occurs during the day. • Identifies temperature higher at 6 p.m., more oxygen production. • Description of how temperature affects oxygen production. • Description of how light intensity affects oxygen production. • Description of how one other factor affects oxygen production.	• Explains why oxygen production is highest at midday and lowest at midnight (different light intensities). • Explains why oxygen production is different at 6 a.m. and 6 p.m. because of different temperatures **explained in terms of particle collisions / rate of reaction / photosynthesis.** E.g. explains warm temperatures increase oxygen production because **enzymes** collide more with substrates. • Explains how an increase in temperature can **denature** enzymes and slow / stop oxygen production. • Explains how one other factor can affect oxygen production.	• Discusses how light intensity AND temperature affect the production of oxygen throughout the day. • Discusses how ONE other factor affects oxygen production / the rate of photosynthesis. • Discusses ONE of the above AND how the rate of photosynthesis will always correspond to the factor that is in least supply.

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.	Meets the criteria for ONE Excellence bullet point.	Meets the criteria for TWO Excellence bullet points.

Q	Expected Coverage	Achievement	Merit	Excellence
TWO (a)		• Identifies 3 of 4 structures correctly.		

(b)	Anaerobic occurs in cytoplasm of cell – glucose is broken down into lactic acid and ATP (energy); no oxygen is present, therefore less energy (2 ATP) is produced compared to aerobic. glucose → lactic acid + (2) ATP. Disadvantage of anaerobic is that it is less efficient and lactic acid build-up causes mako shark cramps and stops muscles from working therefore cannot swim fast. If not removed from cell, it becomes toxic. Advantage is it produces ATP very quickly because does not require O_2. If O_2 is temporarily low in the cell, such as during explosive swimming, cells still get the energy they need to continue functioning. Aerobic respiration occurs in the cytoplasm and the mitochondria. Aerobic respiration is when glucose is broken down in the presence of oxygen to form carbon dioxide, water, and ATP. glucose + oxygen → carbon dioxide + water + (36) ATP Oxygen is present, so more energy (36 ATP) is produced compared to anaerobic, and the mako shark can swim for longer. Therefore, aerobic is more efficient. Lactic acid / ethanol (which can be toxic) is not produced. However, aerobic requires oxygen, so ATP is produced more slowly. E.g. it would be advantageous for the mako shark to anaerobically respire because (dissolved) oxygen concentration would become low during fast explosive swimming. Oxygen cannot be transported to all cells quickly enough. The mako shark's muscles temporarily produce ATP very quickly via anaerobic respiration, so cells would not shut down. However, the amount of ATP is less than for aerobic respiration swimming.	• Describes anaerobic / word equation. glucose is broken down into lactic acid and ATP (energy) without oxygen OR glucose → lactic acid + (2) ATP. • Describes aerobic / word equation. Aerobic respiration is when glucose is broken down in the presence of oxygen to form carbon dioxide, water, and ATP. OR glucose + oxygen → carbon dioxide + water + (36) ATP • Identifies where anaerobic takes place (cytoplasm) AND aerobic respiration takes place in the mitochondria. • Describes one advantage / disadvantage of anaerobic respiration. **advantages** - anaerobic respiration is relatively fast and does not require oxygen. **disadvantages** - less efficient - produces a small amount of energy 2 ATP - can not be sustained for a long period of time - produces lactic acid which is toxic to cells and causes muscle cramps. • Describes one advantage / disadvantage of aerobic respiration. **advantages** - aerobic respiration produces more energy / ATP (per glucose molecule) - it is more efficient - can be sustained over a longer period of time. **disadvantages** - Takes longer to release the energy from glucose. - requires oxygen for this process to start.	• Explains anaerobic respiration and products (***in cytoplasm, no O_2, creates lactic acid which is toxic and creates less ATP***). • Explains aerobic respiration and products (in matrix of mitochondria and inner membrane space, water, requires O_2 and creates lots of ATP). • Explains one advantage of anaerobic respiration. produces ATP quickly without the need of oxygen. • Explains one disadvantage of anaerobic. ***Less ATP*** so less energy for swimming fast, or toxic link to efficiency / cramping of muscles. • Explains one advantage of aerobic. ***Creates a lot of ATP*** and no toxic products, no cramping of muscles, more efficient. • Explains one disadvantage of aerobic. Requires O_2 and slower production of ATP / energy.	• Discusses where and when anaerobic and aerobic respiration occurs in the mako shark. where – linked to when in the shark (fast swimming in chasing prey over short distances). • Discusses the advantages and disadvantages of aerobic respiration in the mako shark. • Discusses the advantages and disadvantages of anaerobic respiration in the mako shark.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes ONE statement from Achievement.	Describes TWO statements from Achievement.	Describes THREE statements from Achievement.	Describes FOUR statements from Achievement.	Explains any TWO statements from Merit.	Explains any THREE statements from Merit.	Discusses ONE bullet point from Excellence.	Discusses TWO bullet points from Excellence.

Q	Expected Coverage	Achievement	Merit	Excellence
THREE	Osmosis is the diffusion of water across a semi-permeable membrane from an area of higher water concentration / water potential / free water molecules to an area of lower water concentration / water potential / free water molecules. Osmosis is passive / has no energy requirement. Water is lost from the fish towards the saltwater / seawater because the fish's body has a higher concentration of water compared to the surrounding saltwater. Saltwater is drunk by fish to replace water lost by osmosis. However, the Na^+ and Cl^- (solutes dissolved in saltwater) are not wanted. Active transport is the movement of substances across a membrane against a concentration gradient from low concentration to high concentration. It requires energy / ATP. It occurs through proteins in the cell membrane. Solutes such as Na+ and Cl- move when it drinks saltwater, but the fish must actively remove them from their body. Because of size / polarity / solubility they cannot move through the cell membrane, so must be actively pumped out through protein channels from an area of low concentration (fish's body) to an area of high concentration (surrounding saltwater), and this takes energy / ATP.	• Describes osmosis: - osmosis is the **passive** movement of water - down a **concentration gradient** - through a semi-permeable (cell) **membrane.** (2 / 3 points needed) • Describe active transport: - active transport requires energy / ATP - moves substances up a concentration gradient - involves ion pumps / protein channels. (1 / 3 points needed) • Describes why osmosis occurs between the fish and saltwater. Osmosis occurs as there is a difference in water potential inside / outside the cells. • Describes why active transport occurs between the fish and saltwater. • Maintains ion concentrations / allows osmosis to continue.	• Explains osmosis: - osmosis is the **passive** movement of water - down a **concentration gradient** - through a semi-permeable (cell) **membrane**. (3 / 3 points needed). • Explains active transport: - active transport requires energy / ATP - moves substances up a concentration gradient - involves ion pumps / protein channels (2 / 3 points needed) • Explains why osmosis occurs between the fish and saltwater: Water moves into the cell as there is a difference in water potential inside / outside the cells. This is maintained as ions are actively removed from cells. Saltwater is drunk by fish to replace water lost by osmosis. • Explains why active transport occurs between the fish and saltwater: Maintains ion concentrations and avoids higher levels that may harm the cell. • Allows osmosis to continue because the concentration gradient is maintained. • Explains the movement of Na^+ / Cl^- across the blue cod membrane (e.g. ion pump / protein channel). • Explains why water is lost from the blue cod. Water is lost from the fish towards the saltwater / seawater because the fish's body has a higher concentration of water compared to the surrounding saltwater.	• Discusses why blue cod must drink saltwater. E.g. Water is taken in to replace water lost / used (for life processes) Seawater contains other ions (Na^+ / Cl^-) These must be removed via active transport. Otherwise concentration gradients would change and the direction of osmosis would reverse. • Discusses why blue cod must actively remove Na^+ and Cl^- from its body. E.g.: Build-up of ions would create a low internal water concentration and prevent osmosis occurring. These ions must be removed through active transport / using ATP due to size / polarity / solubility and because they move against a concentration gradient.

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 bullet point from Excellence.	Discusses TWO bullet points from Excellence.

Cut Scores

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