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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Biology 2023

91605 Demonstrate understanding of evolutionary processes leading to speciation

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.

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 (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

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

QUESTION ONE: GENETIC DIVERSITY

The kākāpō is a flightless parrot, endemic to New Zealand. Once common, approximately 250 individuals are all that remain today, most of them descended from an isolated island gene pool.

Genetic drift theory suggests that a small population is likely to have accumulated harmful mutations. Analyses on the impact of the long-term, small population size shows that the present-day island kākāpō have a smaller number of harmful mutations when compared to mainland kākāpō. This is possibly due to natural selection, where harmful mutations are selected out.

Discuss aspects of kākāpō evolution and link these to the future of the populations.

In your answer, include discussion of:

- the terms mutation and gene pool, including definitions
- how the founder effect enables genetic drift to be more apparent in the kākāpō species
- how genetic drift and natural selection may have implications for the survival of the species.

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

QUESTION TWO: COPROSMA

Coprosma (mingimingi) are a group of approximately 90 species of flowering plants. *Coprosma* originated in New Zealand more than 25 million years ago but are now found in Hawaii, Australia and Tasmania, Borneo, Java, New Guinea, and islands of the Pacific.

They have small, evergreen leaves, which give off a distinctive smell when crushed. They grow in a wide range of habitats, from sand dunes to mountains, with the variety of forms in the genus reflecting the diverse landscapes of New Zealand and the Pacific.

Some are shrubs, some are subshrubs (woody and short), some are trees growing up to 7.5 m tall, and others are more mat-like.

Coprosma repens

Coprosma ochracea

Coprosma acerosa

Discuss adaptive radiation in *Coprosma*.

In your answer, include discussion of:

- adaptive radiation and niche, including definitions
- how different habitats have led to adaptive radiation of *Coprosma*
- why *Coprosma* growing on different islands might have different appearances and can be classed as different species.

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

QUESTION THREE: PERIPATUS / NGĀOKEOKE – THE VELVET WORM

Although there are up to 200 species of velvet worms worldwide, in New Zealand, there are approximately 30 species. Of those 30 species, only 9 have been clearly identified and studied. It is expected that, with more DNA research, new species will be described.

Peripatus (ngāokeoke) are classified in two genera. *Peripatoides* is ovoviviparous, meaning females have live young from eggs which hatch internally. *Ooperipatellus* is oviparous, meaning females lay eggs which then hatch later. Egg-laying peripatus are found only in New Zealand and Australia. Egg-layers tend to be found in colder, more open areas, and at high altitudes, for example, the Tasman Glacier species. Those worms that have live young tend to live in warm, more enclosed habitats and at lower altitudes.

Peripatoides indigo

Live young, hatched internally, then birthed

Adult with infant

Peripatoides novaezealandiae

Discuss aspects of the evolution of velvet worms.

In your answer, include discussion of:

- allopatric speciation and sympatric speciation, including definitions
- how geological processes might give rise to increased speciation in the New Zealand velvet worm
- why DNA analysis might lead to the discovery of new species
- how TWO named, reproductive isolating mechanisms (RIMs) could ensure the worms do not form hybrids.

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

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

QUESTION NUMBER	

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

QUESTION NUMBER

Acknowledgements
Material from the following sources has been adapted for use in this assessment:

Page 2
Image: https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/kakapo/

Page 5
Images: (*C. repens*) https://en.wikipedia.org/wiki/Coprosma_repens
(*C. ochracea*) https://en.wikipedia.org/wiki/Coprosma_ochracea
(*C. acerosa*) https://www.tawapou.co.nz/index.php/catalogue/coprosma-acerosa-red-rock

Page 8
Images: (*P. indigo*) https://www.doc.govt.nz/nature/native-animals/invertebrates/peripatus-ngaokeoke
(Live young), (Adult with newborn) https://www.nzgeo.com/stories/velvet-underground/
(*P. novaezealandiae*) https://en.wikipedia.org/wiki/Peripatoides