

See back cover for an English translation of this cover

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91157M



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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

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Tohua tēnei pouaka mēnā
KĀORE koe i tuhituhi i
roto i tēnei pukapuka

Koiora, Kaupae 2, 2021

91157M Te whakaatu māramatanga ki te rerekētanga ā-ira me te huringa

Ngā whiwhinga: Whā

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki te rerekētanga ā-ira me te huringa.	Te whakaatu māramatanga hōhonu ki te rerekētanga ā-ira me te huringa.	Te whakaatu māramatanga matawhānui ki te rerekētanga ā-ira me te huringa.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOAA kei roto i tēnei pukapuka.

Ki te hiahia koe ki ētahi atu wāhi hei tuhituhi whakautu, whakamahia te wāhi wātea kei muri i te pukapuka nei.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–21 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

Kaua e tuhi ki roto i tētahi wāhi kauruku whakahāngai (X). Ka tapahia pea tēnei wāhi ina mākahia te pukapuka.

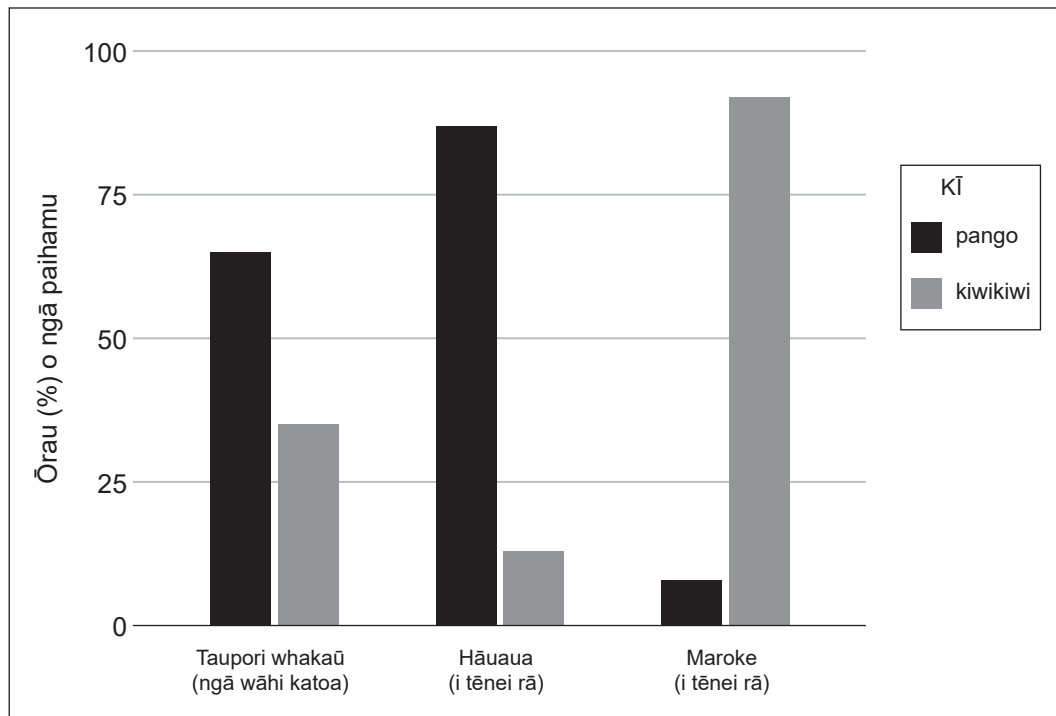
ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TŪMAHI TUATAHI: TE TERENGA IRANGA ME TE WHIRINGA MĀORI

He mea heri mai te paihamu, *Trichosurus vulpecula*, ki Aotearoa i waenga i te tau 1837 me te 1924. Ahakoa te pā mai o te rerekētanga, ka taea te whakarōpū te tae huruhuru o te paihamu ki ngā momo taketake e rua: pango, kiwikiwi rānei. I whakaurua mai ngā paihamu pango me te kiwikiwi ki ngā wāhi katoa o Aotearoa.

Engari kāore e ōrite te tuari tae o ngā paihamu o ēnei rā ki ngā taupori paihamu taketake. E tino kitea ana ngā paihamu pango i ngā wāhi he nui te ua, ā, e tino kitea ana ngā paihamu kiwikiwi i ngā wāhi he iti iho te ua. E whakaatu ana tēnei ehara i te mea i tūpono noa te rerekē o te pāpātanga irarā pango me te kiwikiwi i ngā taupori rerekē.

Ōrau o ngā paihamu pango me te kiwikiwi i ngā wāhi rerekē



He mea urutau mai i Triggs, S.J. rāua ko W.Q Green. 1989, *New Zealand Journal of Ecology*, Vol 12.

Ko te whakapae a ētahi kaimātai koiora he nui ake te pāpātanga whakaeto wai o ngā huruhuru pango tēnā i ngā huruhuru kiwikiwi, nō reira ka taea te whakahaere te mahana tinana i ngā āhuatanga mākū. Kāore pea e pai ngā pāpātanga whakaeto wai nui i tētahi āhuarangi maroke.

Matapakihia ngā pānga o te terenga iranga ME te whiringa māori ki ngā puna ira o ngā paihamu i ngā nōhanga hāuaua ME te nōhanga maroke ake.

I tō tuhinga, me kōrero mō te tauira e pā ana ki te tae paihamu ka:

- whakaahua i te terenga iranga me te pānga whakaū
- whakamārama i ngā āhuatanga e hiahiatia ana kia pā mai ai te whiringa māori, ā, he pēhea te pānga o tēnei ki te rerekē o te pāpātanga irarā tae kei ngā puna ira paihamu
- matapaki ko tēhea te āhuatanga – arā, te whiringa māori, te terenga iranga rānei nā te pānga whakaū – he nui rawa te pānga ki te puna ira o ngā paihamu i ngā nōhanga rerekē.

Whakamahia he taunaki i te kauwhata, i te kōrero pukapuka hoki hei tautoko i tō matapakinga.

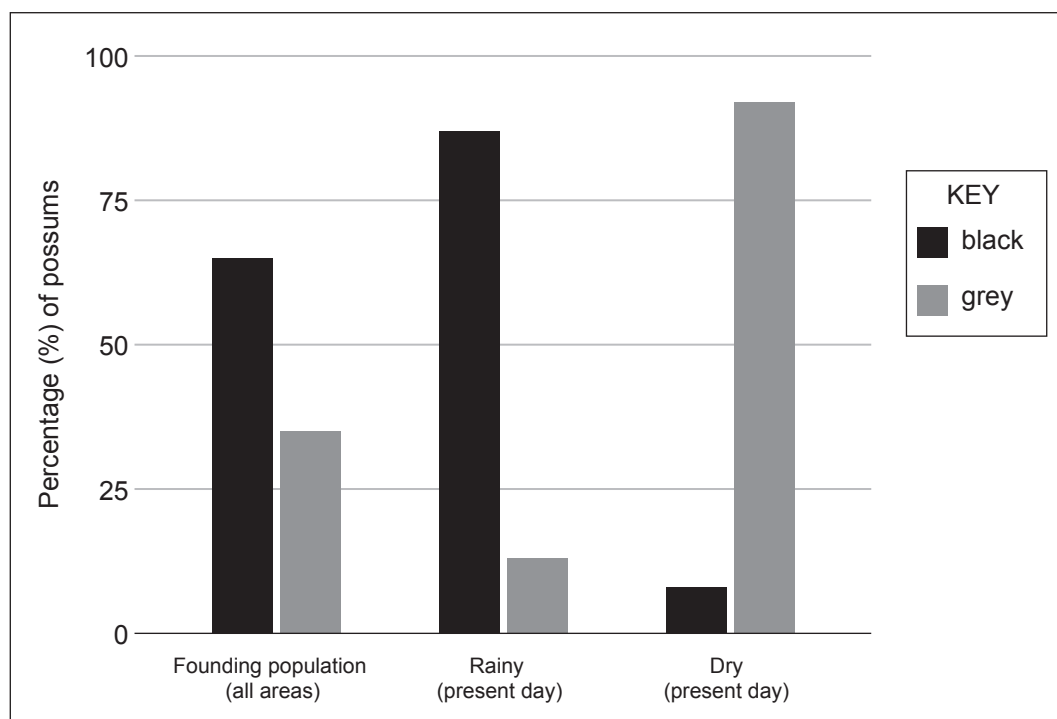
He wāhi anō mō tō tuhinga
mō tēnei tūmahi kei ngā
whārangi o muri mai.

QUESTION ONE: GENETIC DRIFT VS NATURAL SELECTION

Brushtail possums, *Trichosurus vulpecula*, were introduced into New Zealand between 1837 and 1924. Although there is variation, possum fur colour can be classified into two basic types: black or grey. Both black and grey possums were introduced in all areas of New Zealand.

Today's possum populations do not, however, reflect the colour distribution of the founding possum populations. Black possums are more frequent in areas of high rainfall and grey possums are more frequent in areas with less rainfall. This suggests that the change in black and grey allele frequency in different populations is not due to chance.

Percentage of black and grey possums in different areas



Adapted from Triggs, S.J. and W.Q Green. 1989, *New Zealand Journal of Ecology*, Vol 12.

Some biologists hypothesise that the dark coloured fur has a higher rate of water evaporation than the grey fur and therefore could help regulate body heat in wet conditions. High water evaporation rates could be a disadvantage in a dry climate.

Discuss the effects of genetic drift AND natural selection on the gene pools of the possums in BOTH the rainy habitat and the drier habitat.

In your answer, refer to the possum fur colour example and:

- describe genetic drift and founder effect
- explain the conditions needed for natural selection to take place, and how this applies to change in fur colour allele frequency in possum gene pools
- discuss which factor – natural selection or genetic drift as a result of the founder effect – has had the greatest effect on the gene pool of possums in the different habitats.

Use evidence from the graph and reading to support your discussion.

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

TŪMAHI TUARUA: WHAKAWHITI PARITO PŪRUA

Paihamu kiwikiwi

www.smh.com.au/technology/new-zealand-vows-to-eradicate-the-feral-aussie-possum-by-2050-20160726-gqdwpb.html

Paihamu pango

<https://dpiwwe.tas.gov.au/wildlife-management/living-with-wildlife/living-with-brush-tailed-possums>

Ahako ko taua momo anō, ko te tikanga he nui ake ngā paihamu pango i ngā paihamu kiwikiwi. Me kī e whakaatu ana ngā irarā mō ngā huruhuru pango me te rahinga nui i te tāpua¹. He tāpua te pango (B) ki te kiwikiwi (b), ā, he tāpua te rahinga nui (L) ki te rahinga paku (l).

I whakawhitia tētahi paihamu whakaputa uri horomata pango nui me tētahi paihamu whakaputa uri horomata kiwikiwi paku.

- (a) Whakaotihia te tūtohi Punnet hei whakaatu i ngā ōwehenga tohuira me ngā ōwehenga tohuāhua o te whakatipuranga F2 o ngā paihamu.

Tohuira o te paihamu whakaputa uri horomata pango nui: _____

Tohuira o te paihamu whakaputa uri horomata kiwikiwi paku: _____

Tohuira o ngā uri F1: _____

Ngā tohuhema F1

Ngā tohuhema F1

- (b) Te ōwehenga tohuāhua o te F2 ka tūmanakohia:

¹ ngoi

QUESTION TWO: DIHYBRID CROSS

Grey possum

www.smh.com.au/technology/new-zealand-vows-to-eradicate-the-feral-aussie-possum-by-2050-20160726-gqdwpb.html

Black possum

<https://dpiptwe.tas.gov.au/wildlife-management/living-with-wildlife/living-with-brush-tailed-possums>

Although still the same species, black possums are usually larger than grey possums. Assume the alleles for black fur and large size both show complete dominance. Black (B) is dominant to grey (b) and large size (L) is dominant to small size (l).

A pure-breeding large black possum was crossed with a pure-breeding small grey possum.

- (a) Complete a Punnet square to show the genotype and phenotype ratios of the F₂ generation of possums.

Genotype of pure-breeding large black possum: _____

Genotype of pure-breeding small grey possum: _____

Genotype of F₁ offspring: _____

		F ₁ gametes			
F ₁ gametes					

- (b) Expected phenotype ratio of F₂:

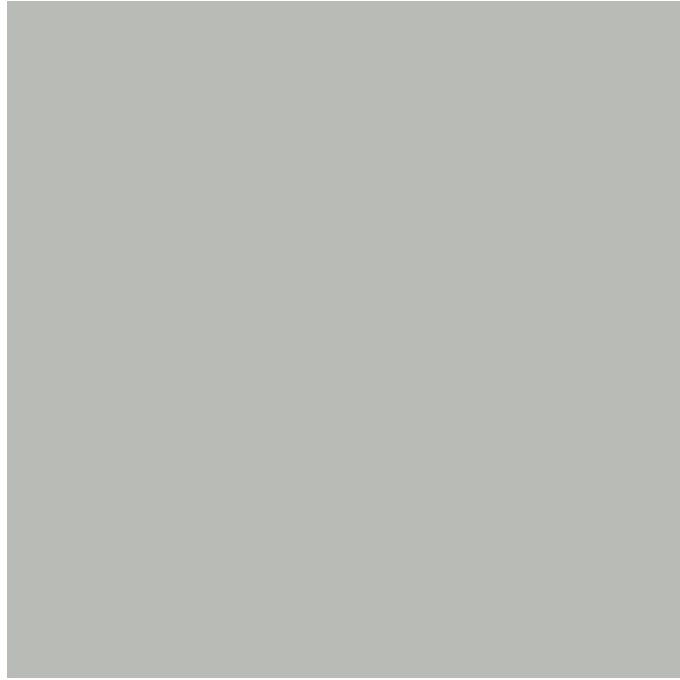
- 3 black large : 1 grey small

Discuss linked genes and how they affect the diversity of both phenotypes and genotypes of the offspring produced by this dihybrid cross.

- a description of linked genes
- an explanation of how linked genes affect the diversity of the gametes produced by the heterozygous parents
- a discussion of how the processes of independent assortment and crossing over affect the linked genes in this example.

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TŪMAHI TUATORU: NĀ IRARĀ HOU



Paihamu koura

www.zooborns.com/zooborns/2012/09/

brushtail-baileys-baby-pics-emerge-a-zooborns-first.html

I tōna whenua taketake o Ahitereiria, kua kitea i roto i te wao ko tētahi irakē e puta ai ngā paihamu koura. Ka taea e ngā paihamu koura te whakaputa uri huruhuru koura. E tohu ana tēnei i Ahitereiria e toru ngā irarā i te iti rawa mō te tae huruhuru. Ko te āhua nei he ngoikore te irarā huruhuru koura ki ngā irarā pango me te kiwikiwi. Ko te raupapatanga tāpua o te irarā pango (F^B), te irarā kiwikiwi (F^G), me te irarā koura (F^g) ko:

$$F^B > F^G > F^g$$

- (a) Whakaahuahia te take he aha i kotahi noa iho ai te tōpūtanga tohuira mātua e taea ai te whakaputa uri me ngā tohuāhua katoa e toru (huruhuru pango, kiwikiwi me te koura).

Tautokona tō matapakinga mā tētahi tūtohi Punnet, ka whakatau i ngā ōwehenga tohuira me ngā ōwehenga tohuāhua o ngā uri.

Tohuira o te matua #1: _____

Tohuāhua o te matua #1: _____

Tohuira o te matua #2: _____

Tohuāhua o te matua #2: _____

QUESTION THREE: NEW ALLELES



Golden possum

[www.zooborns.com/zooborns/2012/09/](http://www.zooborns.com/zooborns/2012/09/brush-tail-baileys-baby-pics-emerge-a-zooborns-first.html)

brush-tail-baileys-baby-pics-emerge-a-zooborns-first.html

In its native Australia, a mutation that produces golden-furred brushtail possums has been seen in the wild. Golden possums can produce golden-furred offspring. This indicates that in Australia there are at least three alleles for fur colour. It appears that golden fur allele is recessive to both the black and grey alleles. The dominance order of the black allele (F^B), grey allele (F^G), and golden allele (F^g) is:

$$F^B > F^G > F^g$$

- (a) Describe why there is only one combination of parental genotypes that could produce offspring with all three phenotypes (black, grey and golden fur).

Support your discussion with a Punnet square, and state the genotype and phenotype ratios of the offspring.

Genotype of parent #1: _____

Phenotype of parent #1: _____

Genotype of parent #2: _____

Phenotype of parent #2: _____

Ōwehenga tohuira o ngā uri: _____

Ōwehenga tohuāhua o ngā uri: _____

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Phenotype ratio of offspring: _____

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- Compare and contrast the mutations in the exposed skin cells, and the golden-fur mutation, and how they affect individual possums and the possum gene pool.

- a description of mutation
- an explanation of the difference between a gametic and a somatic mutation
- a discussion of how gametic mutations and somatic mutations affect both individual possums and the possum gene pool.

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**He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.**

TAU TŪMAHI

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

QUESTION
NUMBER

English translation of the wording on the front cover

Level 2 Biology 2021

91157M Demonstrate understanding of genetic variation and change

Credits: Four

91157M

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of genetic variation and change.	Demonstrate in-depth understanding of genetic variation and change.	Demonstrate comprehensive understanding of genetic variation and change.

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 2–21 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.