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# 3

91603



916030



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## Level 3 Biology 2022

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

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.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (X/X). This area may be cut off when the booklet is marked.

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

**Merit**

**TOTAL**

**16**

## QUESTION ONE: INTRASPECIFIC RELATIONSHIPS

The stitchbird or hihi (*Notiomystis cincta*) is an endemic species that is now found only on islands or mainland regions to where it has been moved, due to predation from animals, such as domestic cats. Hihi have an unusual breeding system that includes pair or **group nesting**.

They **defend a territory in the mating season** of spring and summer, and have known dominance hierarchies. Older birds are dominant over the younger ones, especially those of the same sex. Males are dominant over females, except when chicks are present at the nest.

At the start of the breeding season, the males sing loudly until the end of the egg laying season. They also perform flight displays at the nesting area, which enhances their white and yellow colours.

### Male hihi

Source: <https://nzbirdsonline.org.nz/species/stitchbird>

### Female hihi

Source: <https://nzbirdsonline.org.nz/species/stitchbird>

Discuss how behaviours of the hihi work together to support the population size of the species.

In your answer:

- describe the terms hierarchy<sup>1)</sup>, predation<sup>2)</sup>, and territory<sup>3)</sup>
- explain how a courtship strategy, such as singing or flight displays, can be both an advantage and a disadvantage for the male bird<sup>4)</sup>
- evaluate how behaviours in **bold** above (group nesting and defending territory in the mating season) work together to maintain population size in protected areas.<sup>5)</sup>

A hierarchy is a social order ~~and~~ according to status within a population. as described the older males of a stitchbird population dominate, as the dominant male, they will have <sup>the advantages of</sup> prioritised breeding rights & nesting rights with females, but access to food/resources and be expected to defend their territory. A territory is the core area a population lives in, usually with resources to sustain life such as food, water and nesting sites. The disadvantage to being a dominant male include energy expenditure.



there is a high level of energy required to maintain dominance, taking a physical toll, ~~hence the dominant male may be threatened by~~ not the physical toll in ensuring the success of the stitchbird's population is exhibited when females are wearing chicks. there is a high level of reproductive effort (time and energy) in giving birth hence dominance is placed on females when chicks are present to transfer prioritised rights to resources. in response to the ~~disadvantage~~ disadvantage to dominant males described, many younger males show agonistic behaviour towards the dominant male and each other to challenge/determine the hierarchy. agonistic behaviour includes courtship strategies to represent their own 'fitness' or favourable traits towards successful reproduction to impress female partners. ~~the advantage~~ there is not normally injury or death in courtship behaviours as it is only a method for 'predicting' who would win in a fight. the stitchbird uses loud singing and flight displays to exhibit the strength/health of an individual, the bright yellow and white coloured feathers are indicative of the birds health, hence ability to survive/fertilise. courtship strategies are beneficial to stitchbirds <sup>males</sup> as no fatal fights occur to win over females, this ensures fit and healthy contestants remain in the population and can pass on favourable genes.

predation is the threat to an individual/pop by a predator. group nesting and defending territory can minimise the threat of predation to ensure the success of their pop. a in group nesting altruistic behaviour ~~can~~ is shown. stitchbirds ~~related to~~ may act towards the benefit of

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



unrelated offspring, to the detriment of themselves,  
this behavior is highly advantageous to a pop.  
for the sticklebacks group nest, so adults may feed, teach,  
and protect ~~adults~~ nests lay in a territory,  
hence during mating season, the resources within  
a territory are valuable (like the nests) so  
competing groups will be attacked in order to  
preserve resources. the two behaviors increase the  
likelihood of an individual offspring survival, however, under  
evolution the group nesting may ensure that the  
unfavorable genes of a parent that was unable  
to care for its own remain in the gene pool and  
are likely to be passed onto the next generation.  
however, these methods to ensure survival of offspring  
and maintain territory benefit the population size  
of protected areas.



## QUESTION TWO: MIGRATION OF INDIGO BUNTING



Source: <https://ebird.org/science/status-and-trends/indbun/range-map>

Source: [www.flickr.com/photos/slingher/4522490194/](http://www.flickr.com/photos/slingher/4522490194/)

The indigo bunting (*Passerina cyanea*) is a bird that flies a long distance during its yearly migration, migrating only at night. Indigo buntings fly about 2000 km each way between breeding grounds in eastern North America (shown in red), and wintering areas from southern Florida to southern Central America (shown in blue).

Discuss how the behaviours mentioned above combine to help ensure the success of the species.

In your answer:

- define the term migration
- describe the biological rhythm shown, and give the likely environmental cue for migration <sup>nocturnal</sup> <sup>photoperiod</sup>
- explain a navigational method for the night migration of the bunting
- discuss how, despite the difficulties of a long journey, this repeated journey has enabled the indigo bunting population to be maintained.

migration is the mass movement of a population usually on a seasonal basis. the indigo bunting migrates to and from north and central America, only travelling at night. the bunting therefore displays a nocturnal circadian rhythm. the rhythm exists due to an <sup>endogenous</sup> biological clock, ~~which~~ <sup>and</sup> is ~~not~~ <sup>entrained</sup> by photoperiod.

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



the retina of the eye has specialised ganglion cells which are photosensitive. the SCN receives information about illumination and passes it on to the pineal gland. the pineal gland secretes a hormone melatonin at an inversely proportional level to day light. because melatonin is secreted according to light levels it acts as a zeitgeber, entraining the biological clock of the indigo bunting which may <sup>can</sup> not have coincided with ~~changing~~ photoperiod which it changes di over seasons and weather events. the bunting benefits from having an entrained biological rhythm therefore always flying at night because they can avoid diurnal and avian predators.

the navigation methods the bunting may use is stellar navigation, ~~the poles at which constellations~~ are the indicative of south and north poles therefore aid direction and orientation. however, the bunting can not solely rely on one method of navigation, as the night sky can be clouded very often. so the bunting will cross reference their stellar navigation to the earth's magnetic field, or certain smells (pheromones @ breeding grounds) to ensure navigation is on the correct path.



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because migration is not a huge energy expenditure there are many benefits outweighing the negatives for it to still occur. migration is often a means for better food, resources and shelter. in many locations the butterfly may be avoiding predators that succeed in conditions where butterflies don't. ~~as well~~ they may also be avoiding disease. migration can involve returning to breeding grounds which benefit offspring as the conditions are known to be favourable and well adapted to. migration can be because of butterfly reaching sexual maturity as well. as the butterfly migrate over land they also have access to food, reducing the risk of losing fat stores in the flight. some disadvantages to migration can be risk of exhaustion, new unknown predators, getting lost and unexpected weather events all resulting in death.

because this regular migration is well known to the indigenous butterfly species, populations will have experience from individuals ensuring that most complete migration without fatality. the reward to the butterfly: food, more favourable conditions and breeding grounds then ensure successful reproduction, thus maintaining the butterfly population success.



### QUESTION THREE: DODDER



Source: [https://upload.wikimedia.org/wikipedia/commons/4/42/Cuscuta\\_campestris\\_covering\\_host01.jpg](https://upload.wikimedia.org/wikipedia/commons/4/42/Cuscuta_campestris_covering_host01.jpg)

Source: <https://bygl.osu.edu/node/1682>

The golden dodder (*Cuscuta campestris*) is a leafless and rootless plant that lives off other plants.

It has a growth response, enabling it to wind up and around a host plant, branching to form a tangled mass, which can spread from the initial host to nearby plants. It uses a special organ, the haustorium, to attach itself to the host and grow into host tissues. Through the haustorium, it gains water and nutrients from the host plant.

The flowering time is critical for the successful reproduction of the dodder. Various environmental cues, especially changes in night length (photoperiod), are perceived by the plant. Very little is known about how flowering of the dodder is triggered to start; however it is known that the dodder has both short-day plant (SDP) hosts and long-day plant (LDP) hosts. Scientists have found that the flowering of the dodder seems to be synchronised with the flowering of their hosts, as they flower when the host does.

Discuss reasons for the success of the dodder.

In your answer

- identify and describe the interspecific relationship between the dodder and the host plant
- explain how auxin enables the dodder to grow up and wind around the host plant, and identify and describe this growth response
- discuss how, through the ability to live off other plants and flowering at the same time as their hosts (both SDP and LDP), the dodder species is successful.

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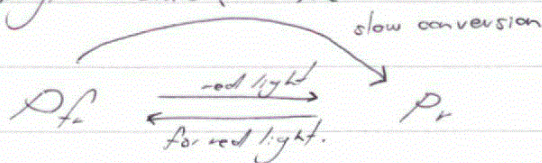
the dodder and host plants where a parasitic relationship where the dodder benefits and the host plant is affected negatively. the haustorium ~~will~~ penetrates the host plant <sup>and exploiting its</sup> ~~and exploiting the host's~~ water and nutrients.

the dodder exhibits <sup>positive</sup> thigmotropism, permanent ~~no~~ growth responses towards the stimulus of touch.

the dodder has tendrils which contain auxin: auxin accumulates on the side of the tendril stimulated by touch and is then transported to the opposite side of the tendril. auxin <sup>cell</sup> initiates elongation in the outer side cells of the tendril which mean it grows towards touch. the benefit to positive thigmotropism is that the dodder does not need to use energy to create/grow a strong root system in order to gain nutrients to the grow more.

the dodder also has access to the host plants nutrients therefore the use of leaves for photosynthesis to produce energy is not required.

Flowering in plants ensures pollination and therefore reproduction to ensure success of its species. Flowering in short day plants is initiated by the absence of Pfr. Flowering in long day plants is initiated by the presence of Pfr. Pfr <sup>(phytochrome for red)</sup> is one of the two forms of phytochrome, the other being Pr (phytochrome red).



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



$P_h$  is converted from  $P_r$  during the day, in ~~daylight~~, hence in longer days where photo period (relative length of night and day) ~~favours~~ favours day light. there is a large amount of  $P_h$  in the dodder. the conversion from  $P_h$  to  $P_r$  is very slow during the night, hence the large amount of  $P_h$  on a long day remains in abundance.

Flowering at the most beneficial time for the dodder is ~~not~~ dependant on ~~occure~~ when its host plant flowers, hence it has access to the pollinators of the host plant attracts which ensures it will be successfully pollinated and reproduce successfully. when a host plant is a LDP, flowering will occur in summer, hence there will be maximum amount of sunlight for photosynthesis, so the host plant will have an abundance of nutrients for the dodder to exploit.

by having both LDP and SDP the dodder can flower all year round (when critical night length is both exceeded and underachieved) therefore ensuring successful reproduction <sup>opportunities</sup> ~~at~~ ~~assured~~ <sup>are</sup> maximised, hence ensuring success of the dodder species.



Extra space if required.  
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QUESTION  
NUMBER



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

QUESTION  
NUMBER

91603



Standard	91603	Display ID	NSN: 135141429	Total score	16
Q	Grade score	Annotation			
1	M5	This candidate develops some of the descriptions of behaviours into explanations which are adequate for the standard expected. They explain why courtship behaviours create an advantage and also there is a clear explanation of the advantages of group nesting. Although there were several other opportunities to gain a Merit point, much of the rest of the answer was considered to be largely descriptive so only bullet points 1 and 3 from the schedule were awarded resulting in the score of M5.			
2	M6	This was the most thoroughly answered question by this candidate with sufficient points at Merit level (3) to gain M6. They were awarded for their explanation of migration avoiding unfavourable conditions (good conditions all year round), why the buntings use a number of navigational methods to avoid going off course, and also explaining an appropriate difficulty of the journey. This was considered to be a borderline E7 response with an understanding of the benefits outweighing the costs. An award of E7 in this question would not have impacted the overall grade.			
3	M5	The candidate failed to expand on some of the points which could have been further developed from Achieved to Merit such as parasitism, whilst detailing the mechanism of flowering of SDP and LDP which was NOT required in this question. The importance of reading the question carefully and not just writing about other aspects of a topic is highlighted by this. There are good explanations of the action of auxin for wrapping the dodder around its hosts as well as how the synchronised flowering means that the dodder is more likely to be on a host plant that is being visited by pollinators regardless of the time of year. Two clear Merit points allowing M5 to be awarded.			

This is a candidate who has done well in this standard because of their understanding of the adaptive advantages of the responses identified in these questions. There is lack of evidence of some of the detailed biology that drives them, and this is an example of where a Merit grade can be gained without having to explain everything so long as sufficient points are covered. By relating the processes to their benefits, they have explained why many of the responses provide an adaptive advantage for the organisms in relation to their ecological niches.