Assessment Schedule – 2016

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

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE	**Territoriality** is behaviour where an animal, such as the tui, actively defends an area where it feeds and nests and raises its young in safety. Having a set territorial area where they feed protects their food source from other tui, which is called **intraspecific competition** and against other bird species which reduces **interspecific competition**. This behaviour increases the tui's food source and available resources therefore more energy to carry out other activities such as feeding of the young nesting and defending its territory. The relationship between the tui and the red mistletoe is one of **mutualism** because the tui benefits from gaining nectar from the flowers which they can open, and the mistletoe benefits from the tui transferring pollen to other flowers of different red mistletoe plants. This increases genetic diversity of the red mistletoe and helps with sexual reproduction of the red mistletoe plants. The relationship between the red mistletoe and the mountain beech is **parasitism** this is where the host mountain beech is harmed and the red mistletoe plant benefits. This is where the red mistletoe grows specialised roots into the mountain beech's vascular system to obtain water and nutrients.	**Identifies behaviours and describes the relationship.** **Territoriality**: The tui's behaviour is territorial where it defends / protects an area used for nesting / raising young, feeding etc. **Mutualism** between the Tui and the red mistletoe. Tui feeds and mistletoe is pollinated. Both species benefit. **Parasitism / hemiparisite** The mistletoe growing into the stem of mountain beech. The mistletoe benefits and the beech is harmed. **Intraspecific competition** Two members of the same species compete for the same (limited) resource. E.g.: The tui and other tui that come into their territory compete for nectar from the mistletoe. **Interspecific competition** Two different species compete for the same limited resource. E.g.: The tui and other birds of different species compete for the same resource – the mistletoe nectar. **Agonistic behaviour** – is behaviour associated with conflict. The tui shows agonistic behaviour towards other tui and birds entering their	**Explains the behaviours with costs and benefits** **Territoriality** E.g.: Benefits e.g. • Defending the area against own species (avoiding intra-specific competition) and other species (avoiding inter-specific competition) Territoriality leads to greater access to food resources and better protection and care of young, so more chance offspring will survive. Costs e.g. • Having a large territory to defend requires excessive use of energy. • Risk of actual conflict / injury. **Mutualism** E.g. : • The tui benefits by gaining nectar and therefore a food source, while the red mistletoe benefits by getting pollinated which allows effective sexual reproduction. • This is a beneficial relationship to each species but costs could include the energy of producing nectar, OR interdependence on	**Evaluates the costs and benefits to each species in the relationships identified.** **Territory** E.g.: • Territorial behaviour results in better resource allocation in a population, as areas with the resources are defended. Having exclusive territories has several advantages as it helps to avoid competition and avoids wasteful energy competing for food in the same areas as all other birds. • Territorial behaviour ensures greater reproductive success due to better mating success (attraction or reconnecting with mates) and greater focus on parental care, resulting in greater fitness of the young. • Intraspecific competition is more intense as the individuals are competing for the same resources with the same adaptations. This is where ritualised displays reduce the chance of injury. • Larger territory would mean more energy required to defend and less time foraging. • If Tui were not territorial, they would have less energy or fitness left to raise young, and foraging would be unsuccessful. Territoriality results in the fitter pairs producing genetically fitter offspring and survival of stronger genotypes and phenotypes. • Benefits outweigh costs. **Mutualism** • The tui benefits by gaining nectar and therefore a food source, which leads to increased energy availability for growth and reproduction.

		territory by swooping down in a threatening display.	each other. **Parasitism** • Mistletoes are (partially) parasitic. They derive water, dissolved mineral ions and support. Therefore requiring less energy overall in order to survive. Costs to the mistletoe are the risk of the host tree dying, and thus losing the water source and vertical support. • The beech tree is losing access to the water and minerals and therefore is likely to have reduced growth and may be blocked from photosynthesis by the presence of the mistletoe. There are no benefits to the beech.	• The red mistletoe benefits by getting pollinated as the tui visit the flowers for nectar. This allows effective sexual reproduction and increases the variability in the offspring leading to increased survivability in future generations. • This is a beneficial relationship to each species but costs could include the energy of producing nectar, and interdependence on each other so if the Tui numbers decreased, the pollination of the mistletoes would be in jeopardy. Alternatively if some other factor reduced the availability of the mistletoe, the Tui's main food source would be at risk. • Benefits outweigh the costs. **Parasitism** • By tapping into the beech The red mistletoe reduces the amount of energy required for growth of a woody stem / complex root system and improves its overall opportunities to grow by reaching the canopy to gain more light for photosynthesis. • Without the beech tree to grow on the mistletoes would be unlikely to survive in a canopy environment. This does put the mistletoe at risk if it were to over parasitise the beech or if the beech trees died because of some other factor. The parasitic lifestyle increases the fitness of the mistletoe but reduces the viability of the beech. • For the parasite, benefits outweigh the costs.

Not Achieved			Achievement		Merit		Excellence	
NØ = no response or no relevant evidence	N1 = 1 point, e.g. one definition / description	N2 = 2 points from Achievement	A3 = 3 points	A4 = 4 points	M5 = 2 points	M6 = 3 points	E7 = 1 point	E8 = 2 points

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<tr><th>Q</th><th>Evidence</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
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<td>TWO</td>
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A hierarchy is a form of animal social structure in which a linear or nearly linear ranking exists, with each animal (hyena) dominant over those below it and submissive to those above it in the hierarchy. This is maintained by ritualised displays and aggression.
In the hyena example
Hyenas doing the biting
<table>
<tr><th>Hyenas being bitten</th><th></th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th></tr>
<tr><td></td><td>A</td><td>-</td><td>0</td><td>10</td><td>11</td><td>9</td><td>20</td></tr>
<tr><td></td><td>B</td><td>7</td><td>-</td><td>18</td><td>8</td><td>6</td><td>8</td></tr>
<tr><td></td><td>C</td><td>0</td><td>0</td><td>-</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td></td><td>D</td><td>0</td><td>0</td><td>17</td><td>-</td><td>12</td><td>11</td></tr>
<tr><td></td><td>E</td><td>0</td><td>0</td><td>6</td><td>4</td><td>-</td><td>27</td></tr>
<tr><td></td><td>F</td><td>0</td><td>0</td><td>18</td><td>0</td><td>0</td><td>-</td></tr>
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In the hyena example C is dominant to F as C bites F 18 time and C does not get bitten by F or any other hyenas which suggests that C is the most dominant individual. E is the next dominant hyena after F as it is bitten by both C and F. E is also bitten by D but because E bites D more times than D bitting E, E is ranked higher in the hierarchy. A is bitten by all hyenas except B so A is more dominant than B. This establishes the linear hierarchy as being C-F-E-D-A-B.
Establishing a hierarchy lowers conflict and aggression in the clan, as the hierarchy is determined early in life during brief fights (‘trials of strength’) or threats and displays, after which status is seldom contested except by newcomers.
The advantages of group living must outweigh the disadvantages if group living is to continue.
Advantages can include any or all of:
• protection from the physical environment – e.g. hyenas huddle together to keep warm
• greater ability to detect predators – amongst a group there is always likely to be a pair of eyes and ears on the lookout
• better defence against predators – e.g. hyenas maintain a territory defending the young and weak inside it
• greater ability to find resources such as food – e.g. co-operative
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• Define linear hierarchy as “hierarchy that occurs in a social group when the individuals are ranked from highest to lowest or from ‘alpha’ to ‘omega’ (sometimes known as a ‘pecking order’). The alpha individual is the top-ranked individual (has the highest status).”
• Order of the hierarchy in the table is
C F E D A B All correct
• Hyena D is challenging for a higher position in the hierarchy.
• Describes how hierarchy is maintained. The most dominant individual wins displays of strength or fights, and the least dominant is more submissive.
• Describes a possible factor that might affect position in the hierarchy – Any TWO factors from this list:
- Age
Older hyenas are more dominant than younger hyenas.
- Size
Larger hyenas would be stronger and larger, therefore win more interactions.
- Length of time in group
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• Explains how hierarchy is maintained:
“In most animals, the position in the hierarchy is determined early in life during brief fights (‘trials of strength’), after which status is seldom contested except by newcomers.”
- This reduces the amount of aggression in the clan
- and allocates the resources ensuring access to all of the clan.
• Explanation linked to factors that affect position (at least TWO) E.g.:
- Female hyenas that are more aggressive will win more interactions giving them a higher position in the clan.
- Older females with more experience at aggression and fighting would be higher in the hierarchy as they would win more interactions.
- Sex – males are lower ranking than the lowest ranking female.
• Explains why D is the hyena that is challenging for a higher position.
E bites D 12 times but D bites E 4 times. (in all other
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• Compares and contrasts the costs and benefits to the hyena of clan vs solitary lifestyle. (Must link biological ideas i.e. identify advantages and disadvantages and link each to state how the individual or group in the hierarchy is affected.)
- Being part of the clan provides more opportunities for reproduction. The dominant individuals leave more offspring than subordinate ones. The best adapted individuals breed / pass on their genes → population / species becomes better adapted / increased fitness.
- Even for the lower ranked omega individuals, there is the prospect of eventual reproduction if one or more of the dominant animals die. For an outcast / solitary individual the prospects of reproduction may be nil. Weaker individuals that normally would not breed can still contribute towards the survival of offspring of related parents → contribute towards survival of common genes.
- By being members of a clan
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	hunting by hyenas • mates available – no need to waste energy searching over time and distance for a mate • provision of learning opportunities for young – young can learn from adults and other young (e.g. hunting behaviour, social behaviour) • regulation of population through controlled access to mates / resources. Disadvantages can include any or all of: • increased intraspecific competition – as a group gets larger, resources become limited leading to competition within the group; can cause increased stress, poor nutrition and health, reduced natality, increased mortality • increased risk of contracting and spread of disease – closer proximity of individuals increases risk of contracting disease from infected individuals and spread of disease throughout the group • access to mates may be restricted to only higher-ranked individuals. • increased risk of infant mortality in some groups if young harmed / cannibalism by other adults or siblings. The advantages of high rank are more food and better access to mates, a dominant female leaves more offspring than a subordinate one. the advantage for the omega individuals, there is a slim prospect of eventual reproduction if one or more of the dominant animals die. For an outcast, the prospects of reproduction may be nil. Lower-order animals also benefit by being members of a group – a group means reduced risk of predation, greater chance of obtaining food, etc.	Being in the group longer means that they might be higher up the hierarchy as they have had more time to establish themselves in the hierarchy. - **Experience** More experience could mean the hyenas with more experience in using aggression. - **Health status** Individuals with better health are better able to win aggressive displays and challenges. - **Propensity to aggression** The more aggressive individuals will have more aggressive interactions and therefore a greater chance of being more highly ranked in the hierarchy. - **Sex** Whether they are male or female.	relationships only one hyena bites the other). i.e. at present D is challenging this relationship. • Explains adaptive advantages to the individual of remaining in a hierarchy / clan. (at least TWO) e.g. The advantages of high rank are that with more food and better access to mates, a dominant individual leaves more offspring than a subordinate one. e.g. Even for the lower ranked omega individuals, there is the prospect of eventual reproduction if one or more of the dominant animals die. For an outcast, the prospects of reproduction may be nil. e.g. Lower-order animals also benefit by being members of a group – a group means reduced risk of predation / better chances of getting food, as the group provides better protection / feeding opportunities for the individual than if they were alone. OR other reasonable answers.	there is reduced risk of predation as the group provides better protection – the dominant individuals protect lower / weaker ones against outside attack. - In a clan there are better chances of getting food / feeding opportunities for the individual than if they were alone. Pack hunting / searching is more effective than individuals, who may not find or overpower prey on their own. Individuals within the clan have a place / allocation of food so even if they were not directly involved they still get to feed. - Lower ranked individuals can be target of much aggression especially when resources become scarce → so there is a chance of injury / infection / death however compared to being solitary individuals outside of the clan this risk is far lower. OR other reasonable answer.

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Q	Evidence	Achievement	Merit	Excellence
THREE	The weta is **nocturnal** and initially emerges at 6 p.m. and is active until about 6 a.m. the following day. This is shown on both actograms. On the first actogram after about day 5 the rhythm is **free running** as the rhythm continues but starts to occur later each day as there is no **zeitgeber**. Because the experiment was held in constant environmental conditions and darkness and the rhythm continues in the absence of any enviromental cues, which means this rhythm is controlled **endogenously**. In Graph B the rhythm was reset by the **zeitgeber**, which is changes associated with dusk or in this case the dark conditions did not occur until 8 hours later when the lights were switched off. This caused a **phase shift** which **entrained** the activity of the weta from onset of activity at about 12 hours regularly until day 18. After the extra length of light, the onset of activity occurred later which showed a **phase shift** and that the rhythm became **free running** from that point.	**Describes the weta as being nocturnal** As it active at night / during the dark period. **Describes endogenous rhythm**: • Endogenous (biological clock) rhythm / Circadian rhythm that is built in / internally generated / not dependent on external cues. **Describes a phase shift** • Entrainment involves a process called **phase shifting**, in which the start of the rhythm / activity is advanced or retarded. Phase shifting can be accomplished using an appropriate environmental cue. Often this cue is light (or absence of light). **Describes zeitgeber:** • An external stimulus or cue, such as daylight or a regularly repeated occurrence, that serves to regulate an organism's biological clock. In this case it is the light introduced on day 18, which has caused a phase shift with the rhythm starting 6-7 hours later. **Describes the term entrained:** • Where the endogenous rhythm / Circadian rhythm is re-set by a zeitgeber / outside factors / light and dark. **Describes aspects of the graphs:** • Weta's activity is reset by change in photoperiod / exposure to light. • Weta's activity is not reset / becomes free-running when left in darkness / Weta's biological clock keeps running when left in darkness. • Wetas are active in the earlier part of the night / (1800-0400) or (6 p.m. – 4 a.m.) when left in darkness. **Gives an advantage for behaviour:**	**Analyses the response and pattern with reasons:** • The response is endogenous (biological clock) because the rhythm is regularly repeated and doesn't disappear when the light-dark regime changes to dark only / continues in the absence of external cues. **Differences in the actograms are explained:** • Graph 1 shows that weta's rhythmic behaviour continues in the dark but that it is not re-set by exposure to light / there is no zeitgeber / environmental cue, it is **free running.** • Graph 2 weta show a regular pattern of activity from 1800 to 0400 or 6 p.m. to 4 a.m. when exposed to a constant 12 hr light-12 hr dark regime. Their biological clock / rhythm is being reset by the change in light / dark. **An adaptive advantage is explained:** • The weta nests deep in the tree where it cannot sense day and night. The biological clock triggers activity at the right time so feeding can happen in darkness / activity happens when there are fewer visual predators / when it is safer. The wetas metabolism is synchronised to anticipate the active time. Eg feeding, avoidance	• **The pattern of the weta's behaviour is fully analysed through explanations and comparisons of the actograms.** Graph 2 shows weta's activity in laboratory conditions under a constant 12 hr light – 12 hr dark regime, where the **Endogenous** biological clocks are entrained into a regular rhythm. There is **no** fluctuation in the activity up to day 18. After day 18, the constant environment conditions mean that the rhythm is free running again and is similar to Graph 1. Graph 1 removes the **zeitgeber** by placing the weta in a regime of constant / 24 hr darkness. With **no zeitgeber** / entrainment, the rhythm becomes **free-running** and shows weta's natural endogenous rhythm is 24 hours and 20 / 30 mins. This can be seen where the wetas' activity becomes later each day. • **The adaptive advantages are considered.** In the absence of light, for short periods the biological clock will lead to activity at the right time – cover of dark. Activity will still happen even if the photoperiod changes. Energy is conserved, as weta are active only when they need to be. Avoidance of predators. Avoidance of dehydration etc. Leads to greater survival / reproductive success. Having an endogenous rhythm that can be entrained to a Zeitgeber ensures that the weta can adjust to changes in

		• Weta go out at the right time / night. • Weta stay in tune with day and night cycles. • Weta rely on their biological clock to tell them when to be active.	of predators / avoidance of dehydration	daylight as the seasons change.

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 12	13 – 18	19 – 24