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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Biology 2026

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 2–16 in the correct order and that none of these pages is blank.

Do not write in the margins (////). This area will be cut off when the booklet is marked.

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QUESTION ONE: Greenish warblers

Different species of greenish warbler (*Phylloscopus sp.*) live around the Tibetan Plateau. The plateau is an area of high, flat ground that acts as a geographic barrier between some populations.

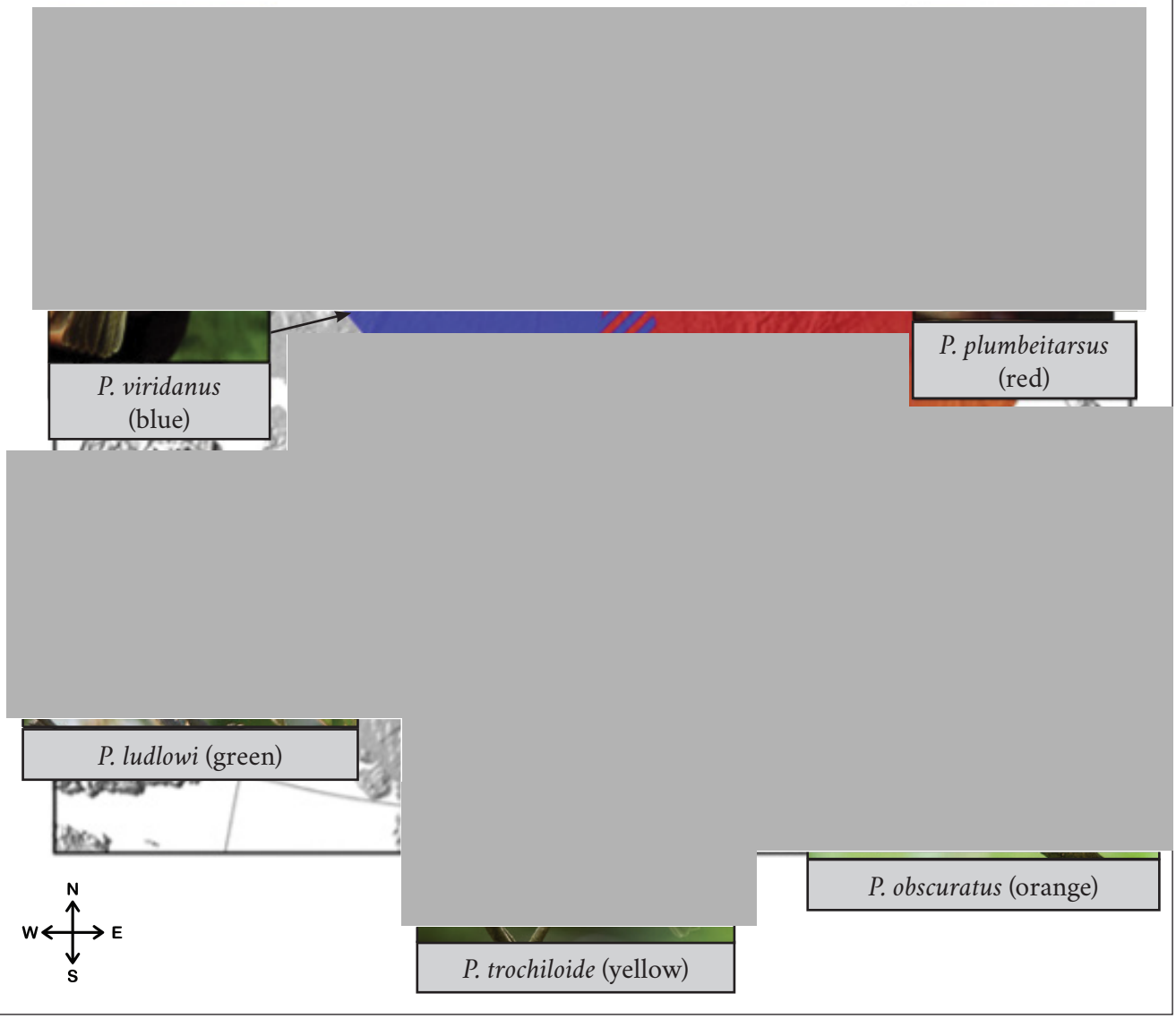
Evidence suggests that a single ancestral greenish warbler population began in the south of the plateau and over time spread gradually around the plateau. Figure 1 shows five species of greenish warblers that exist today. This is an example of a ring species.

The species, with their range in Figure 1, are: *P. viridanus* (blue), *P. plumbeitarsus* (red), *P. ludlowi* (green), *P. trochiloide* (yellow), *P. obscuratus* (orange).

Neighbouring populations of different species can interbreed with each other. However, the species at the end of the ring (*P. plumbeitarsus* (red) and *P. viridanus* (blue)) do not interbreed with each other, even though they coexist in the same area (central Siberia).

Vocalisations (songs and calls) and genetic markers differ between *P. plumbeitarsus* (red) and *P. viridanus* (blue). Phenotypic traits, such as songs, show gradual change around the ring.

Figure 1: Map showing the geographic ranges of greenish warbler species



Discuss the process of speciation using the greenish warbler ring species example.

In your answer, include discussion of:

- a species and ring species
- why neighbouring populations interbreed with each other and how this effects allele frequency between populations
- how a geographic and a behavioural isolating mechanism may prevent interbreeding between some populations
- why *P. plumbeitarsus* (red) and *P. viridanus* (blue) do not interbreed with each other, even though they coexist.

QUESTION TWO: Gophers and lice

The pocket gopher (*Pappogeomys spp.*) (Figure 2) is a burrowing rodent that is isolated from other gopher species by rivers, soil type, or mountain ranges.



Figure 2: Pocket gopher

The chewing lice parasite (*Geomydoecus spp.*) (Figure 3) lives permanently on gophers, feeding on skin and hair. Having many chewing lice reduces the host gopher's fitness. Chewing lice parasites are transferred from gopher parent to offspring.

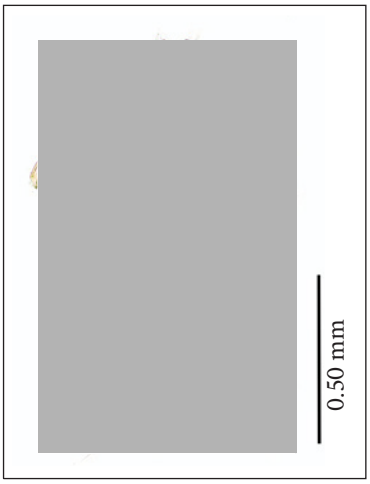


Figure 3: Chewing lice parasite

Over time, differences in gopher species' phenotype and behaviour have developed. For example:

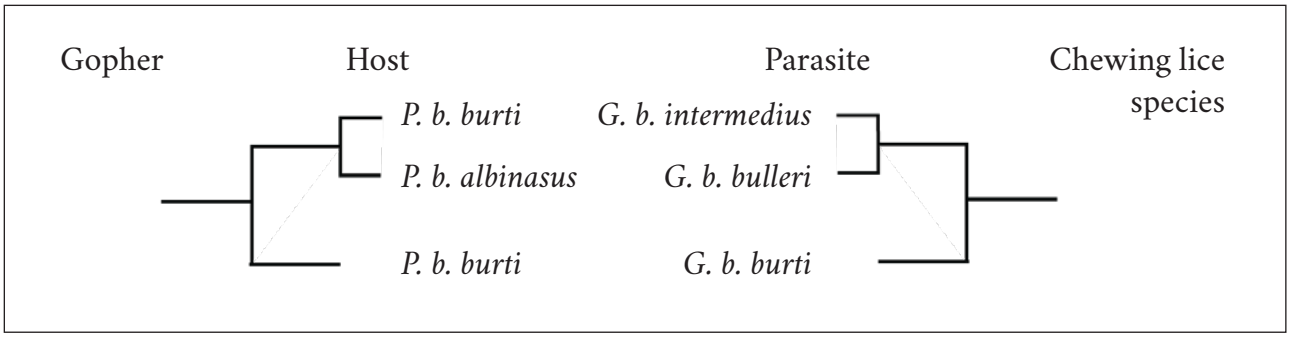
- differences in body size
- fur thickness
- hair diameter
- fur colouration
- grooming behaviour.

Differences in chewing lice parasites species' phenotype have also developed over time. For example:

- colouration to match host fur
- claws shaped to grip the exact diameter of the host gopher's fur
- body size that is proportional to the host's body size.

Figure 4 shows the phylogenies of the pocket gopher (*P. bulleri*) and its chewing lice (*G. bulleri*).

Figure 4: Phylogenies of the pocket gopher and its chewing lice



Discuss why a co-evolutionary relationship exists between gophers and chewing lice.

In your answer, include discussion of:

- why gopher and chewing lice speciation are both examples of allopatric speciation and not sympatric speciation
- the process of co-evolution in the formation of species
- natural selection and the selection pressures influencing the speciation of gophers and chewing lice
- why the gopher and chewing lice species show matching phylogenies.

QUESTION THREE: Velvet worms

The theory of evolution is based on scientific evidence, including comparative anatomy and molecular biology.

Biologists are particularly interested in studying the velvet worm or ngāokeoke (*Peripatus spp.*) because it has features of both annelids and arthropods.

Based on appearance, the velvet worm was originally thought to be closely related to annelids. However, evidence from mitochondrial DNA (mtDNA) and developmental (Hox) gene order shows patterns more similar to arthropods than annelids.

It was concluded that annelids and velvet worm similarities are an example of convergent evolution, and arthropods and velvet worm similarities are an example of divergent evolution.

Table 1 details some features of velvet worms, annelids, and arthropods.

Table 1: Features of the velvet worm, annelid, and arthropod

Velvet worm	Annelid	Arthropod
		
Soft bodied with a thin chitinous cuticle	Soft bodied, no exoskeleton	Hard chitinous exoskeleton
Weak external segmentation	Clear external segmentation	Segmented body
Hydrostatic skeleton	Hydrostatic skeleton	Exoskeleton for support and muscle attachment
Unjointed legs	Unjointed body, no legs	Jointed legs
Movement by peristaltic waves and leg action	Movement by peristaltic waves	Movement by jointed legs
Tracheal system	Gas exchange through moist skin	Tracheal system
Open circulatory system	Closed circulatory system	Open circulatory system
Moist environment	Moist environment	Moist and dry environment

Discuss the evolution of the velvet worm.

In your answer, include discussion of:

- homologous structures and how they support the common ancestor concept
- a reason why similarities between the velvet worm and the annelid are an example of convergent evolution
- a reason why similarities between the velvet worm and the arthropod are an example of divergent evolution
- why molecular evidence is used to determine phylogenetic relationships in the velvet worm rather than appearance.

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

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