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SUPERVISOR'S USE ONLY

Level 2 Biology, 2017

91157 Demonstrate understanding of genetic variation and change

2.00 p.m. Wednesday 22 November 2017
Credits: Four

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 space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

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

TOTAL

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QUESTION ONE: PIGEON GENETICS

Pigeon wing pattern and leg feathering both show complete dominance. The bar wing allele (**B**) is dominant to the barless allele (**b**). The allele for leg feathers (**F**) is dominant to the allele for not feathered (**f**). These two genes are not linked.

**Bar (B)****Barless (b)**<http://learn.genetics.utah.edu/content/pigeons/pattern/>**Feathered (F)****Not Feathered (f)**<http://unews.utah.edu/pigeon-foot-feather-genes-identified/>

- (a) A breeder crossed a pigeon homozygous for the bar allele and the leg feathers allele with a pigeon that had a barless wing pattern and no feathers on its legs.

State the genotype of the F1 generation: _____

State the phenotype of the F1 generation: _____

- (b) Use the Punnett square below to show the gametes of the F₁ generation and all of the possible genotypes of the F₂ generation.

		F ₁ gametes			
F ₁ gametes					

- (c) Describe the predicted phenotype ratios produced by this cross.

QUESTION TWO: SOUTH ISLAND SADDLEBACK

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The South Island saddleback's gene pool has been affected by both the founder effect and the bottleneck effect at different points in history. The South Island saddleback was originally widespread over the mainland and also had established populations on some of the offshore islands, such as Big South Cape Island, because they were within flying distance from the mainland. The graph below compares the genetic diversity of historic saddleback populations on the offshore island of Big South Cape Island and the South Island mainland in the 1800s with the current population (in 2005) on Kaimohu Island.

After Māori and European settlers arrived, the South Island saddleback eventually became extinct, with the exception of the population on Big South Cape Island. In 1964 all South Island saddlebacks were removed from Big South Cape Island and taken to pest-free island sanctuaries such as Kaimohu Island. Safe from rats and other predators, the South Island saddleback population on Kaimohu Island is increasing, and is being used to establish other populations around the South Island.

Discuss how the founder and bottleneck effects have influenced the current South Island saddleback gene pool on Kaimohu Island.

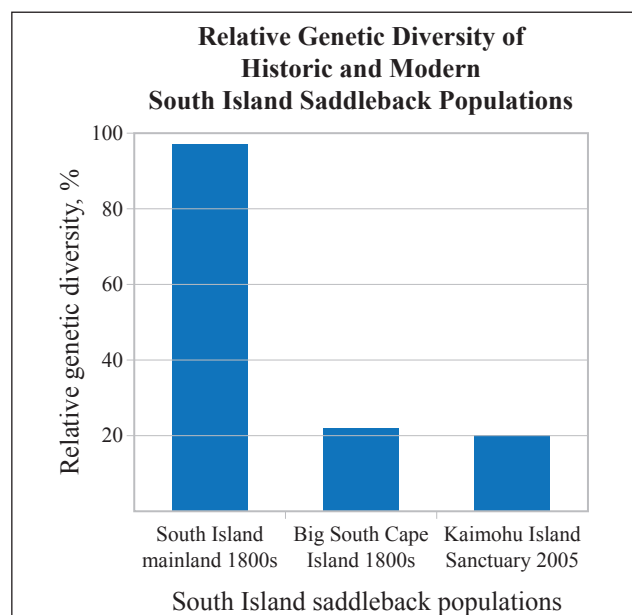
Refer to the information above, and the graph, to support your discussion.

Your discussion should include:

- a description of a gene pool
- an explanation of the bottleneck effect AND the founder effect
- a discussion of why the 1800s Big South Cape Island population had low genetic diversity compared to the 1800s South Island population
- a discussion of why the Kaimohu Island population has low genetic diversity.



<http://nzbirdsonline.org.nz/species/south-island-saddleback>



Adapted from: Jameson, Ian G., 2009, 'Loss of genetic diversity and inbreeding in New Zealand threatened bird species'.

Science for Conservation 293, p. 20. Department of Conservation, Wellington.

QUESTION THREE: NATURAL SELECTION AND MIGRATIONASSESSOR'S
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Lactase is an enzyme produced by babies that allows them to digest and gain nutrition from milk. Most young children lose the ability to produce lactase after they stop drinking their mother's milk, at about three years old. Adults and older children who cannot produce lactase suffer severe stomach upsets if they drink milk. This is called lactose intolerance.

Between 7 000 and 9 000 years ago, two different mutations arose independently in north-European and African populations that allowed these populations to produce lactase into adulthood (lactose persistence – see areas A and B on the map). Both populations A and B used cattle and their milk as a food source. Over time, the mutations became established in each of these European and African populations.

The map below shows the percentage of humans in the population who can digest milk today.



<http://www.hhmi.org/biointeractive/making-fittest-got-lactase-co-evolution-genes-and-culture>

Discuss how a mutation would become established in a population's gene pool and spread to other gene pools.

Your discussion should refer to specific populations on the map, and include:

- a description of both natural selection AND migration
- an explanation of how the mutations became established in A and B populations
- a discussion of why populations B, C, and D would have different percentages of the mutation.

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

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