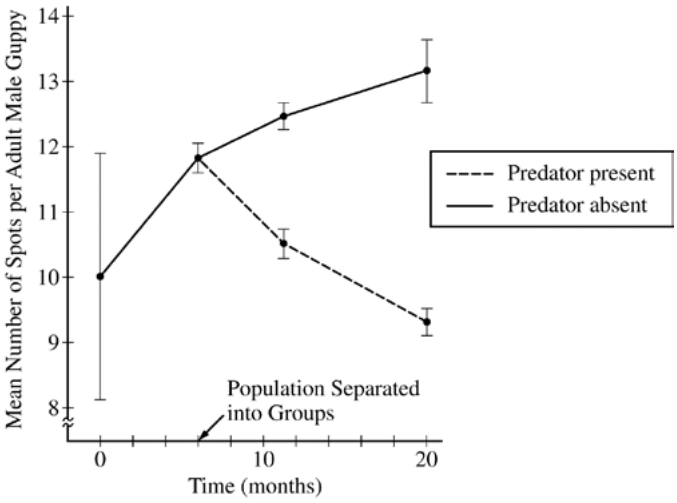
AP® BIOLOGY
2014 SCORING GUIDELINES

Question 4

Adult male guppies (*Poecilia reticulata*) exhibit genetically determined spots, while juvenile and adult female guppies lack spots. In a study of selection, male and female guppies from genetically diverse populations were collected from different mountain streams and placed together in an isolated environment containing no predators.

The study population was maintained for several generations in the isolated area before being separated into two groups. One group was moved to an artificial pond containing a fish predator, while a second group was moved to an artificial pond containing no predators. The two groups went through several generations in their new environments. At different times during the experiment, the mean number of spots per adult male guppy was determined as shown in the figure below. Vertical bars in the figure represent two standard errors of the mean (SEM).



(a) **Describe** the change in genetic variation in the population between 0 and 6 months and **provide** reasoning for your description based on the means and SEM.
(**2 points maximum**; LO 1.2, 2.24, 4.12, 4.26)

Describe change (**1 point**)	Provide reasoning (**1 point**)
Genetic variation is decreasing	SEM gets smaller

(b) **Propose** ONE type of mating behavior that could have resulted in the observed change in the number of spots per adult male guppy between 6 and 20 months in the absence of the predator.
(**1 point**; LO 1.2, 1.5, 2.40, 3.26, 3.40)

- Sexual selection for individuals with more spots
- Random mating behavior resulted in increased number of spots by chance

Question 4 (continued)

(c) **Propose** an evolutionary mechanism that explains the change in average number of spots between 6 and 20 months in the presence of the predator.
(**1 point**; LO 1.2, 3.26, 4.19)

- Directional selection against individuals with large numbers of spots
- Directional selection for individuals with fewer spots
- Natural selection used in context
- Genetic drift resulted in several generations of decreased numbers of spots

4A1

4. Adult male guppies (*Poecilia reticulata*) exhibit genetically determined spots, while juvenile and adult female guppies lack spots. In a study of selection, male and female guppies from genetically diverse populations were collected from different mountain streams and placed together in an isolated environment containing no predators.

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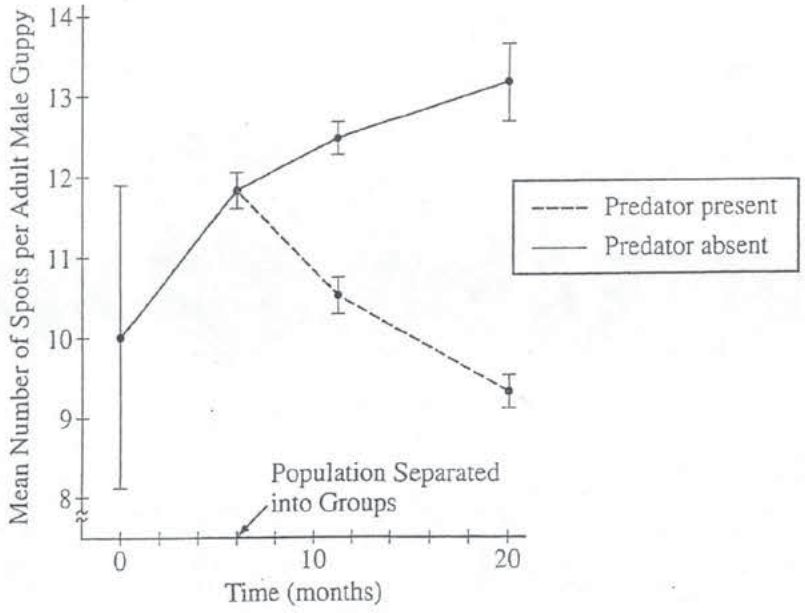

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(c) **Propose** an evolutionary mechanism that explains the change in average number of spots between 6 and 20 months in the presence of the predator.

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In the period lasting from 0-6 months, the amount of genetic variation in the population decreased. The mean number of spots increased from 10 to 12 and the SEM decreased, which indicates that there was variation in the number of spots, and more

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of the individuals had a number closer to the mean.

One mating behavior that could've resulted in the further increase in the average number of spots in the absence of the predator is sexual selection or preference. Perhaps female guppies showed a preference for males with a greater number of spots. This would make having spots a favorable trait in males and thus increase its frequency.

An evolutionary mechanism that would explain the decrease in spots in the presence of predators is the potentially decreased fitness of males with spots. This could be for a number of reasons, but perhaps the spots made the guppies more visible to predators and thus caused them to be eaten more frequently. This would decrease their ability to mate (they may die before they sexually mature) and thus result in a lower frequency of spots.

4B,

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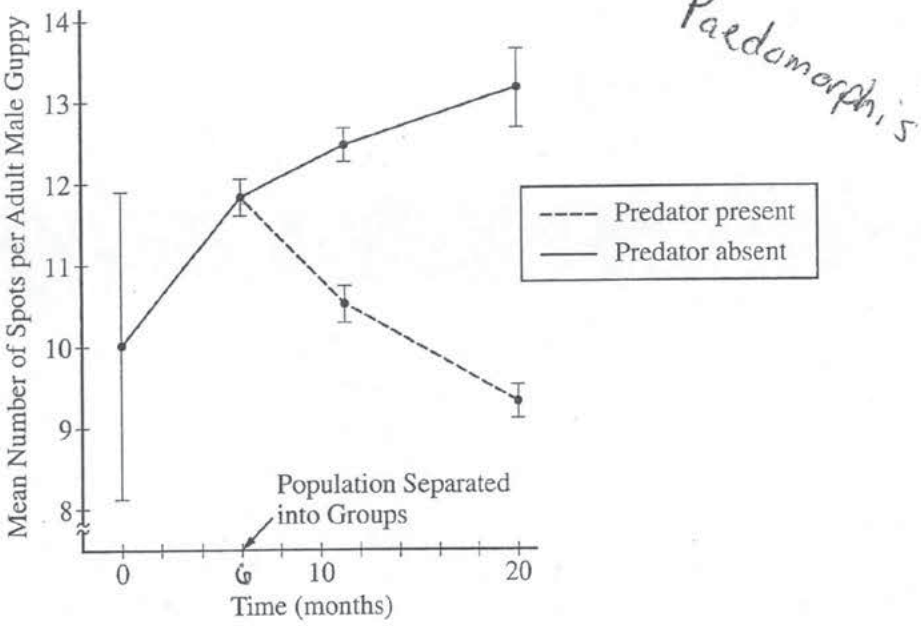
Paedomorph, 5



(a) **Describe** the change in genetic variation in the population between 0 and 6 months and **provide** reasoning for your description based on the means and SEM.

(b) **Propose** ONE type of mating behavior that could have resulted in the observed change in the number of spots per adult male guppy between 6 and 20 months in the absence of the predator.

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Adaptation

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The number of spots per adult male guppy increased in the first 6 months of the study. At the beginning of the study, the average number of spots was 10 with the lowest SEM # being 8 and

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the highest SEM # being 12. B. ~~mo~~ month 6, the mean ~~was~~ number of spots was 12 with highest SEM # being about 12.3 and the lowest SEM # being about 11.5.

Genetic variation decreased ~~for guppy male adult guppies with spots because~~ because ~~more~~ adult ~~guy~~ male guppies were gaining more spots as opposed to a balance of decreasing spots and then increasing spots.

Sexual selection is when a mate is picked based on supposed fitness and physical traits. male guppies could've began to pick mates based on which female they believed would produce the strongest babies. *taken out of the guppy gene pool, leaving the genes for less spots in the guppy gene pool.

Natural selection could explain why the number of spots on the male guppies decreased from month 6 to 20 when ~~to~~ the guppies were in the presence of a predator. The more spots the guppy had, the more visible it was to a predator. The more spotted guppies were eaten and the genes for a lot of spots were removed.

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4C,

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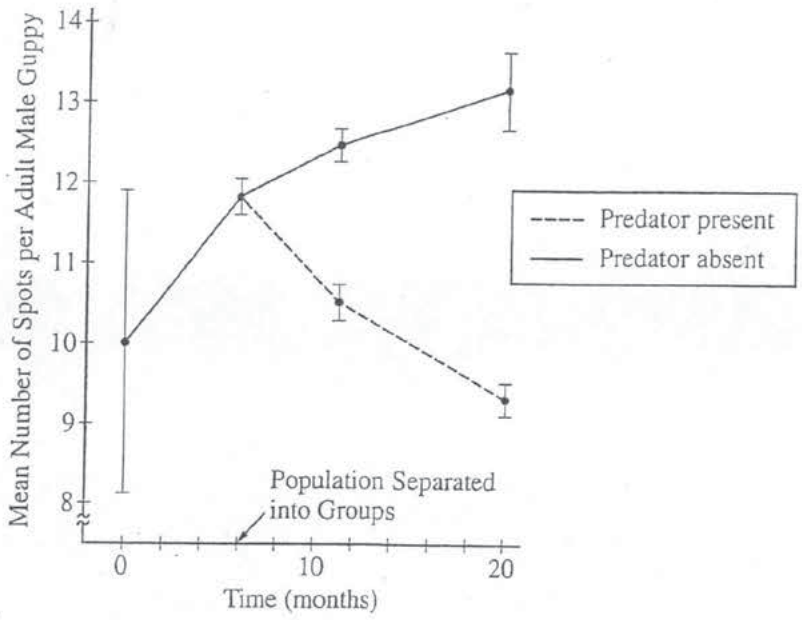

(a) **Describe** the change in genetic variation in the population between 0 and 6 months and **provide** reasoning for your description based on the means and SEM.

(b) **Propose** ONE type of mating behavior that could have resulted in the observed change in the number of spots per adult male guppy between 6 and 20 months in the absence of the predator.

(c) **Propose** an evolutionary mechanism that explains the change in average number of spots between 6 and 20 months in the presence of the predator.

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The number of spots started at 10 per adult male, and rose to a mean of 11.7 ± .1 for sem, thus 1.7 ± .1 spots were added to the male guppies between 0-6 months.

4C2

One reason between 6 and 20 months spots increased is because female guppies are more attracted to male guppies with spots, so selection occured where the guppies with more spots reproduced causing there children to have spots ultimitly changing the mean number of spots.

In the presense of a predator, the average number of spots decreased as a result of natural selection. Predators were able to see guppies with spots easier, so they were killed and did not have a chance to pass on their genes to their offspring.

AP® BIOLOGY
2014 SCORING COMMENTARY

Question 4

Question 4 was written to the following Learning Objectives in the AP Biology Curriculum Framework: 1.2, 1.5, 2.24, 2.40, 3.26, 3.40, 4.12, 4.19, 4.26

Overview

Question 4 asks students to analyze data from an investigation of natural selection in a population of guppies and connect changes in the phenotype with different selective pressures. The question presented a graph of the data, and asked students to describe the change in genetic variation in the population over the first 6 months of the experiment. Students were asked to use appropriate evidence from the graph to support their description. Students were asked to propose a type of mating behavior that could have resulted in the change in phenotype experienced by the guppy population in the absence of predators. Students were asked to propose an evolutionary mechanism that explains the change in phenotype experienced by the guppy population in the presence of predators.

Sample: 4A
Score: 4

The response in Sample 4A earned 1 point in part (a) for describing that the genetic variation decreased. The response also earned 1 point for providing the reasoning that the SEM gets smaller.

The response earned 1 point in part (b) for proposing that there was sexual selection for males with more spots.

The response earned 1 point in part (c) for proposing that predation caused selection against guppies with more spots.

Sample: 4B
Score: 3

The response in Sample 4B earned 1 point in part (a) for providing the reasoning that the SEM gets smaller. The response also earned 1 point in part (a) for describing that the genetic variation decreased.

The response earned 1 point in part (c) for proposing that there was directional selection against guppies with more spots in the presence of predators.

Sample: 4C
Score: 2

The response in Sample 4C earned 1 point in part (b) for proposing that there was sexual selection for males with more spots.

The response earned 1 point in part (c) for proposing that there was directional selection against individuals with large numbers of spots in the presence of predators.