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Level 3 Biology 2020

91605 Demonstrate understanding of evolutionary processes leading to speciation

2.00 p.m. Tuesday 24 November 2020
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of evolutionary processes leading to speciation.	Demonstrate in-depth understanding of evolutionary processes leading to speciation.	Demonstrate comprehensive understanding of evolutionary processes leading to speciation.

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.

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QUESTION ONE: FLAT-WINGED CRICKETS

Figure 1: Male cricket and parasitic fly.
www.pnas.org/content/116/25/12116

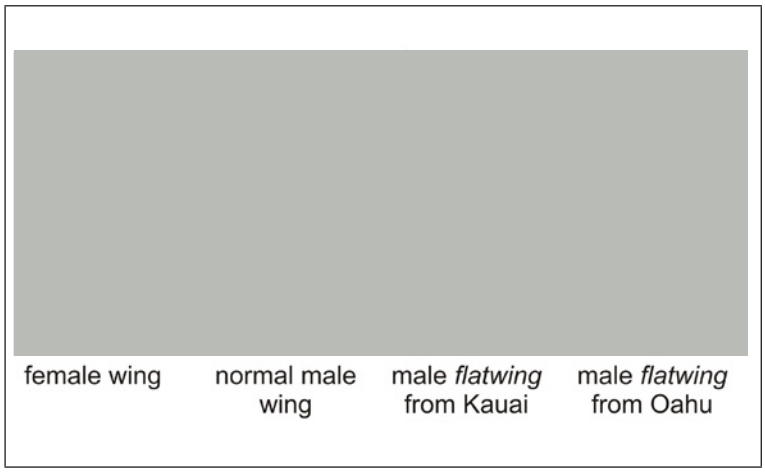

Figure 2: A comparison of 'flatwings' and normal wings.
https://elementy.ru/nauchno-populyarnaya_biblioteka/432357/Cverchki_zagovor_molchaniya

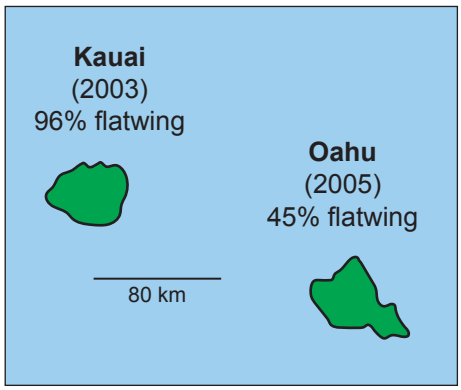

Figure 3: Two of the Hawaiian islands.

The oceanic cricket lives in the Hawaiian Islands. Normal males have wings that produce a chirp when rubbed together. Flat-winged males on the other hand, have wings more like those of a female, without the noise-making features. Usually male crickets are known to be noisy when attracting a mate. However researchers have recently shown that a silent type of the oceanic field cricket, *Teleogryllus oceanicus*, has evolved twice, independently and quickly, on two neighbouring Hawaiian islands.

The chirping sounds of the male cricket not only attract mates on these islands but also a parasitic fly, *Ormia ochracea*, (seen in Figure 1) that can lay its larvae in the cricket, killing it when the young hatch one week later.

Discuss aspects of cricket evolution.

In your answer:

- suggest how the flat-wing phenotype may have arisen
- explain why different locations have different proportions of flat-winged crickets
- discuss what DNA evidence scientists might have needed to show this was convergent evolution, and not simply crickets moving from one island to another.

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

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QUESTION TWO: LITTLE PENGUINS

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https://mission-blue.org/2019/04/ocean-conservation-front-and-center-in-australia-with-sydney-coast-hope-spot/

One of the chewing lice found on the kororā.

https://collections.tepapa.govt.nz/agent/19598

Kororā, also known as little blue penguins or blue penguins, are so named because of their size and slate-blue plumage. In Australia, they are often called fairy penguins because of their small size. While most scientists still consider them variants of one species, some birds have shown mitochondrial DNA evidence that suggests that they are diverging and may become separate species. Kororā breed in colonies along the southern coastlines of Australia and New Zealand. Fairy penguins will travel south from Australia across the Tasman Sea and around the south coast of New Zealand to form large colonies in Otago and Canterbury. This ensures that these two groups, in New Zealand and Australia, maintain genetic similarity.

Kororā can have up to 14 species of chewing lice, which are small parasites that feed on their feathers. Chewing lice can be found on the feathers, where their long thin body shape allows them to avoid the preening behaviour of the penguins as they hug closely to the feathers. Chewing lice, found on the penguin heads, are a different species, and are out of range of the bird's beak and are round in shape. Chewing lice on penguins allow scientists to link penguin groups, as chewing lice can only be passed from host to host during copulation (mating), leading to speciation due to isolation.

Discuss aspects of speciation using information from the examples of the penguins and their chewing lice.

In your answer:

- define allopatric and sympatric speciation, identifying the type of speciation between the head and body chewing lice
- explain how adaptive radiation has led to so many species of chewing lice on just one species of penguin
- discuss reproductive isolating mechanisms that would need to happen if speciation were to occur between kororā and fairy penguins.

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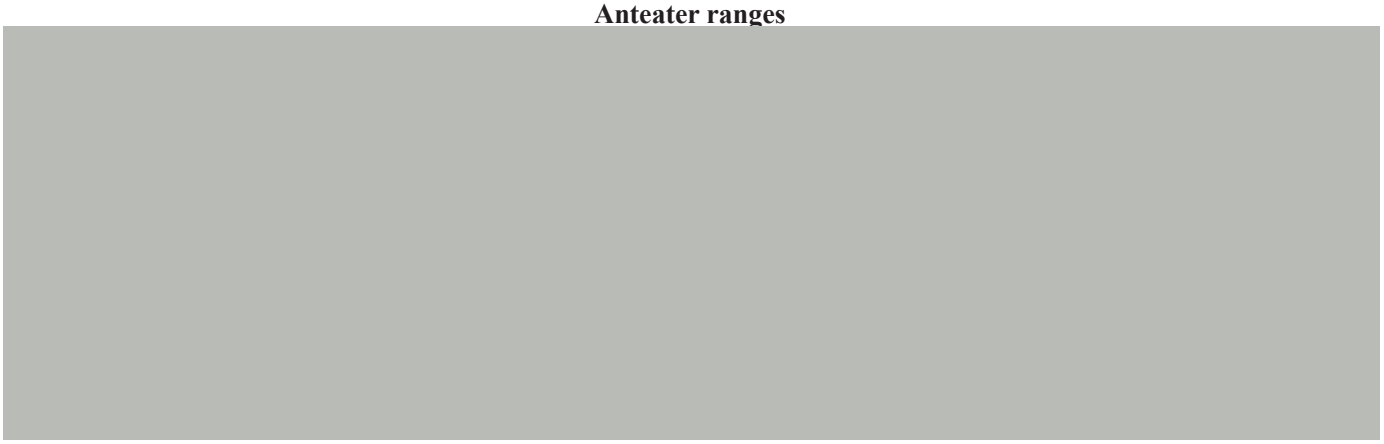
QUESTION THREE: ANTEATERS

https://nationalzoo.si.edu/animals/giant-anteater

South America is home to four species of anteaters in the suborder *Vermilingua*: the giant anteater, *Myrmecophaga tridactyla*, shown above, the southern tamandua, *Tamandua tetradactyla*, the northern tamandua, *Tamandua mexicana*, which is mostly nocturnal, and the arboreal silky anteater, *Cyclopes didactylus*.

Anteater ranges



Giant anteater (probably extinct in orange areas)	Southern tamandua	Northern tamandua	Silky anteater
https://en.wikipedia.org/wiki/Giant_anteater	https://en.wikipedia.org/wiki/Southern_tamandua	https://en.wikipedia.org/wiki/Northern_tamandua	https://en.wikipedia.org/wiki/Silky_anteater

Anteaters are edentate animals, which means they have no teeth. Their long tongues are able to lap up the 30 000 – 35 000 ants and termites they swallow whole each day. Since the giant anteater and its evolutionary ancestors have been feasting on ants and termites for nearly 60 million years, ants and termites may have evolved various defences, which help them avoid predation. Ants can excrete chemicals and also use their jaws to pierce the skin of an attacker. Anteaters will feast on ants until soldier ants, armed with sharp mandibles and toxic chemicals, arrive in large numbers. The anteater will then move on, allowing the well-armed ants to survive.

Discuss aspects of anteater evolution.

In your answer:

- describe the evolutionary pattern seen in this example of the relationship between ants and anteaters
- explain an advantage and a disadvantage of this evolutionary relationship
- discuss how natural selection has led to divergent evolution in anteaters.

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