2023 MCAS Sample Student Work and Scoring Guide

High School Biology Question 21: Constructed-Response

Reporting Category: Evolution

Practice Category: Evidence, Reasoning, and Modeling

Standard: <u>HS.LS.4.2</u> - Construct an explanation based on evidence that Darwin's theory of evolution by natural selection occurs in a population when the following conditions are met: (a) more offspring are produced than can be supported by the environment, (b) there is heritable variation among individuals, and (c) some of these variations lead to differential fitness among individuals as some individuals are better able to compete for limited resources than others.

Item Description: Determine a genotype for a trait based on an inheritance pattern, describe the expected allele frequencies in a population, and explain how changes in allele frequencies can be a result of natural selection.

View item in MCAS Digital Item Library

Scoring Guide

Select a score point in the table below to view the sample student response.

Score*	Description
<u>4A</u>	The response demonstrates a thorough understanding of inheritance patterns. The response correctly identifies the genotype of a chicken with a pea comb, clearly describes the expected frequencies of the alleles in a chicken population that lives in a cold climate, and clearly explains how these frequencies would be produced as a result of natural selection.
<u>4B</u>	
<u>3</u>	The response demonstrates a general understanding of inheritance patterns.
<u>2</u>	The response demonstrates a limited understanding of inheritance patterns.
<u>1</u>	The response demonstrates a minimal understanding of inheritance patterns.
<u>0</u>	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

^{*}Letters are used to distinguish between sample student responses that earned the same score (e.g., 4A and 4B).

Score Point 4A

This question has three parts.

The comb on the top of a chicken's head may be full size, intermediate size, or small size. The small-size comb is called a pea comb. A chicken with a pea comb is shown.



Part A

The allele for a full-size comb (H) and the allele for the pea comb (h) show incomplete dominance.

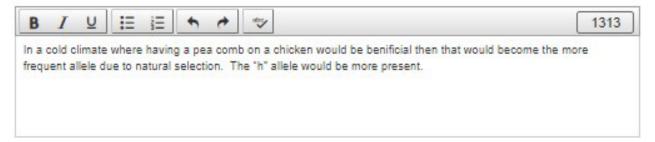
Using allele symbols, identify the genotype of a chicken with a pea comb.



Part B

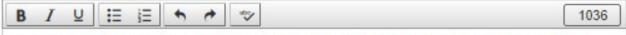
Chickens with pea combs have an advantage in cold climates because the pea comb reduces the amount of heat loss the chicken experiences.

Describe how the frequencies of the H allele and the h allele are expected to compare in a wild chicken population that lives in a cold climate.



Part C

Explain how the allele frequencies you described in Part B could be produced as a result of natural selection.



The "h" allele would be more present in the population because having the "h" allele, or the pea comb, give that chicken a higher fitness. Having a higher fitness means you have a higher chance to survive and reproduce. If the chicken can reproduce then it can pass on it's "h" allele, and if more chicken with the "h" allele are reproducing and more chickens with the "H" allele are dying and not reproducing then there will be more chicken having the "h" allele.

Score Point 4B

This question has three parts.

The comb on the top of a chicken's head may be full size, intermediate size, or small size. The small-size comb is called a pea comb. A chicken with a pea comb is shown.



Part A

The allele for a full-size comb (H) and the allele for the pea comb (h) show incomplete dominance.

Using allele symbols, identify the genotype of a chicken with a pea comb.



Part B

Chickens with pea combs have an advantage in cold climates because the pea comb reduces the amount of heat loss the chicken experiences.

Describe how the frequencies of the H allele and the h allele are expected to compare in a wild chicken population that lives in a cold climate.



Part C

Explain how the allele frequencies you described in Part B could be produced as a result of natural selection.



Since the chickens with pea combs have an advantage over chickens with full size combs, the chickens with pea combs are more likely to survive long enough to reproduce and send their genes onto the next generation. This process is called natural selection, and the end result would be a higher frequency of the h allele.

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Part B

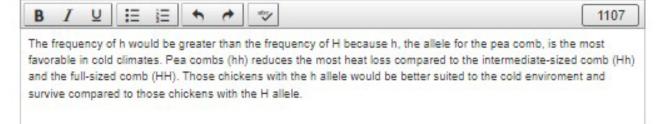
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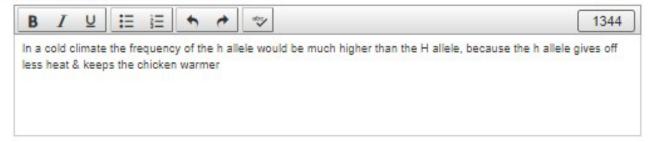
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Part B

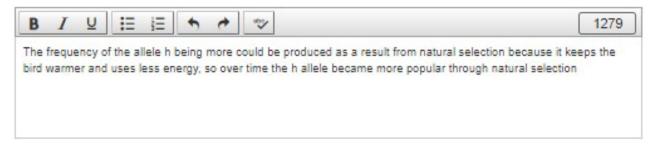
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Explain how the allele frequencies you described in Part B could be produced as a result of natural selection.



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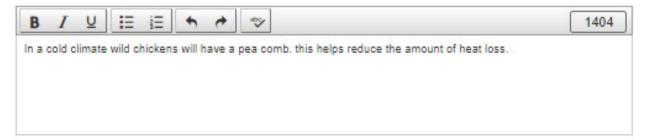
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Part B

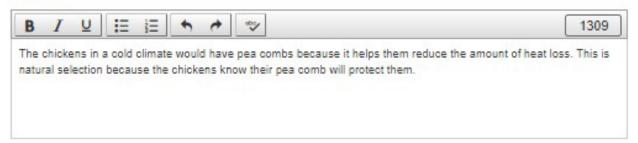
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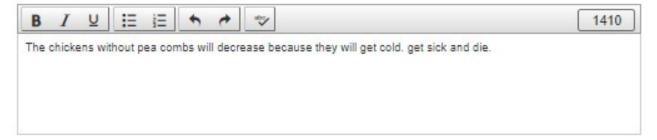
Using allele symbols, identify the genotype of a chicken with a pea comb.

Hh, hh

Part B

Chickens with pea combs have an advantage in cold climates because the pea comb reduces the amount of heat loss the chicken experiences.

Describe how the frequencies of the H allele and the h allele are expected to compare in a wild chicken population that lives in a cold climate.



Part C

Explain how the allele frequencies you described in Part B could be produced as a result of natural selection.

