2024 MCAS Sample Student Work and Scoring Guide

High School Biology
Question 16: Constructed-Response

Reporting Category: Heredity
Practice Category: Evidence, Reasoning, and Modeling
Standard: HS.LS.3.3 - Apply concepts of probability to represent possible genotype and phenotype combinations in offspring caused by different types of Mendelian inheritance patterns.
Item Description: Complete a Punnett square for a genetic cross between two heterozygous individuals, determine the percentage of offspring that would inherit a certain trait, and explain how the trait affects the fitness of an individual in a particular environment.

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
3A	The response demonstrates a thorough understanding of Punnett squares. The response correctly completes the Punnett square for a cross between two heterozygous mice. The response correctly determines the percentage of offspring that are expected to have light-colored fur and clearly explains the answer. The response also clearly explains why the student's claim is not supported by the information provided.
3B	
2	The response demonstrates a partial understanding of Punnett squares.
1	The response demonstrates a minimal understanding of Punnett squares.
0	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., 3A and 3B).

Score Point 3A

This question is part of a module with an introduction. The full introduction is available via the link to the Digital Item Library on the first page of this document. The first part of the introduction is shown.

Rock pocket mice are small rodents that live in Arizona and New Mexico. They can have either light-colored fur or dark-colored fur. Fur color is determined by a group of pigments called melanin. Two types of melanin are pheomelanin and eumelanin. Mice with light-colored fur mostly have pheomelanin, whereas mice with dark-colored fur mostly have eumelanin.

In rock pocket mice, the *Mc1r* gene controls whether eumelanin or pheomelanin is produced. Scientists have identified two alleles, **D** and **d**, for the gene. The allele for dark-colored fur (**D**) is dominant to the allele for light-colored fur (**d**).

Most of the habitat for rock pocket mice consists of light-colored rock called granite. However, there are several areas where the mice live that are made up of dark-colored rock called basalt. Basalt rock formed when lava flowed over granite rock and cooled. Owls and other predators use their sense of sight to hunt

This question has three parts.

Fur color in rock pocket mice is primarily controlled by the *Mc1r* gene.

Part A

Two mice that are heterozygous for the *Mc1r* gene mate and produce offspring.

Complete the Punnett square for this cross. Drag and drop an allele or allele pair into each box. Each allele or allele pair may be used once, more than once, or not at all.

D | d | DD | Dd | dd

	D	d
D	DD	Dd
d	Dd	dd

Part B

Based on the Punnett square, determine the percentage of offspring from this cross that are expected to have light-colored fur. Explain your answer.

25% of the offspring will most likely have light fur. Since the recessive allele, "***d***", is light fur, there is only one offspring with the two recessive alleles. One offspring out of four is 25%.

Part C

A student claims that having genotype **DD** or **Dd** would increase the fitness of a mouse living on granite rock.

Explain why this student's claim is **not** supported by the information provided.

Granite is a light rock and the genotypes **DD** and **Dd** are dominant dark fur traits. This means that the mice will have dark fur and they will be easily seen by predators. therefore, those genotypes would not increase the mice's fitness.

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Score Point 3B

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This question has three parts.

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Part A

Two mice that are heterozygous for the *Mc1r* gene mate and produce offspring.

Complete the Punnett square for this cross. Drag and drop an allele or allele pair into each box. Each allele or allele pair may be used once, more than once, or not at all.

D | d | DD | Dd | dd

	D	d
D	DD	Dd
d	Dd	dd

Part B

Based on the Punnett square, determine the percentage of offspring from this cross that are expected to have light-colored fur. Explain your answer.

1 out of four, or 25% of the offspring are expected to have light colored fur. The allele for light colored fur is recessive (d) and only 1 out of the four possiblities retains the allele pair dd.

Part C

A student claims that having genotype **DD** or **Dd** would increase the fitness of a mouse living on granite rock.

Explain why this student's claim is **not** supported by the information provided.

If an individual's genotype is DD or Dd, their phenotype is dark colored fur, as dark colored fur is dominant. Granite is a light colored rock. If individuals with dark colored fur live on light colored rock they are more ikely to be seen by predators. Mice having the genotype dd have a greater advantage on granite, they can camoflauge easier.

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Score Point 2

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Part A

Two mice that are heterozygous for the *Mc1r* gene mate and produce offspring.

Complete the Punnett square for this cross. Drag and drop an allele or allele pair into each box. Each allele or allele pair may be used once, more than once, or not at all.

D | d | DD | Dd | dd

	D	d
D	DD	Dd
d	Dd	dd

Part B

Based on the Punnett square, determine the percentage of offspring from this cross that are expected to have light-colored fur. Explain your answer.

25% of the offsrping are expected to have light colored fur. Since light colored fur is recessive, it will only show when there is not a dominant trait present (in this case that would be when the allele is dd) and there are only a 1/4 chance that the allele will be homozygous recessive.

Part C

A student claims that having genotype **DD** or **Dd** would increase the fitness of a mouse living on granite rock.

Explain why this student's claim is **not** supported by the information provided.

This is incorrect because an allele can't just change the fitness of a species, if the species did have an advantage being homozygous dominant, or heterozygous, it would have to evolve and the ones who could survive and reproduce better will create more offspring. Also the color of the fur most likely will not affect the fitness on granite rock.

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Score Point 1

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D | d | DD | Dd | dd

	D	d
D	DD	Dd
d	Dd	dd

Part B

Based on the Punnett square, determine the percentage of offspring from this cross that are expected to have light-colored fur. Explain your answer.

The percentage of ligh colored mice would be 75%.

Part C

A student claims that having genotype **DD** or **Dd** would increase the fitness of a mouse living on granite rock.

Explain why this student's claim is **not** supported by the information provided.

Because their is no vidence that having a certain genotype will increase or decrease your chances of surviving.

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Score Point 0

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D | d | DD | Dd | dd

	DD	DD
Dd	Dd	Dd
Dd	Dd	dd

Part B

Based on the Punnett square, determine the percentage of offspring from this cross that are expected to have light-colored fur. Explain your answer.

there's a 17 perecent that one of them will be expected to have loght colored fur because in the punnet square theres only dd one time 1 out of 6.

Part C

A student claims that having genotype **DD** or **Dd** would increase the fitness of a mouse living on granite rock.

Explain why this student's claim is **not** supported by the information provided.

The students claim is not supported by the information because a basalt rock forms over a granite rock and a granite rock has more that are light colored fur .

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