2022

AP® CollegeBoard

AP® Biology

Sample Student Responses and Scoring Commentary

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Free-Response Question 4

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Question 4: Conceptual Analysis — 4 points

Existing isolated brook trout populations in Newfoundland, Canada, were once part of a larger population that was fragmented at the end of the most recent glaciation period about 10,000 to 12,000 years ago. Researchers investigated 14 naturally separated stream populations of brook trout. They found that the populations are all genetically distinct and show differences in morphology.

(a)	**Describe** the prezygotic barrier that results in these genetically distinct populations. • Geographic isolation prevents gene flow between the populations.	**1 point**
(b)	Brook trout with longer fins are able to swim faster than brook trout with shorter fins. In one of the Newfoundland streams, the main prey of the brook trout evolved to move faster. For brook trout living in this stream, **explain** why there is a difference in fitness between longer-finned individuals and shorter-finned individuals. • Individuals with longer fins are more likely to capture prey and reproduce.	**1 point**
(c)	If two morphologically and behaviorally distinct populations of brook trout remain isolated for many generations, **predict** the likely impact on both populations. Accept one of the following: • The two populations will become separate species. • The two populations will continue diverging (behaviorally/morphologically/genetically).	**1 point**
(d)	Researchers claim that there are more genetic differences between any two current brook trout populations than there are between any single current population and the ancestral brook trout population from which all the trout are descended. Provide reasoning to **justify** their claim. Accept one of the following: • Each single population has accumulated mutations/experienced genetic drift (distinguishing it from the ancestral population). The mutations each population accumulated are likely to differ (as a result of different selective pressures). • Allele production (as a result of random mutation) and genetic drift/selection by local environmental conditions has resulted in a collection of alleles unique to each population.	**1 point**
	Total for question 4	**4 points**

BEGIN Question 4

Begin your response to **QUESTION 4** on this page. Do not skip lines.

a) habitat geographic isolation, they live in separate areas so they do not meet and mate, so no gene flow occurs and they become genetically distinct over time.

b) longer-finned trout can move faster and more easily catch their fast-moving prey than shorter-finned trout, so they have more fitness because they are better adapted to survive + reproduce in this environment because they have a more accessible food supply.

c) they will become separate species (speciation will occur) because there is no gene flow between the populations, so their differences will become more pronounced until they can no longer interbreed and are classified as separate species.

d) they are all descended from the same common ancestor, so most of the alleles in their pools, excepting recent mutations come from that ancestor. They split from each other as the frequency of alleles changed based on their environments and the niches they needed to fill, so they are more different from each other than their ancestors, from whom they received almost all of their traits, and natural selection acted to remove different alleles from the gene pools of different populations, causing them to differ greatly from each other and only slightly

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Additional page for answering Question 4

Continue your response to **QUESTION 4** on this page. Do not skip lines.

From their ancestors.

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BEGIN Question 4

Begin your response to **QUESTION 4** on this page. Do not skip lines.

a. The prezygotic barrier was the glaciation period in which the trout were geologically separated into different streams. This made them evolve to be genetically different.

b. Longer finned individuals will be able to have a greater fitness than short finned individuals. This is because the prey of these trout has evolved to swim faster, making it difficult for short finned trout to feed and eventually reproduce. The longer finned individuals evolved to be faster than short finned individuals, so long finned trout have a ~~better~~ chance of catching prey and reproducing.

c. The impact on both populations is that they will most likely evolve into two different species. This is because they are already morphologically and behaviorally ~~diffe~~ distinct, and being isolated from each other will make them evolve differently.

d. Each population of brook trout are isolated from each other. This means that each population will eventually evolve to become different species from each other. This is why two separately observed populations have more differences than their common ancestor.

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Q5329/10

BEGIN Question 4

Begin your response to **QUESTION 4** on this page. Do not skip lines.

The environment that the populations of Brook trout was the reason for the populations to be genetically distinct.

The longer-finned individuals had a greater chance of surviving their predators when compared to short finned individuals because of the increased speed of the longer-finned individuals.

The populations will continuously grow genetically different due to the isolation from one another. As time went on different trout used different genetics to survive making the genetic differences between any 2 brook trout populations greater than their ~~common~~ ancestral brook trout population.

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Q5329/10

Question 4

Note: Student samples are quoted verbatim and may contain spelling and grammatical errors.

Overview

Question 4 described isolated brook trout populations that differ morphologically and genetically.

Responses to part (a) were expected to describe that geographic isolation serves as a prezygotic barrier and prevents gene flow among the trout populations (Learning Objective EVO-3.F).

Responses to part (b) were expected to explain that trout with longer fins have higher fitness than do shorter-finned individuals, because those with longer fins are more likely to catch their prey and reproduce (Learning Objective EVO-1.E).

Responses to part (c) were expected to predict that populations that remain isolated for many generations will become separate species (Learning Objective EVO-3.D).

Responses to part (d) were expected to justify the claim that there are more genetic differences between any two current brook trout populations than there are between any single current population and the ancestral brook trout population by explaining divergent evolution (Learning Objective EVO-3.E).

Sample: 4A
Score: 4

The response earned 1 point in part (a) for describing that there was a geographical barrier that prevented gene flow between the populations. The response earned 1 point in part (b) for explaining that the longer-finned trout can more easily catch prey and are "better adapted to survive & reproduce" than the shorter-finned fish. The response earned 1 point in part (c) for predicting that the populations will become separate species. The response earned 1 point in part (d) for justifying that in each population of fish, the "frequency of alleles changed based on their environments ... so they are more different from each other than [from] their ancestors."

Sample: 4B
Score: 2

The response did not earn a point for part (a) because the response does not describe the lack of gene flow between the populations. The response earned 1 point in part (b) for explaining that the longer-finned trout "have a better chance of catching prey and reproducing." The response earned 1 point in part (c) for predicting that the populations will "evolve into two different species." The response did not earn a point for part (d) because the response does not justify that mutations or genetic drift cause a collection of unique alleles in each population.

Sample: 4C
Score: 1

The response did not earn a point for part (a) because the response does not describe the lack of gene flow between the populations. The response did not earn a point for part (b) because the response explains that the longer-finned trout can swim faster to avoid being preyed upon instead of explaining that they are more likely to catch prey and reproduce. The response earned 1 point in part (c) for predicting that the populations will become more genetically different. The response did not earn a point in part (d) because it incorrectly justifies that "different trout used different genetics to survive."