Assessment Schedule – 2019

Biology: Demonstrate understanding of the responses of plants and animals to their external environment (91603)

Evidence Statement

Question One

Evidence	Achievement	Merit	Excellence
Migration is the seasonal mass movement of a population from one geographically defined location to another and back again. The most likely cue for migration is day length because this is more reliable than seasonal changes like changes in temperature or rainfall etc., as these are variable and there can be a cold day in warm months. If these latter cues were used, migration might occur at the wrong time, whereas changes in day length are consistent. The bar-tailed godwit *Limosa lapponica* could use stellar navigation. This is where they use the stars at night to navigate their migration pathway. The stars move around the south celestial pole or the north celestial pole, providing a direction point to navigate their course from. They could also use a fixed star or constellation, but would also require an endogenous clock to allow for the changes in the sky as the earth rotates on its axis. Also, when moving from one hemisphere to another, there would be different constellations and they would have to use both to use the stars. The godwit could also use Earth's magnetic fields to navigate their migration route, as this provides a direction as the godwit detects the changes in the magnetic fields which allows for a guide of their migration route. The godwit could also use the Sun as a compass or guide as it has a fixed point in the horizon. Again, because the godwit uses the sun as a compass, it will require a fairly accurate internal clock and will probably need to calibrate its compass system to local and current patterns of solar movement. It is most likely that the godwit uses all three methods as the sun or stars could be blocked out by clouds then the godwit could use magnetic fields to navigate direction, as well as using the sun during the day and the stars at night. They could also use landmarks to navigate their journey. By using all these methods of navigation, the godwit would be more successful on their long migration. The benefits of migrating means that the godwit leaves the colder climates of	Describes the behaviours exhibited by the bar-tailed godwit during its migratory process. • **Migration** is the seasonal mass movement of a population from one geographically defined location to another and back again. • **Stellar navigation** uses the position of the stars to determine the direction to fly on their migration journey. • **Magnetic navigation** – the birds use the magnetic fields that surround the Earth to determine the direction they should head on their migration journey. • **Solar navigation** – the godwit uses the position of the sun to determine the direction to travel on their migration journey • **Landmarks** to guide their journey and navigate their journey (this is less likely for the new fledglings as they have not travelled the migration route) e.g. the	Explains how cues could enable the godwit to navigate their migratory path effectively. • **Stellar navigation explained**. The bar-tailed godwit is able to determine the patterns of stars and the point in the sky around which they appear to rotate. This permits the birds to infer the pole point – true north in the northern hemisphere – from even a partial view of the sky. OR Because the stars are fixed in the night sky and they revolve around the celestial poles, the godwits fly towards a fixed point (star), and this causes the birds to know the direction to fly on their migration journey. AND The birds must have an internal biological clock to allow for the change in the stars position and the time of the night. • **Magnetic navigation explained.** Magnetite has been found in the beak region of the godwit and allows the bird to detect changes in the Earth's magnetic fields, and determine the direction of the	Comprehensively discusses the costs and benefits of migration to the Godwit by linking to the overall survival advantage. Some advantages include: • The animals remain in favourable temperatures; this means that they will not use as much energy to maintain suitable body temperature. • They have a constant supply of food, so they can grow larger and store energy reserves for the return trip. • Better breeding conditions, so they can leave more offspring, as their offspring have a higher chance of survival. • Reduction of predation / parasitism / disease as the predators have no prey and parasites no host etc. • Greater genetic mixing due to different populations sharing breeding grounds. Some of the costs include: • They could get lost or blown off course and not have enough energy to complete the journey. • They might get eaten by predators during the journey and can't contribute to the gene pool. • They might starve and die during the migration due to lack of food en route and can't contribute to the gene pool. • Its huge investment in energy, so they may arrive depleted and unable to court

Alaska and arrives at the warmer climates of New Zealand during spring and summer. This will benefit the godwits as they will use less energy keeping warm and avoiding the cold harsh climate during winter. More daylight hours are available as the day length is longer in summer and autumn compared to winter; this gives more time to forage for food and to feed young and look for mates. By making the migration, only the birds best adapted for the migration are able to survive the journey. This ensures that only the best alleles in the population survive and are passed on at breeding. This means that the population will be a collection of the alleles that best support survival in the current conditions. Due to the long distance, the godwit requires a large amount of energy, therefore need to eat a lot, to lay down fat reserves required for the long journey. If they do not do this, then the godwit might not be able to complete the migration. Cost to the individual is that a bird could be blown off course in a storm event during migration. The godwit may become disorientated due to adverse weather conditions disrupting the celestial (sun / star) compass, not allowing effective navigation during the migration and be blown off course, lose too much energy, and die.	coastline or mountain range – harder to use when flying over water. • **Sense of smell -** the godwit may also use scents or scent trails as adults can use the scent of the ocean and the scents of nearby landmasses to guide their way. • The **cue for migration** is most likely day length as seasonal migrants must know what time of year it is. The most common and reliable cue is day length (photoperiod) • Describes a cost OR benefit that applies to the Godwit	migration route. • **Solar navigation explained.** Because the direction of the Sun's perceived movement differs between the northern and southern hemispheres (left-to-right versus right-to-left), and changes twice a year in the tropics. Because the godwit uses the Sun as a compass it will require a fairly accurate internal clock and will probably need to calibrate its compass system to local and current patterns of solar movement. • **Day length explained.** The cue for migration is day length, as it is more reliable than temperature, as temperature varies and it could be an unusually cold day that could encourage migration. But because day length is more reliable, it will determine the best time to leave an area to allow the birds time to recover and replenish their resources while the grounds they are moving to will be ready with a flush of new resources and better conditions for survival. • Explains a cost AND benefit that applies to the Godwit	/ mate / breed successfully. All E answers must relate that: **Benefits of migration must outweigh the costs associated with migration. (Survival and reproductive success must be increased.)**

Not Achieved		Achievement			Merit		Excellence	
NØ = no response or no relevant evidence	N1 = 1 point from Achievement	N2 = 2 points from Achievement	A3 = 3 points	A4 = 4 points	M5 =2 points	M6 = 3 points	E7 = A cost and a benefit discussed, AND linked to overall survival advantage	E8 = 2 costs and 2 benefits discussed AND linked to overall survival advantage.

Question Two

Evidence	Achievement	Merit	Excellence
The growth of both the roots of ryegrass and the canola plant is positive geotropism. This occurs when the roots grow in a direction downwards in the direction of gravity. Redistribution of auxin to the bottom cells of the root, inhibits the cell growth and due to the normal growth of cell on the upper part of the root, the root bends down towards gravity. The interaction between the canola and the ryegrass is one of **interspecific competition.** The way that canola reduces interspecific competition is with **allelopathy / antibiosis.** This is when the canola plant releases chemicals from its roots that suppress/inhibit the root growth in the rye plants. Interspecific competition is where both the canola and ryegrass compete for water and minerals from the soil as well as light and space for growth. Because the canola produce and release chemicals into the soil this causes the root length to be suppressed. This means that the ryegrass's ability to compete for minerals and water is reduced, which will reduce the plants photosynthesis and its growth. Better root growth means that the canola plant will have better access to minerals and water. This means it will have a higher rate of photosynthesis and more energy available for growth therefore outcompeting the ryegrass species.	Describes the plant response in the growth of the roots. • This is **positive** geotropism / gravitropism, as the roots grow down toward gravity. • Detection of gravity occurs in the root cap. • Auxin moves down to the bottom cells in the radicle / root and inhibits cell growth. Describes interactions between canola and ryegrass. • The interaction between the canola and the ryegrass is one of **interspecific competition.** • The way that canola reduces interspecific competition is with **allelopathy / antibiosis**. • Identifies the best distance for planting canola is 1 cm. • The closer the ryegrass is planted to the canola, the shorter their root length • Identifies that higher densities of canola causes shorter roots of the ryegrass.	Explains how positive geotropism / gravitropism works in seedlings. Explains **how** the auxin moves down to the roots in the plants. • Gravity leads to the redistribution of auxin to the bottom cells of the roots inhibiting the cell growth and due to the normal growth of cells on the upper part of the root, the root bends down towards gravity. **Explains** the effects of **sowing distance** on the ryegrass seedling root length due to sowing distance. • The closer the ryegrass is planted to the canola, the shorter their root length due to the greater effect of the chemical released by the canola plant roots. e.g. The ryegrass that was 1cm from the canola plant had an average root length growth of 35–36 mm, while the ryegrass planted 2 cm from the canola plant had an average growth of 37–38 mm growth, compared to ones that were planted 3 cm from the ryegrass, which had an average root length growth of 42–44mm growth. ***(Refers to the graphs to back up their explanations)*** **Explains** the effects of **canola density** on the root length growth of rye. • E.g. The greater the number of canola plants, the more chemicals released in the soil. The results of this are shown in Fig. 2, where ryegrass planted in conditions of 0	Analyses the information to suggest how positive gravitropism and allelopathy provide an adaptive advantage to growing canola. • **Positive gravitropism** results in the roots growing downwards more effectively and therefore this means that the canola plant will have better access to minerals and water. Links to adaptive advantage This means it will have a higher rate of photosynthesis and more energy available for growth and future reproduction. • **Density of planting** Because the length of root growth of the ryegrass is supressed due to the closer planting of the canola, the effect of suppression on the growth of roots is greater. This would provide an adaptive advantage, as the canola plant would have a greater access to water and minerals, providing the plant with a greater competitive advantage, being able to grow more quickly, outcompeting the ryegrass. Planting the canola at high density, higher than 30 greatly increases the effect of allelopathy / antibiosis • **Links to adaptive advantage.** By suppressing the growth of roots they would be able to outcompete the ryegrass plants for water and minerals. This also means that the canola plant can get more water and nutrients, and photosynthesise at a higher rate, as water is not as limited compared to the ryegrass. Because the canola has a higher rate of photosynthesis, and more energy available for growth and future reproduction. • **Distance of planting** The closer the canola is planted to the ryegrass, the

		canola plants had the greatest rye root length, which decreased as the number of canola plants increased until reaching 55% shorter than the control when grown in seedling beakers with a density of 60 seedlings per beaker. ***(Refers to the graphs to back up their explanations)*** • Explains an adaptive advantage but without reference to the graphs.	greater the effect of the chemical released (allelopathy / antibiosis) by the canola on the root growth of the ryegrass. The ryegrass that was 1 cm from the canola plant had an average root length growth of 35–36 mm while the ryegrass planted 2 cm from the canola plant had an average growth of 37–38 mm growth compared to ones that were planted 3 cm from the ryegrass that had an average root length growth of 42–44 mm growth. Links the pattern of planting to competition. Explains that the best distance to plant canola is within 1 cm of ryegrass for the greatest effect of allelopathy / antibiosis reducing the effect of competition with ryegrass by reducing the root growth of rye. **Links to adaptive advantage** This also means that the canola plant can get more water and nutrients, and photosynthesise at a higher rate, as water is not as limited compared to the ryegrass. Because the canola has a higher rate of photosynthesis, and more energy available for growth and future reproduction.

Not Achieved			**Achievement**		**Merit**		**Excellence**	
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Question Three

Evidence	Achievement	Merit	Excellence
A territory is a defined area that is defended from individuals of the same species. A home range is an area where the organism can be found, but is not defended. It is an area that contains the territory and contains all the resources required to survive. The costs of maintaining a territory to the kiwi is energy it expends to defend and mark the boundaries with calls and displays. The cost of the kiwi getting injured while defending the territory, and the cost of eating, mating, and doing other activities to maintain the territory. The benefits include the male kiwi's ability to attract a mate for reproduction, but is dependent on the quality and size of the territory. It provides a safe area to raise and rear young in a protected nesting site. It also reduces competition within the species by allocating the resources to defined geological locations where each breeding pair and their young have the necessary resources to survive. This is a situation where the benefits must outweigh the costs for this behaviour to continue. The mating behaviour for the kiwi is that they form a pair bond and work together on the rearing of the young. This ensures that even though the kiwi only have a few offspring (chicks), they invest energy in caring for them while they are vulnerable, which helps to ensure success (k-selected species). Because both parents are involved in caring for and looking after the egg, there is a greater chance that the egg will hatch, as there is less time that the egg will be left unattended and get cold. Therefore forming a pair bond increases reproductive success. The great spotted kiwi invests a lot of energy in the one egg they lay so are more k-selected. This is shown by the female developing the egg over 34 days that is 20% of its total body weight and only producing one egg. The males use a lot of energy once the egg is laid by sitting on the for long periods of time and losing about	**Describes the great spotted kiwi's territorial behaviour.** • A territory is an area that is defended from other individuals of the same species. • A home range is an area where the organism can be found, but is not defended. It is an area that contains the territory and contains all the resources required to survive. **Describes the costs and benefits of its territorial behaviour.** **Costs** • The cost of a territory is the energy the kiwi uses to maintain the territory. • The cost of the kiwi getting injured while defending the territory. • The opportunity cost of the forgone activity to defend the territory, e.g. getting food. **Benefits** • A benefit of maintaining a territory is the male kiwi can attract a mate for reproduction. • Selection of a mate can be based on the size and quality of the territory. • Provides a safe area where the young are protected (nesting site). • Reduces intraspecific competition by separating resources to the defended areas (resource	**Explains how the activity pattern is controlled in the great spotted kiwi.** • The timing behaviour is controlled endogenously because after day 10 in constant environmental conditions, the kiwi's activity continued without any environmental cues. OR After day 10, the activity of the kiwi is free running, as the beginning of the activity occurred later each day. This means that the period of the activity is greater than 24 hours, which suggests that the activity is controlled endogenously. **Explains the costs and benefits of its territorial behaviour.** • Defending the territory can use up a lot of energy which can lead to stress and reduced fitness. If conflicts arise then there is also an increased risk of injury or death. • By maintaining a territory, the intraspecific competition is reduced because the resources within the territory are defended and therefore only used by the kiwi in the territory. This apportions the resources in the area to the territories for individuals in the population. **Explains how pair bond behaviour helps the spotted kiwi to survive.** • Because both parents are involved in caring for and looking after the	**Discusses how behaviours of forming a pair bond help the great spotted kiwi to survive in its ecological niche.** **The great spotted kiwi has a pair bond <u>linked</u> to energy required for the rearing and raising of the young, and higher survival.** • The great spotted kiwi invests a lot of energy in the one egg they lay, so are more k-selected. This is shown by the female developing an egg over 34 days that is 20% of its total body weight, and only producing one egg. • The male uses a lot of energy once the egg is laid by sitting on the egg for long periods of time and losing about 20% of its body weight. By forming a pair bond the parents are sharing the task of rearing and raising the young kiwi, reducing the amount of energy each expends to reproduce. This investment by both parents provides the young great spotted kiwi with enough care to ensure survival into adulthood. **Discusses how keeping and maintaining territories help the great spotted kiwi to survive in its ecological niche.** • After forming a pair bond, the great spotted kiwi share in the task of maintaining the territory. This reduces the energy required for either kiwi in maintaining the territory, thereby reducing intraspecific competition with the other great spotted kiwi in the area for resources.

20% of their body weight. By forming a pair bond, the parents are sharing the task of raring and raising the young kiwi, reducing the amount of energy each expends to reproduce. This investment by both parents provides the young great spotted kiwi with enough care to ensure survival into adulthood. While the female kiwi is out feeding, she is also marking the territory, making calls, and when she comes back, the male will leave and feed, also making calls. This means that the territory is maintained. Finally, by forming a pair bond, both the female and the male ensure that their genes are passed on to the next generation. The activity pattern of the great spotted kiwi is nocturnal as it is active in the night and inactive during the day. It is controlled endogenously because after day 10 in constant environmental conditions, the kiwi's activity continued without any environmental cues. By having an endogenous biological clock, the kiwi can start preparing physiologically for the foraging behaviour, e.g. producing enzymes and digestive juices ready for the activity. Also, respiration could increase to produce energy for the night's activity. Because their rhythm is controlled endogenously they can anticipate the time of activity and feed when their predators are not active. It may also be a time that their prey are active and more easily obtained.	allocation). **Describes mating behaviour.** • Kiwi form a pair bond and work together for the rearing of the young. **Describes the activity pattern.** • The great spotted kiwi is nocturnal, as it is active in the night. • The great spotted kiwi's activity is controlled endogenously / by a biological clock). • It is circadian, as its pattern is about 24 hours. • Describes an advantage of the activity pattern.	egg there is a greater chance that the egg will hatch as there is less time that the egg will be left unattended and get cold. Therefore forming a pair bond increases reproductive success. • While the female kiwi is out feeding, she is also marking the territory, making calls, and when she comes back, the male will leave and feed, also making calls. This means that the territory is maintained. • By forming a pair bond, both the female and the male ensure that their favourable genes are passed on to the next generation. **Explains how nocturnal behaviour helps the spotted kiwi to survive.** • E.g. explaining activity of predators OR prey.	**Discusses how the activity pattern helps the kiwi live and survive in its ecological niche.** • Any two points linked to survival of the kiwi (2 of these are worth 1 BP). Examples below: - By having an endogenous biological clock the kiwi can start preparing physiologically for the foraging behaviour, e.g. producing enzymes and digestive juices ready for the activity. - Respiration could increase to produce energy for the night's activity. - Because their rhythm is controlled endogenously, they can anticipate the time of activity e.g. they don't need to use up energy by coming out of their burrows to check light levels. - They can feed when their predators are not active. - It may also be a time that their prey are active and more easily obtained. - Synchronise with other Kiwi for mating etc.

Not Achieved			Achievement		Merit		Excellence	
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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8-13	14-18	19– 24