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91603

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NZQA

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MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
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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.

Excellence

TOTAL 23

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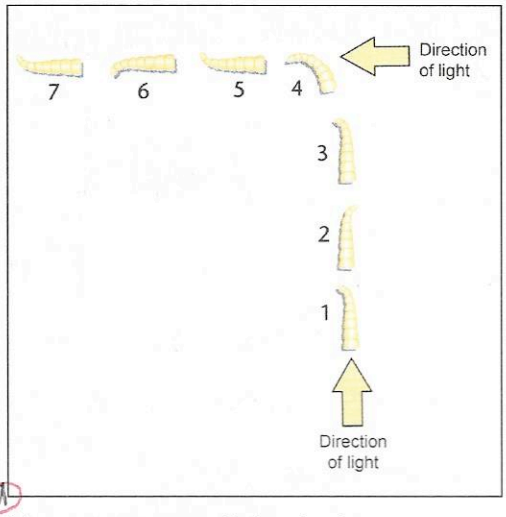
QUESTION ONE

genetic

Some animals display innate behaviours.

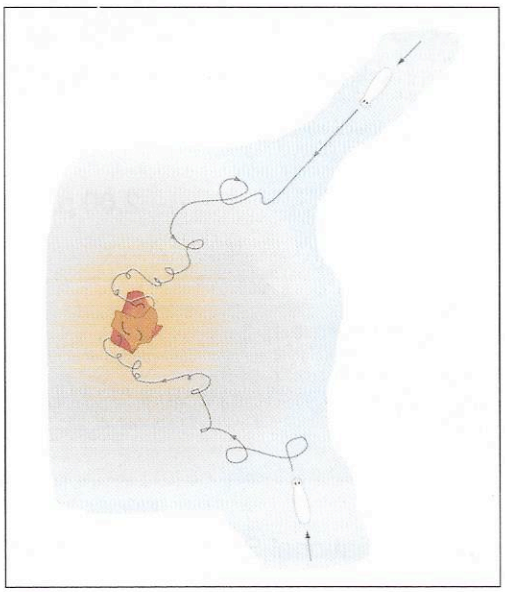
As green bottle fly maggots (*Phaenicia sericata*) crawl, they turn their heads, comparing the light intensity from each side. They always turn towards the darker side, taking them away from light.



Maggot response to light stimulus.

taxis - directional
kinesis

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
- 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.

The maggots display negative phototaxis. This means that they move away from the environmental stimulus of light. Flatworms display chemokinesis, which involves the increase of random movement when the intensity of the environmental stimulus, the chemical concentration, increases.

Negative phototaxis occurs as the maggots compare the light intensity from ~~the~~ either side of their heads. They then exhibit a directional response by turning away from the light source, ~~into~~ into a more dark environment. The

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Maggots must have photo receptors on the exterior of their bodies in order to compare the light intensity on either side of their heads. Their innate behaviour, a genetically predetermined behaviour, prompts the maggots to turn away from the source of light. By displaying these behaviours, the maggots have an adaptive advantage. The light source indicates heat, which could cause dessication in the maggots if they were exposed to the light source for a long period of time. By turning away from the light, the maggot avoids dessication and dying from drying out in the sun. Thus the maggots move into a ~~food~~ more favourable environment for them to find food and grow. This allows the maggots to survive and grow into the green bottle flies, so that they can reproduce and successfully pass on their favourable alleles to the next generation. The flatworms exhibit chemokinesis as they move along a normal path until they detect a change in the concentration of chemicals in the water. Kinesis is a non directional response, as the rate of movement increases with the change in intensity of the stimulus. The flatworms increase their movement by turning more, prompted by the increase in the chemical concentration of the water. By turning randomly, they increase their chance of moving to the area containing the meat. Therefore chemokinesis in flatworms increases their chance to find a reliable food source under normal conditions. The flatworms must have chemical receptors which trigger a positive feedback loop in

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

the flatworms. Chemokinesis is an adaptive advantage in the flatworms as ~~the likelihood of~~ flatworms displaying this innate behaviour have a higher likelihood of finding a food source. Those successful individuals who are able to feed of a source ~~for~~ found through chemokinesis will be able to survive and reproduce, and thus pass their favourable alleles onto their offspring and the next generation.

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E8

QUESTION TWO

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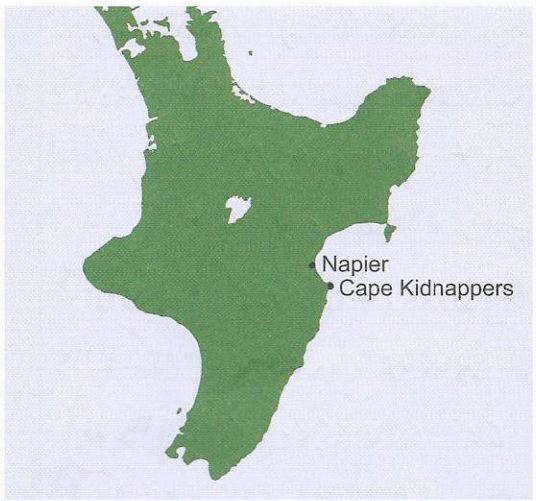
Cape Kidnappers on the coast of Hawke's Bay is an exposed headland, which hosts the largest mainland gannet *(Morus serrator)* colony in New Zealand, with around 6500 breeding pairs arriving in early August each year. The birds remain until the young fledglings are mature enough to leave, and then return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

K-Strat.

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.

(migration, territorial behaviour, monogamy/pair bonding)

The gannets display the behaviour of migration, as they make the round trip from Australia to New Zealand, and back, annually. Migration is the annual mass movement of a population from one environment to another. Migration involves a two-way trip, and allows the populations of Gannets to exploit two different locations, for various purposes, such as breeding, and feeding.

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

The gannets also exhibit territorial behaviour, which involves the constant protection of a specific environment used for feeding, ~~and~~ breeding, and caring for young. Territorial behaviour occurs between members of the same species, as they are competing for the same land space, food source, and potentially mates (Gannets occupy the same ecological niche). Gannets also display monogamy, or pair bonding, between two individuals. This is the social process whereby gannets have the same mate over many breeding seasons, ~~a~~ and work cooperatively to raise the gannet chicks. The costs of migration ~~factor~~ must not outweigh the benefits, as then it would not occur in the gannet species. During migration between Australia and New Zealand, gannets could be killed by severe weather conditions, or get lost and not fly on course. Predation of the gannets could also occur, which would deplete the overall population of the gannets. Migration also involves a very large expenditure of energy, and some birds may not have enough energy to survive the trip from one colony to the other. Benefits of migration are that the gannets live in the warmer climate in Australia throughout the winter months, in which they are more likely to survive. This is also where their most abundant food source is, so they can feed their young and consume as much food for energy before the migration trip to New Zealand. New Zealand is a better suited environment for them to lay eggs and protect ~~from~~ their young throughout the summer months, at the gannet colonies. Around 6500 breeding pairs arrive each year on the colonies

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//which could promote healthy gene flow when the young gannets are old enough to mate. This could assist with the variation within the population, so that the success of the species is greater in the next generations. Territorial behaviour also involves a lot of time and energy for the gannets to protect their nesting site. This is a disadvantage as it would take away from the time needed to gather a food source for the individuals, and the new young chicks. Positives of territorial behaviour, is that the gannets within each territory will be protected and ensured a secure environment to feed and raise their chick in. Territorial behaviour reduces the competition between individuals of different territories, as each have their own definite environment and food source, and will not constantly be competing for them, which uses a lot of energy. The disadvantages of monogamy is that less genetic variation within the gannet population will occur, as pairs re-establish their relationship at the beginning of each breeding season. The gannets in the pair relationship will not reproduce will different gannets, and therefore the same mixing of alleles will occur in their offspring. Advantages of monogamy is that their is more time and energy invested into a small number of offspring (only one egg laid ~~e~~ each year). This shows the K-strategy reproductive technique, whereby there is a large investment of time and energy into a single offspring, ~~a~~ giving it a better chance of survival. The young gannet is more likely to survive its first weeks as two parents are actively taking care of it//

P.T.O extra paper →

E8

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.

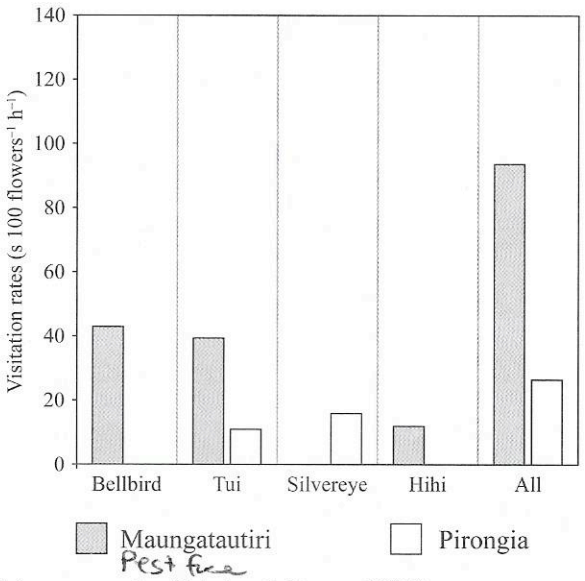
Fuchsia excorticata trees have one of two flower types:

- 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.

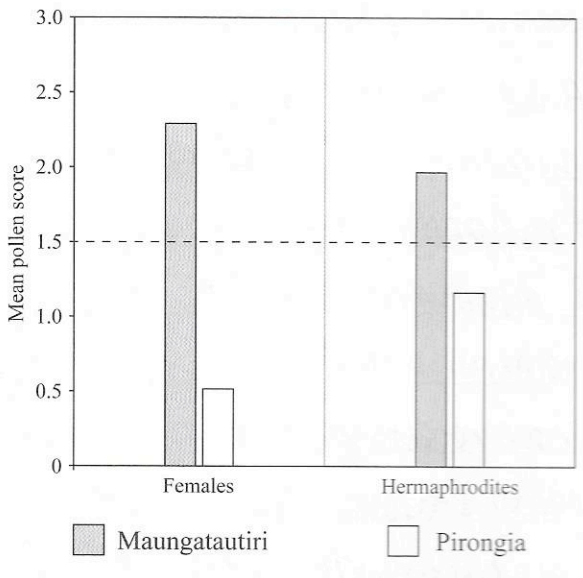
Visitation rates of pollinating birds to *Fuchsia excorticata* flowers



(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.

Mutualism is the relationship whereby both species in the relationship benefit from the interaction (+,+). Predation is a form of exploitational relationship, whereby one species benefits and the other is harmed (+,-). Interspecific competition is competition for resources between different species.

The relationship between the fushia and native birds is mutualistic, as the birds work to pollinate the flowers, essential to the reproductive success of the fushia. In return, the native birds have a food source of the nectar in the flowers of the native trees. Pollination is important for fushia as it ensures genetic variation, as pollen is transferred far from the parent plant. This ensures greater success of the species, as it is more likely to survive, if disease were to strike, as there would be variation between the fushia plants and not all would die out in an outbreak. Pollination is important to native birds as is ensures the continued providing of their food source - Pollination means that seeds of the trees are produced, which produces more plants and flowers for the birds to feed off.

Key native birds visited the flowers much more often, in every case, in the Maungatautiri (M) site compared to Pirongia (P) site. For example, for all species of birds together, the visitation rates of birds increased from approx. 25 100 flowers^{-1} h^{-1} to 95 flowers^{-1} h^{-1} between the P to M sites. M site was much more successful than P

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site for all birds to visit flowers. In both female and hermaphrodite plants the pollen scores were greater for M site than P. eg: ~~2V3VA3~~ 0.5 to 2.3 mean pollen score between P and M site for females. This means that all species of the flower did better when in the predator-free environment. More were pollinated (as there were more birds in non-predator site) and thus more trees were able to grow, with better variation.

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

QUESTION NUMBER

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2. The young gannet will be more likely to survive the return migration trip back to Australia. The combination of these behaviours provide adaptive value to the gannets. The most ideal living conditions from the different environments from migration are exploited, which allows the gannets to have a better chance of surviving, and of their offspring surviving. Territorial behaviour ensures that the resources that they need or look after are protected. Monogamy ensures that the most energy and care is taken to ensure the survival of their offspring. As a result of all these techniques, there is a greater likelihood of them surviving and passing on their favourable alleles, and thus allowing a better chance of survival of the gannet species as a whole.

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Seen

Excellence exemplar for 91603 2015		Total score	23
Q	**Grade score**	**Annotation**	
1	E8	This is a near perfect answer with the candidate showing a clear logical progression through the question, taking account of the scaffolded bullet points in the question. The adaptive advantages of the behaviours are comprehensively explained and comparisons made between them, as well as indicationg the increased survival and reproduction which result in the inheritance of the favourable alleles in future generations.	
2	E8	There is a thorough unpacking of the question, with clear links made between the different behaviours showing how a combination provides adaptive value to the gannets. The candidate has used clear biological language and shows good structure through their answering of the different points in the question.	
3	E7	The candidate uses relevant data from the question to comprehensively compare the relationships between the birds and fuchsias in both sites. If more detail had been given on either the significance of lower pollen scores in the hermaphrodite plants, or the exact nature of competition between bird species, then this candidate could have reached E8.	