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Level 3 Biology, 2019

91603 Demonstrate understanding of the responses of plants and animals to their external environment

2.00 p.m. Tuesday 12 November 2019
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the responses of plants and animals to their external environment.	Demonstrate in-depth understanding of the responses of plants and animals to their external environment.	Demonstrate comprehensive understanding of the responses of plants and animals to their external environment.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

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QUESTION ONE

Migrating birds make the longest non-stop flights in the animal kingdom. Bar-tailed godwits or kuaka, *Limosa lapponica*, can fly about 12 000 km at one time; further than any other known birds.

Researchers found that godwits leave non-breeding grounds of New Zealand from the second week of March to the end of the month. They make the long, usually non-stop, flight from non-breeding grounds to coastal rest-and-recovery grounds in the Yellow Sea region of East Asia. After an average rest-and-recovering period of 41.2 days, they fly over the north Pacific Ocean before heading northeast to the Alaskan breeding grounds.

During the breeding season, the godwits breed, laying a clutch of four eggs on the coast of Alaska. Parents share incubation and brooding post-hatching.

The godwits then return to New Zealand on a non-stop flight across the Pacific Ocean, taking 7–9 days, from September to mid-October. Juveniles arrive in New Zealand after their first trans-Pacific flight when approximately four months old.

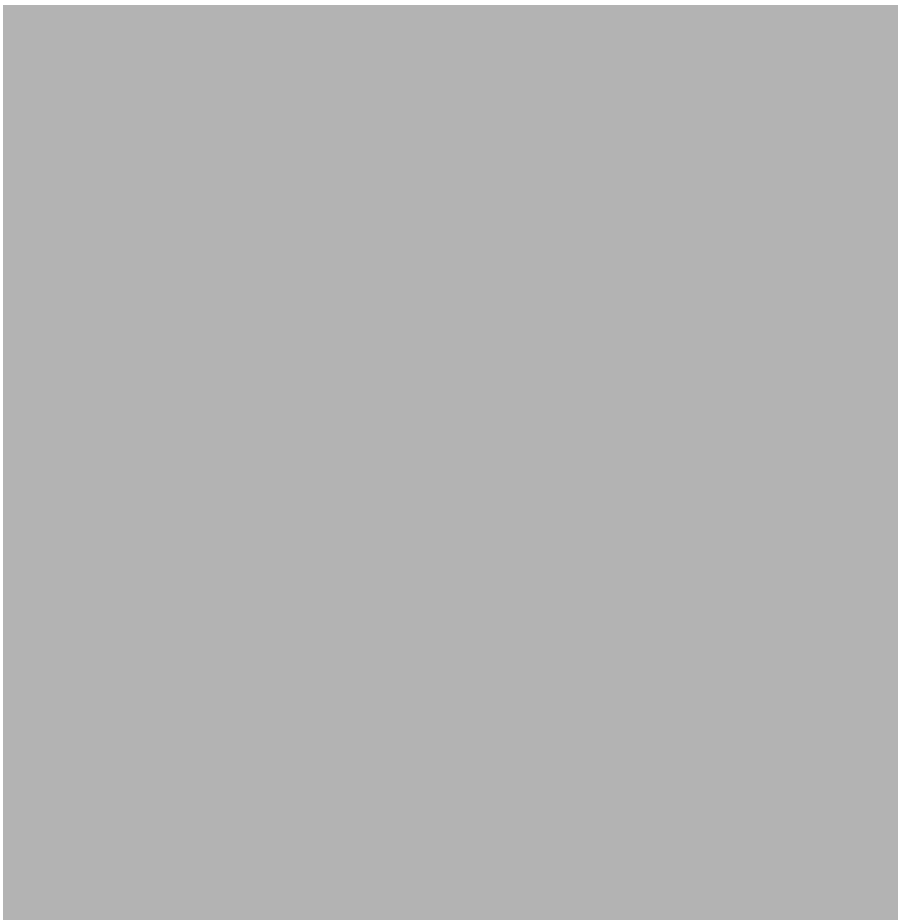

Fig. 1: The migration route of the bar-tailed godwit.
Geographx

Fig 2: A bar-tailed godwit in flight.
http://nzbirdsonline.org.nz/species/bar-tailed-godwit

Fig. 3: A clutch of eggs of the bar-tailed godwit.
http://nzbirdsonline.org.nz/species/bar-tailed-godwit

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Evaluate the behaviours exhibited by the bar-tailed godwit during this migratory process.

The evaluation should:

- describe migration
- explain which cue is the most likely to encourage migration of the godwit, AND explain three methods the godwit could use to navigate this migratory path effectively
- compare the costs and benefits to the bar-tailed godwit of making this long-distance migration.

There is more space for your answer to this question on the following pages.

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QUESTION TWO

Canola *(Brassica napus)* is grown in both New Zealand and Australia. Most of it is used to make food-grade canola oil. Annual ryegrass *(Lolium rigidum)* is a common weed found growing alongside canola crops, reducing how well they grow. Suppression of weeds by natural chemicals produced and released by crop plants is a tactic for weed management. Researchers carried out experiments on two basic factors:

- density, and
- distance between canola and annual ryegrass

to establish if either or both of the above features had any major roles on canola seedling interference ability on the ryegrass.

Experiment 1 and 2 show the effects of sowing distance and density of canola on root growth of ryegrass.

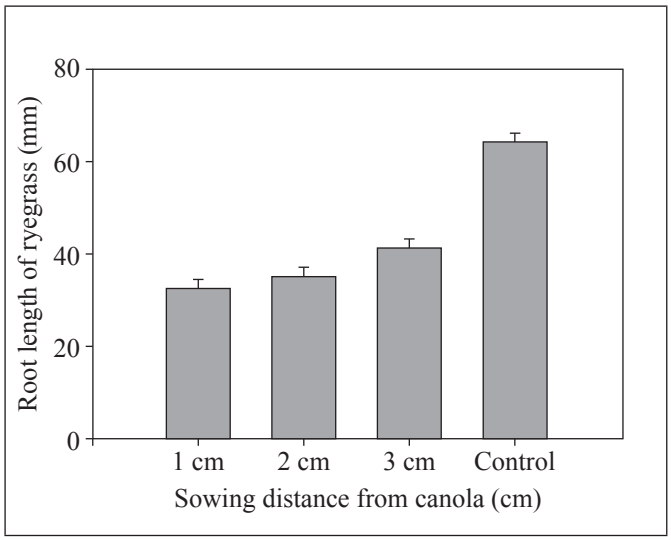

Fig. 1. Sowing distance effect of canola root chemicals released on root growth of annual ryegrass. The distances were 1 cm, 2 cm, and 3 cm from the canola plants, and the control is grown in the absence of canola.

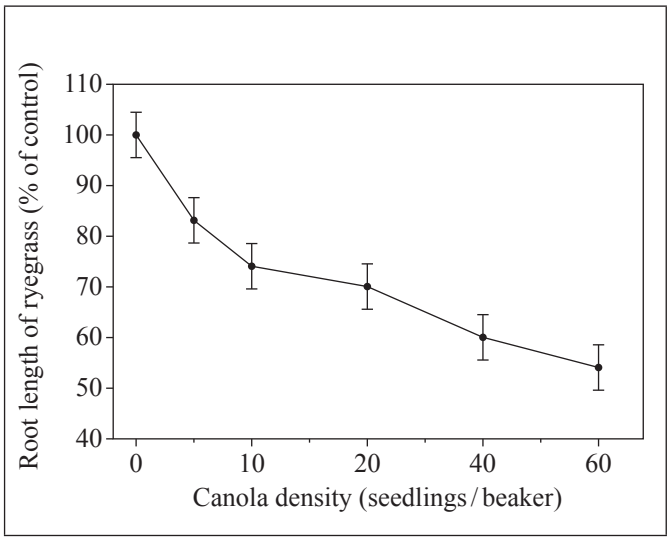

Fig. 2. Effect of density of canola on the root growth of ryegrass. % root length compared to control (root length of rye grass planted without canola present).

Discuss the response of the canola roots to gravity and the effects of sowing distance and canola density on ryegrass root growth.

In your answer use evidence from the experiments to:

- fully describe the plant response in the growth in roots from seedlings and the interaction between canola and ryegrass
- explain how the growth response in the roots from seedlings occur
- compare the ryegrass seedling root length in the various conditions above
- analyse the results to suggest how these two responses could provide an adaptive advantage to the canola plants.

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QUESTION THREE

The great spotted kiwi or roroa, *Apteryx haastii*, is a species of kiwi endemic to the South Island of New Zealand. In an experiment, their activity was observed over 10 days in normal environmental conditions, and they were then moved into constant darkness after day 10. The results are displayed in the actogram below.

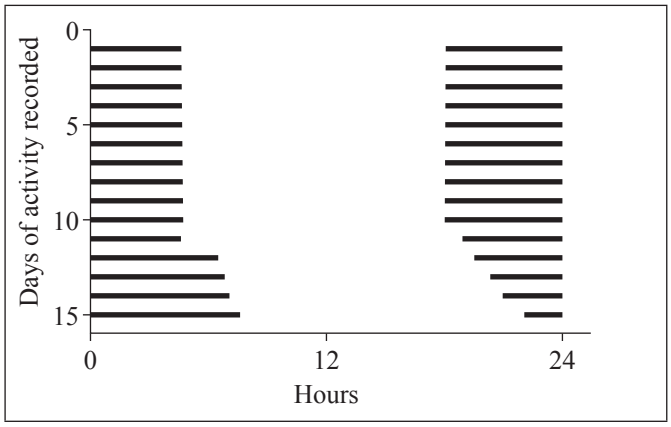

Fig 1: The great spotted kiwi activity of 10 days in normal environmental conditions followed by another 5 days in constant darkness.

Fig 2: The great spotted kiwi.
http://nzbirdsonline.org.nz/species/great-spotted-kiwi

The great spotted kiwi is territorial and is active at night. Once territories are established, disputes are usually resolved by calls, which can be heard up to 1.2 km away.

When the great spotted kiwi are ready for mating, a female kiwi will call, alerting the male that she is near. If the male is interested, he will follow the female, and if she is receptive they will form a **pair bond**.

The female great spotted kiwi produces a single, large egg (20% of her body weight). This takes a lot of energy to produce. By regularly weighing females, scientists were able to determine when their weights started to rise as a result of "pregnancy". It was found that thirty-four days were needed to grow an average egg. Most other species of birds take only one or two days for this task.

Females of the great spotted kiwi are monogamous, and consistently lay clutches of only one egg. The harsh environment seems to compel these females not only to help their partners with incubation, but also to reduce their clutch size to the absolute minimum.

The kiwi spend an average of 83 days incubating each egg. It is mostly the males that spend time and energy looking after the egg. A male will sit on the nest almost all day, leaving it to search for food for only a few hours each night. Luckily for the males, after the first few days, the chicks become self-reliant. A week after hatching, they can sniff out food on their own, and they return to the burrow only to be warmed by the male during the day and part of the night. Males can then slowly begin to recover the more than 20% of body weight they have lost.

Discuss how the great spotted kiwi's behaviours help it to survive in its ecological niche.

In your answer:

- describe the activity pattern of the great spotted kiwi, what a pair bond is, and the difference between territory and home range
- explain how the activity pattern is controlled in the great spotted kiwi AND the costs and benefits of its territorial behaviour
- discuss how behaviours of forming a pair bond, keeping and maintaining territories, and activity patterns help the great spotted kiwi to survive.

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