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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Biology 2025

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.

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

QUESTION ONE: The apple maggot fly and the hawthorn fly

Figure 1: Apple maggot fly laying eggs in apple fruit.

Figure 2: Hawthorn fly on a North American hawthorn tree.

Rhagoleti pomonella is a fly species native to North America. The species originally laid its eggs on the red fruit of the hawthorn tree (also native to North America) as a food source for larvae.

Approximately 200 years ago European settlers introduced apples to North America, and *R. pomonella* evolved into two distinct groups – the apple maggot fly and the hawthorn fly. These groups are physically similar and are still considered to be the same species. There is no geographic separation between the two groups.

The hawthorn fly lays its eggs in the native North American hawthorn fruit as a food source for its larvae, while the apple maggot fly now prefers to lay its eggs in apples. Apples ripen earlier in the season than hawthorn fruit, so apple maggot flies emerge earlier. Females and males prefer to mate and lay their eggs in the same type of fruit they are hatched in.

Data shows that the two groups have differences in their enzymes. They also differ genetically in their development time: maggots in apples develop in about 40 days, while maggots in hawthorn fruit develop in 55–60 days.

Discuss speciation and the mechanisms leading to the formation of the two different groups of fly.

In your answer, include discussion of:

- speciation and reproductive isolating mechanisms, with definitions
- how TWO named isolating mechanisms may have caused the formation of the two groups of fly
- a suggestion as to why the two groups are not yet considered separate species.

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QUESTION TWO: Lamprey and eels

The lamprey (*Petromyzontiformes*) is an ancient fish. Adult lamprey look like eels physically even though they have been separate species for millions of years. The similarities between the two include:

- a long flexible body that can move through narrow spaces
- swimming in an undulating (wave-like) motion
- no paired fins
- covered in mucus
- tolerance of low oxygen environments.

Figure 3: Phylogenetic tree for the lamprey.

Figure 4: Adult lamprey.

Figure 5: Longfin eel.

However, there are many differences, as listed in Table 1 below.

Table 1: Differences between lamprey and eel.

Lamprey	**Eel**
Cartilage skeleton	Bony skeleton
No jaw; mouth is a circular sucker, filled with hundreds of small teeth and a rasping tongue	Bony jaw and teeth
Continuous dorsal (back) fin only	Dorsal (back), pectoral (arm), anal fins
Seven gill openings on each side of head with no gill cover	Single gill opening on each side of head covered by a bony gill cover
No scales, skin is smooth and slimy	Tiny scales, which are hard to see
No backbone	Has a backbone
Many parasitic species that use sucker-like mouths to attach to fish for feeding or to scavenge	Most species are predators or scavengers
Live in the ocean and reproduce in rivers	Live in rivers and reproduce in the ocean

Discuss the evolution of lamprey and eel using the information provided.

In your answer, include discussion of:

- convergent evolution and an analogous structure, including descriptions
- how TWO named selection pressures influenced the similarities between lamprey and eel
- TWO examples of scientific evidence that can be used to determine that the physical similarities between the lamprey and the eel are an example of convergent evolution, not divergent evolution.

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QUESTION THREE: Tetraploid treefrogs

The gray treefrog (*Dryophytes versicolor*) and Cope's gray treefrog (*Dryophytes chrysoscelis*) are identical in physical characteristics and behaviour. However, the two species can be identified by different mating calls and chromosome numbers.

The tetraploid gray treefrog is related to the diploid Cope's gray treefrog and is thought to have evolved through multiple hybridisation events, with different diploid ancestors. Gray treefrogs have double the number of chromosomes. This has caused their mating call to be a slower musical call than that of Cope's gray treefrog, which is faster and more high-pitched.

The treefrogs share similar habitats, but the two species do not interbreed.

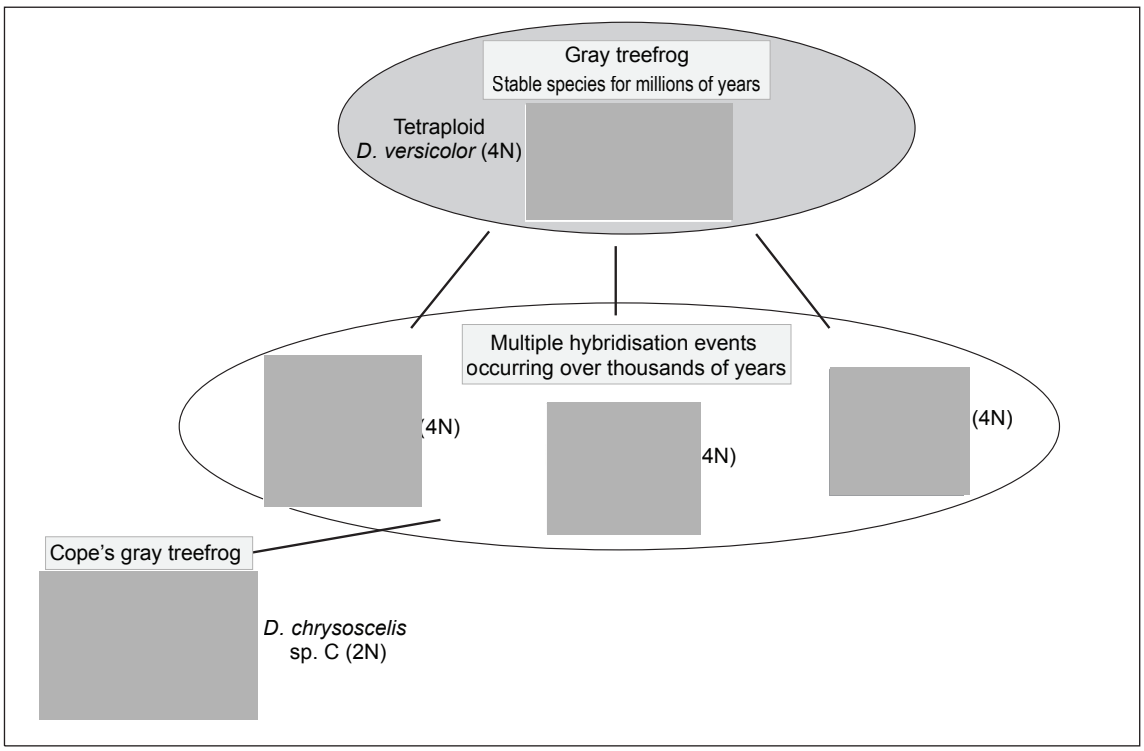

Figure 6: Polyploid speciation in treefrogs.

Discuss processes that caused the gray treefrog and Cope's gray treefrog to become separate species with different evolutionary patterns. You may use diagrams to support your answer.

In your answer, include discussion of:

- hybridisation and polyploidy, including definitions
- how polyploidy can produce hybrid frogs
- why the process of speciation in treefrogs is an example of sympatric speciation and not allopatric speciation
- why this is an example of punctuated equilibrium and not gradualism.

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

Figure 1: https://phys.org/news/2017-01-apple-maggot-flyhow-formation-species.html
Figure 2: https://www.barbless-flies.co.uk/pages/match-a-hatch-hawthorn
Figure 3: https://www.odt.co.nz/lifestyle/magazine/blood-sucking-fish-its-own-league
Figure 4: https://www.nzgeo.com/stories/blood-suckers/
Figure 5: https://www.sciencelearn.org.nz/resources/441-longfin-eels
Figure 6: https://www.frogpets.com/gray-tree-frog/
https://www.sdherps.org/species/hyla_chrysoscelis
https://www.sciencedirect.com/science/article/pii/S096098220601253X