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91603

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NZQA

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MANA TOHU MĀTAURANGA O AOTEAROA

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Level 3 Biology, 2015

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

2.00 p.m. Monday 23 November 2015
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 2–12 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.

Merit

TOTAL 15

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QUESTION ONE

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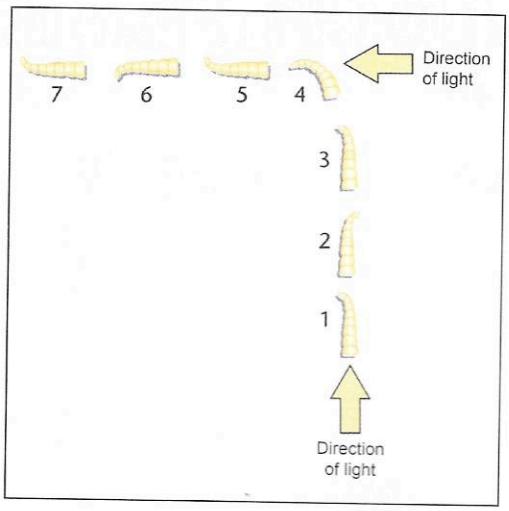
Some animals display innate behaviours.

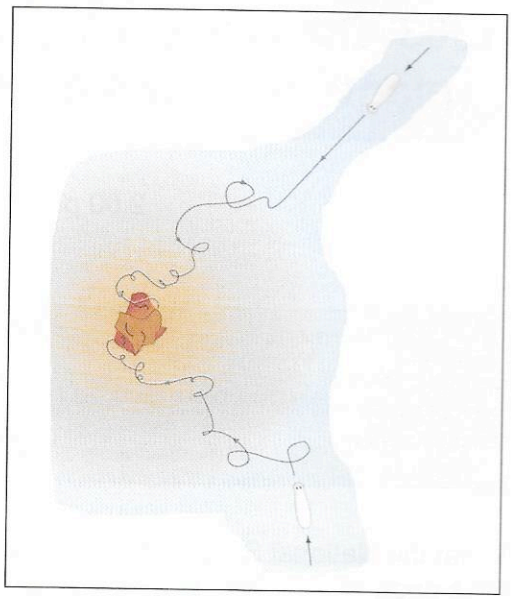
As green bottle fly maggots (*Phaenicia sericata*) crawl, they turn their heads, comparing the light intensity from each side. They always turn towards the darker side, taking them away from light.

Klinokinesis - turning
Orthokinesis - movement



Maggot response to light stimulus.

A piece of meat in water causes a chemical gradient. Flatworms, such as *Planaria torva*, move along a straight path until they detect an increase in chemical concentration. The flatworms increase their rate of turning in the area until they touch the meat and start feeding.



Flatworm response to chemical stimulus.

Compare these responses, the adaptive advantages gained for the animals that display them, and how these animals come to have them.

In your answer:

- identify the full term given for both responses, and define these terms kinesis
- using the information above, justify the types of orientation you have described, and explain how they operate in both the maggots and the flatworm
- compare the adaptive advantages these animals gain by displaying these behaviours.

When the green bottle fly maggots crawl and turn their heads, they are displaying kinesis ~~and a taxis response~~. More specifically, the type of kinesis is klinokinesis. Klinokinesis is defined as a response by animals where the intensity of the external stimulus determines the rate of ~~movement~~ turning. Klinokinesis is also in the other example for the flatworm. Additionally, the first example is also an example

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of a taxic response. Taxic responses are responses by an animal where a uni-directional stimulus causes the movement of an animal towards or away from the source of the stimulus. For the maggot in steps 1, 2 and 3, the maggot is light sensitive and detects the light behind it by carrying out klinokinesis, and once continually turning to detect where the source of light is coming from, the maggot will move away from the direction of the light, and this process is repeated in steps 4, 5, 6 and 7. This allows the maggot to move away from direct sunlight, as this generally means dry, bright places. Maggots will thrive in moist, cool conditions, such as under a dead organism like a sheep. This response allows them to find a food source and prevents them drying out. The flatworm, however, is constantly in water, and most of the stimuli are via chemicals, such as those released by the meat in the water. This is an example of klinokinesis, where the flatworm increases their rate of turning as they move. The flatworm is sensitive to changes in chemical signals, so as it constantly turns and the chemical stimuli grows stronger, the ~~flatworm~~ would turn more constantly, ~~as the chemicals given off by the meat~~ which

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

guides the flatworm to the meat. This provides the flatworm with a substantial source of food. The survival advantage of this is that the flatworm can eat plenty of food, which provides energy for life process such as growth and reproduction. Additionally, this ensures that the flatworm is reproductively fit, where the flatworm is able to lay eggs that are likely to hatch and thus the genes are passed on to the further generations. Similarly, the maggot is guided to a cool, moist area where there is less of a chance of drying out and dying and a larger chance of finding a food source where under a dead animal light intensity is limited. Furthermore, this ensures that once the maggots have found a viable food source, they are able to recieve energy from eating decaying animals, in order to grow and metamorphise into a fly, before having a greater chance of laying eggs and passing on their genetic traits/characteristics.

QUESTION TWO

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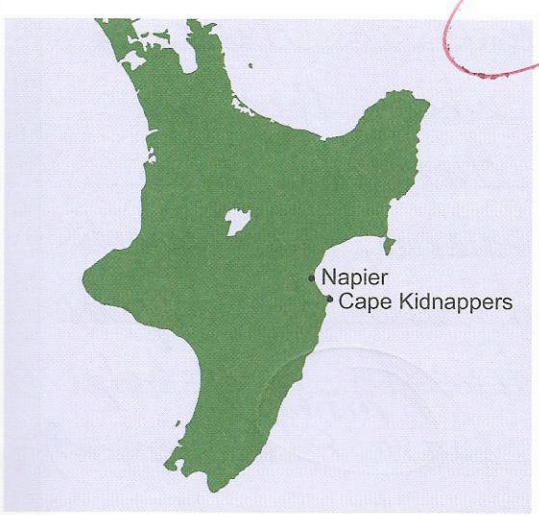
Cape Kidnappers on the coast of Hawke's Bay is an exposed headland, which hosts the largest mainland gannet *(Morus serrator)* colony in New Zealand, with around 6500 breeding pairs arriving in early August each year. The birds remain until the young fledglings are mature enough to leave, and then return to Australia in March the following year.

Gannets usually have the same mate over many breeding seasons and re-establish their relationship at the beginning of each breeding season. During the breeding season, the area is densely occupied by the gannets which actively defend their nesting sites.

Females lay a single pale blue egg, the size of a large hen's egg, any time from mid-September till mid-December. It is laid in a nest prepared from dried seaweed, cemented with guano (bird droppings), and incubated by each parent in turn. After 43 days, a blind, naked chick hatches, and is fed and cared for by both parents.



https://upload.wikimedia.org/wikipedia/commons/e/e9/Gannet_colony_cape_kidnappers.jpg

Evaluate the behaviours the gannet displays, using the given information above.

In your answer:

- identify and describe THREE behaviours displayed by the gannets
- explain the costs and benefits of the behaviours you have identified
- discuss how the combination of behaviours provides adaptive value to the gannets.

When travelling to New Zealand, the gannets display migratory behaivour. The gannets will make a journey in excess of 2000 km between New Zealand and Australia. Only those who are fit and can withstand a large energy-consuming journey make it to New Zealand, meaning those individuals that are

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

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weaker will be unsuccessful in passing on their genes to the next generation. A benefit of the gannets migration is that by early spring in New Zealand, food sources would start to replenish after winter, which provides food for young gannets, ensuring they have a greater chance of surviving. Additionally, the gannets may avoid predators such as seals in Australia that may prey on the birds when they are vulnerable if they nested in Australia. To make the journey to New Zealand, the gannets would use multiple environmental cues to migrate. The earth's magnetic field strength may help guide them, along with the sun's position (solar compass), prevailing winds, and star position in the night sky to help them reach the coast of New Zealand. Once arrived, the gannets show another behaivourral display, which is courtship. Courtship is a ritualised event preceddding sexual acts which will lead to the conception of offspring. For the gannets, this allows them to recognise gender and more specifically their mating partner, who they share a pair bond with. As the courtship allows the gannets to find their mating partners, it also acts to reduce aggression between males and females. Once courtship has taken place and successful fertilisation of the egg has occured, the gannets

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display another behavioural action, which is establishing a territory. A territory is an area which an animal has established itself and is prepared to defend. An intruders that will try to claim another gannets territory will encounter conflict, as the parents of the offspring are trying to protect their offspring to pass on their genetic information into the offspring.

These behaivours provide adaptive value for the gannets, as firstly during migration, slow and/or sick individuals die as they are unable to pass on their genes. Additionally, courtship helps to establish a pair bond, where more dominant males may have a more inviting courtship. This allows males with stronger, more appealling phenotypes to pass on their successful genes, providing they have a successful migration to begin with. Furthermore, territories help to establish what pair is willing to defend their territory to protect their young. Again, larger more dominant males are likely to be successful in retaining their territory, meaning it is more likely their offspring won't be killed and their genes are passed on, as these individuals are successful. This ensures that the next generation retains their parents strong genes for a greater chance of species survival.

M5

QUESTION THREE

Mutualistic relationships exist between New Zealand's native birds and trees, but introduced mammalian predators can affect this.

Maungatautari in the Waikato is a large area of forest where mammalian predators have been eradicated and a perimeter fence has been built to keep it predator free. The area has been used to study the effect of predator removal on the ability of birds to successfully pollinate species of native plants.

The New Zealand fuchsia, (kōtukutuku) – *Fuchsia excorticata*, was used as an indicator species, and comparisons were made with nearby Pirongia Forest Park, where mammalian predators are present.

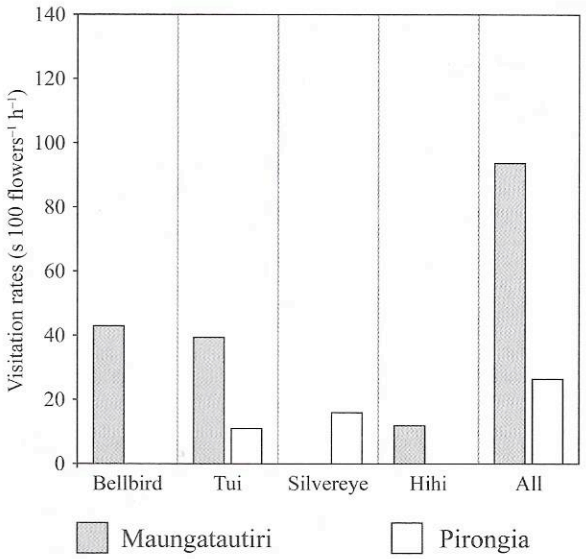
Fuchsia excorticata trees have one of two flower types:

- female flowers which need pollination
- hermaphrodites (male and female) which can self-pollinate.

Successful pollination results in formation of fruit.

Some results from the study are summarised below.

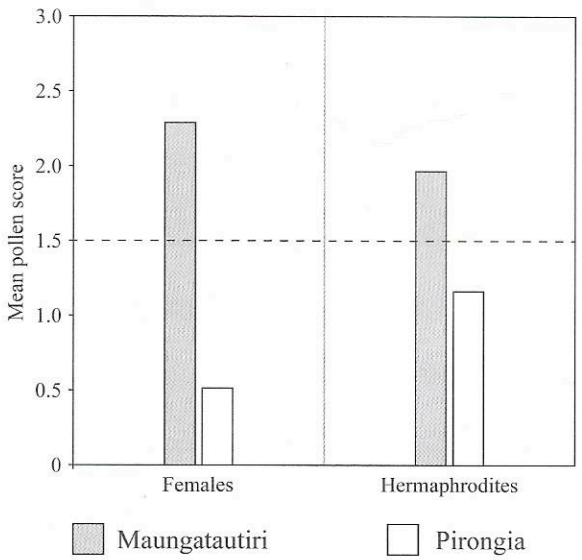
Visitation rates of pollinating birds to *Fuchsia excorticata* flowers



(Mean seconds of bird activity per 100 flowers per hour)

Adapted from Iles J.M. & Kelly D. School of Biological Sciences, Canterbury. Published online 9 April 2014.

Pollen scores of female and hermaphrodite *Fuchsia excorticata*



A pollen score index of at least 1.5 (dashed line) indicates a good pollination score, based on the relationship between pollen load and formation of fruit.

Adapted from Iles J.M. & Kelly D. School of Biological Sciences, Canterbury. Published online 9 April 2014.

Discuss the ecological relationships between the fuchsia trees, the bird species, and the presence or lack of mammals within the two forests, using the information given above to support your discussion.

In your answer:

- define the terms mutualism, predation, and interspecific competition
- explain the importance of pollination for both the fuchsia and the native birds
- use the data to compare, with reasons, the outcomes for *Fuchsia excorticata* and the key native bird species involved at the two sites.

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Mutualism is a type of interspecific relationship where both individuals recieve a benefit and are neither harmed. Predation is another type of interspecific relationship where one species is actively preyed on by another species, resulting in the death of one species and a food source for the other. Interspecific competition is where ~~species~~ different species are competing for the same limited resources. Pollination is extremely important for survival of ~~species~~ both fuchsia trees and the native birds. Pollination for the fuchsia ensures that fruit can develop and seed dispersal occurs, while at the same time maintaining a mutualistic relationship with the native bird species. The birds are important in this relationship as by pollinating the flowers, the birds are also provided with a food source, which comes in the form of nectar. However, the success of the fuchsia is dependant on the interspecific competition between the birds and the rate of predation in Pirongia by mammalian introduced predators. By looking at the second graph which details pollen scores, we see that the pollen score for Pirongia is below 1.5, which shows that they are most likely unsuccessful in developing fruit/ seeds ((

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

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no matter if they are hermaphrodites or females. ~~This is because~~ However, there is a greater chance that the successfully pollinated plants are self-pollinated. This is because the mammalian introduced predators prey on native birds in Pirongia, and so fewer native birds survive that are also able to pollinate the fuchsia. In Pirongia, this lowers the chance of survival for the fuchsia trees as there is less of a chance of seed dispersal and germination of seeds. Additionally, the competition between the bird species such as tui and bellbirds may increase as the flowers numbers diminish, meaning they compete more intensely for the nectar of the fuchsia trees. Alternatively, the chances of survival of fuchsia trees in Maungatautari is greater than at Pirongia due to a greater pollination score. The pollination score is above 1.5 here, meaning there is more of a chance of successful seed growth, dispersal, then germination. Additionally, there is no predation occurring, so there are many native birds around to pollinate the fuchsia whilst recieving nectar as food. It is likely that the key native bird species involved in pollinationation are this and bellbirds, as the sum of each bird types from each location shows that

11 N5

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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Question 3

these are the most numerous, so there is more of a chance that it is one of these two species who will visit fuchsia trees first. Additionally, tui's are much larger than the likes of Silvereyes, so this may play part in establishing who has more dominance and first visit to the fuchsia trees' flowers

seen

Merit exemplar for 91603 2015		Total score	15
Q	**Grade score**	**Annotation**	
1	M5	This answer provides clear explanation of the adaptive advantage of the maggot's behaviour. Insufficent detail is given to progress to E7 in this area of the question, and the difference between the behaviours is not made clear in terms of the klino/chemo kinesis leading to the stimulus being reached by chance.	
2	M5	Although described, the explanation of the behaviours is not thorough enough except with regards to the pair bond/courtship to gain further Merit credit. The benefits outweighing the costs is not made clear. Had this been done, the candidate would likely have gained further credit leading to M6.	
3	M5	The candidate compares outcomes for Fuschia at the two sites effectively, but doen't reach the same critical level for the outcome for the birds. The relationship between the birds and Fuchsia is described but there is no mention of increased genetic variability, which would have allowed the progression to M6 or higher.	