Assessment Schedule – 2014

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

Evidence Statement

Q1	Evidence	Achievement	Merit	Excellence
	Territorial behaviour is where an animal, such as the gannet, actively defends an area where it nests and raises its young in safety. Having a set territorial area within the nesting colony provides a small but relatively secure area where a chick can be hatched and raised. There will be safety in numbers, where the chances of being attacked by predators are reduced. It is where mates can be found and is usually close to food sources. It provides a defended area exclusively for the use of the breeding pair and is unlikely to be encroached upon by other birds. Stronger breeding pairs will usually gain the best breeding sites and defend more strongly, resulting in better survival chances of their chicks, with stronger genetic heritage. It would be impossible to defend a territorial area at sea as the areas to be defended would be too large and the birds would spend all their time and energy defending, and none actually foraging for food. However, maintaining separate foraging areas at sea means there is less competition for food. A bird won't arrive at a site and find others have picked up all the available food before them. The birds tend to return to the same nesting sites by migration each year, which is probably a learned and / or genetic behaviour, and it follows that foraging sites at sea are probably also accessed through learned or genetic behaviour, or both. Therefore, they would keep to mutually exclusive foraging areas specific to their own colonies.	• **Describes territorial behaviour** as defending / protected an area used for nesting / raising young. • **Describes adaptive advantages of territorial behaviour.** Eg: - Protection from predators due to number of gannets. - Where mates can be found. - Greater survivorship for chicks - More parental care. - Strongest birds have better defended territories. - Provides an exclusive area for raising young. - Decreased aggression in group. - No territorial behaviour at sea as not defending place where chick is.	• **Explains adaptive advantage of one of the explained territorial behaviours using biological ideas.** Eg: - Protection from predators means greater survival opportunities. - Stronger birds are more likely to have the better territories and raise stronger offspring. - Territoriality leads to greater protection and care of young, so more chance offspring will survive (and genes be passed on.) • **Provides a sensible reason why gannets maintain mutually exclusive (colony specific) foraging areas / non territorial in area at sea** Eg: - Impossible to be territorial at sea due to large areas to defend requiring excessive use of energy. - No need to be territorial at sea due to not a place for rearing young. - Gannets may have learned or	• **Comprehensively links ideas between the advantages to gannets of the discussed territorial behaviour.** Eg: - Despite small nesting sites and close proximity to other birds, which causes fighting and possible spread of disease, it is still much safer to hold a territory amongst others offering protection from predators and adverse environmental conditions. • 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. • Territoriality results in the fitter pairs producing genetically fitter offspring and survival of stronger genotypes and phenotypes. • Territorial behaviour is not apparent at sea as the birds have no need to waste energy on protection of young and nesting site. • **Links ideas between the territorial behaviour in gannets with analyses of reasons why gannets appear to**

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<td colspan="2">have a genetic imprint which guides them to preferred foraging areas at sea.
- Cant overcrowd at sea as the birds fly to the sea and overcrowding at this point could injure members of their own species.
- They forage with their own group as safety in numbers feeding / less likely to be lost .
- Feed in group so altruistic behaviour / kin selection lets them know where the food is, (gain more and safe due to this).
- Feed in areas for their colony due to proximity and less energy used for flight so more gained from food for young.</td>
<td colspan="2">maintain mutually exclusive (colony specific) foraging at sea
Eg:
- Staying within mutually exclusive foraging areas has several advantages as it helps to avoid competition and avoids wasteful energy searching for food in the same areas as all other birds. If birds were territorial at sea, they would have no energy or fitness left to raise young, and foraging trips would be unsuccessful.
- Mutually exclusive foraging areas could be due to learned behaviour, or be genetically inherited similar to migration routes. These show selective advantage in partitioning food sources, reducing competition.</td>
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Q2	Evidence	Achievement	Merit	Excellence
	Wheat competes with ryegrass / shows an allelopathic response / shows antibiosis. The wheat is able to produce a chemical within its roots that can inhibit germination and root growth of competing ryegrass. This is important to wheat farmers who want to keep ryegrass away from their wheat crops and maintain a good return on their wheat. The graph shows that the wheat plant extract has a small effect on ryegrass from 15% of full concentration, but root growth is affected more. Just under 100% of seeds germinate, but root length reduces to 80%. At 20% concentration root growth is strongly inhibited. The chemical within the wheat has prevented ryegrass from growing, but has not affected germination of the seeds as much. At 50% wheat concentration, there is a low rate of germination, but almost zero root growth; and at 70% concentration, ryegrass germination and root growth is completely inhibited. Presence of the wheat plant extract inhibits both ryegrass germination and root growth. This response could provide an adaptive advantage to growing wheat plants as it enables the wheat to inhibit and outcompete the ryegrass, which could otherwise prevent the wheat from growing to its full capacity by taking water and nutrients and light from growing wheat plants. What we do not know is if the chemical from the crushed wheat plants is normally produced in growing conditions, it may not be released from the root cells or be released in sufficient concentrations to have any significant effect on ryegrass. It may require particular soil conditions to activate, which were not evident in the trial and it could be non-selective and affect other wheat plants,	• **Describes interaction** as allelopathy / amensalism / antibiosis / competition / exploitation. • **Describes importance –** Ryegrass can have a negative impact on wheat crop growth. • **Identifies a response from the graph.** Wheat extract inhibits germination / growth of ryegrass seeds / seedlings / roots. • **Describes an advantage or otherwise.** Wheat has more room to grow / has no competition from ryegrass / extract may not work in wheat roots / roots may not make enough / extract may not be produced or released by roots.	• **Explains the interaction between wheat extract and ryegrass.** An example of allelopathy / competition, where wheat extract inhibits growth and germination of ryegrass seedlings. Root growth more severely affected by lower concentrations. Germination is not as severely inhibited until the concentration of wheat extract reaches approx. 50%. • **Explains either how the response / effect seen could provide an adaptive advantage (or not)** Wheat plants contain a substance that inhibits the germination and growth of ryegrass which competes with the crop plant for nutrients, light, water space etc. Released in low concentrations (as low as 15%) it may not stop germination but it will reduce the growth of ryegrass so that the wheat plants can get established. OR Wheat plants contain an extract that can inhibit growth and germination of competing ryegrass. However, fairly high concentrations are needed for any effect on ryegrass – over 40% full strength. The plants may not produce enough of this or the right concentration.	• **Comprehensively links ideas to explain the competitive interaction between wheat extract and ryegrass as shown from graph giving benefit to wheat / farmer.** An example of allelopathy / interspecific competition, where wheat extract inhibits growth and germination of ryegrass seedlings. Radicle growth more severely affected by lower concentrations (15% of full extract inhibits root growth to 80%). Germination is not as severely inhibited until the concentration of wheat extract reaches approx. 50%. This means that the ryegrass roots, if affected by the wheat extract, would not be able to grow as far or the plant as tall, due to stunted root growth and would not be able to crowd out the roots and growing shoots of the wheat. The farmer may dig wheat into the soil to reduce ryegrass growth / germination. • **Analyses results of the experiment on competition with figures to both germination and root length to show adaptive advantage: (**giving reasons why this response could and why it may not provide an adaptive advantage to growing wheat plants) Wheat plants contain an extract that can inhibit growth and germination of competing ryegrass. However, results at low concentrations are small, affecting growth more than germination. High concentrations are needed for any significant effect on ryegrass – over 40% full strength. The plants may not

	inhibiting their growth, which is not the outcome a farmer wants. It needs further scientific investigation and, after testing, could be produced ultimately for farmers to apply to their fields so that it provides a growth advantage to growing wheat crops.						produce enough of this or the right concentration. It may not be present in the root cells / not be released. It may require particular soil conditions to activate, and it might affect other wheat plants as well as ryegrass. It would need more investigation. If the extract was found to affect ryegrass and not wheat, it could be applied to fields by farmers, providing an advantage to growing wheat crops.	
	Not Achieved			**Achievement**		**Merit**		**Excellence**	
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Q3	Evidence	Achievement	Merit	Excellence
	The type of response is a (nycti)nastic (photonastic) response and a circadian or diurnal rhythm. It is not dependent on the direction of light, just the presence of light. The leaves fall down at night due to sudden changes in turgidity of cells at the base of the leaves (pluvini) due to ion concentration changes. This is reversed during daylight so that the leaves are lifted horizontal again. The response is regularly repeating every 24 hours. The rhythm is endogenous as it continues in the absence of any change in environmental conditions. This is seen when the plant is kept in constant light conditions and the leaves continue to rise and fall in a regular 27 hour cycle. The change in photoperiod / light conditions is the zeitgeber, but as the light remains constant, the cycle has become free running and the response is happening three hours later each day. This can be seen from the trace, where the peaks are happening later than the 24-hour lines each day and have fallen behind by 12 hours in 4 days. There are several possible adaptive advantages for plants and flowers in this behaviour. Having less surface area exposed at night can reduce heat loss from leaf surfaces, which can save energy losses. It may prevent plants from being browsed upon by nocturnal herbivores as the leaves are not as easily accessible. It may help with water collection as night-time condensation rolls off the leaves and onto the ground above the roots. For flowers, closing up may protect parts of the flower against cooler temperatures and dampness at night, or protect them from night-time browsers that might damage the flowers or displace the pollen. The flower may avoid unsuccessful pollinator attempts. The flower may conserve energy by reducing heat and moisture loss. It may also be a means of keeping pollen dry so that it will stick to pollinators. The adaptive advantage may be due to a co-evolutionary.	• **Describes the response** as a (photo)nastic / nyctinasty, due to photoperiod / light intensity. • **Describes a cause** – changes in turgidity (water movement / ion movement) of leaf bases. • **Describes rhythm / activity** as diurnal or circadian / daily pattern. • **Describes a possible and relevant adaptive advantage** – could conserve heat / retain temp / protect leaves / keep pollen dry in flowers / stops herbivory / stops pollen thieves.	• **Explains the cause of the nastic response.** Changes in turgidity at the base of the leaves due to change in concentration of / movement of ions / pluvini / in response to change in photoperiod (picked up by phytochrome). • **Explains endogenous nature of the nastic response by referring to graph.** Response continues regularly in the presence of constant light / free running in constant light conditions in a 27-hour cycle. Response is occurring later each day by 3 hours, as there is no dark phase to reset the clock. • **Explains an adaptive advantage of the explained nastic response** Allows plant to reduce its leaf surface area at night so there's less chance of damage due to exposure to colder temperatures. Heat can be conserved / lowering leaves means less chance of damage by night-time predators.	• **Comprehensively links ideas to explain the endogenous nature of the nastic rhythm and the underlying responses causing it. Refers to graph and explains changes over time.** Internally controlled by the plant's biological clock, the endogenous rhythm is greater than 24 hours and continues as free-running when conditions remain constant, such as continuous light. The natural rhythm is normally entrained by a change in photoperiod, but, as shown in the graph, the leaf drop is happening later each day, as the peak moves further to the right, towards and then past the 24-hour period, so that the leaves are falling in the early stages of the day, by the end of the 6th 24-hour period on the trace. • **Evaluates adaptive advantages (may also include why there may not be an adaptive advantage).** Allows plant to reduce its leaf surface area at night so there's less chance of damage due to exposure to colder temperatures and may lead to less frost exposure on cold nights. Heat can be conserved. Collection of night-time moisture onto lowered leaves will lead to water being channelled onto the ground

								where it can be absorbed by the roots. In the case of flowers, closure at night can keep pollen dry, as dry pollen will stick better to pollinators than wet pollen. Lowering leaves and closure of flowers means less chance of damage by nighttime predators, especially loss of pollen.	
	Not Achieved			**Achievement**		**Merit**		**Excellence**	
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Cut Scores

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