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Level 3 Biology 2022

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 (▨). 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.

QUESTION ONE: POISON

Pufferfish
Source: www.scienceabc.com/nature/animals/what-are-pufferfish-and-are-they-toxic.htm

Blue-ringed octopus
Source: www.nhm.ac.uk/discover/blue-ringed-octopus-small-vibrant-deadly.html

Rough-skinned newt
Source: www.sciencenewsforstudents.org/article/toxic-germs-on-its-skin-make-this-newt-deadly

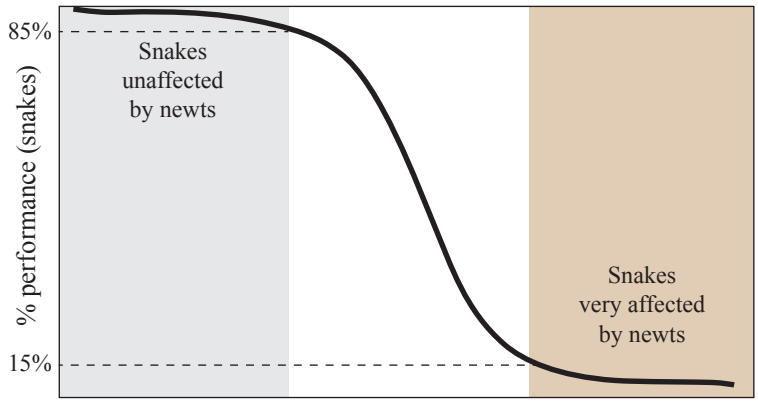
The most important poison found in newts, the blue ringed octopus, and pufferfish is tetrodotoxin (TTX). It is one of the most dangerous toxins known. It acts on the nervous system of prey, and can result in muscles not being able to work, leading to death. It is used by the animals as an antipredator defence.

An adaptation of extreme resistance to this chemical has come about in several species of snakes that eat newts.

Snakes living in areas where there are prey who make TTX, have a protein expressed with a different amino acid which prevents nerve and muscle tissue being affected. Some snakes, such as the garter snake (*Thamnophis sirtalis*), are able to eat highly toxic newts because they have developed resistance to TTX, due to changes in a number of protein coding genes.

Researchers studied the success of snakes in eating newts in an area. They gave a percentage performance score based on the survival of the snake population in the survey area, as shown in the graph below. A score of 85% meant that 85% of the snakes in the area survived and reproduced.

Source: www.newscientist.com/article/dn13438-toxic-newts-lose-war-against-super-immune-snakes/



Source: https://evolution4e.sinauer.com/exercise1301.html

Discuss how both coevolution and convergent evolution are demonstrated in this example of animals with TTX- producing genes and those with resistance to TTX.

In your answer

- define the terms coevolution, convergent evolution, and mutation
- explain how the octopus, the pufferfish and the newt each having TTX is an example of convergent evolution
- using data from the graph, discuss how coevolution has led to an increase in TTX production in newts, and evaluate the implications of this for the survival and success of the newt species.

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

QUESTION TWO: TRIPLE-FINNED FISH

Source: www.researchgate.net/figure/Triplefin-species-used-in-this-study-and-their-respective-distributions-Bellapiscis_fig2_351878084

Approximately 130 species of triplefin have been identified worldwide living in many habitats, such as in tropical, subtropical, temperate, subantarctic, and the Antarctic Peninsula polar sea regions. In New Zealand, we see a large diversity of triplefin species. New Zealand has over 20 species of triplefin, all of which are endemic.

Discuss how the New Zealand triplefins are an example of adaptive radiation.

In your answer:

- describe what is meant by the terms endemic and species
- explain how temperature may act as a selection pressure, and leads to different species being found at different zones of the beach, such as the three species of triplefin that are shown in the diagram above
- discuss how the process of natural selection has resulted in such a large number of species of triplefin here.

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

QUESTION THREE: POLYPLOIDY AND SPECIATION

When Māori arrived in New Zealand from tropical Polynesia around AD 1250, they brought with them a number of tree and root crops. Polyploidy is inferred in the origins of three of these species – kūmara (sweet potato), tī pore (the Pacific cabbage tree, now only found on Raoul Island, approximately 1000 km from New Zealand), and uwhi (yams). Polyploids are often larger than the species they are formed from, and are reproductively isolated from them.

Kūmara
Source: www.nature.com/articles/nature.2013.12257

Tī pore
Source: www.nzpcn.org.nz/flora/species/cordyline-fruticosa/?web=1&wdLOR=c5453C15F-CE62-0243-961A-E58D334D15C8

Uwhi
Source: https://teara.govt.nz/en/photograph/17506/uwhi

Discuss processes that result in new species.

You may use a diagram to support your answer.

In your answer:

- define the terms polyploid and reproductive isolation
- explain how polyploids are formed
- discuss how the process of polyploidy is an example of sympatric speciation, and explain how two **other** reproductive isolating mechanisms (RIMs) could have contributed to the speciation of the kūmara, tī pore, and uwhi.

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

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

QUESTION NUMBER

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QUESTION NUMBER