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AP® CollegeBoard

AP® Biology

Sample Student Responses and Scoring Commentary

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Question 4: Conceptual Analysis — 4 points

In 1981 a single immature male *Geospiza conirostris* finch flew more than 100 kilometers from the Galápagos island of Española to the Galápagos island of Daphne Major, where no *G. conirostris* finches were living. The immigrant finch bred with a female *G. fortis*, a species of finch common on Daphne Major. The F_1 finches and later generations interbred only within their lineage. By 2012 scientists counted 23 individuals, including eight breeding pairs, within this hybrid lineage on Daphne Major. The hybrid lineage became known as Big Bird.

Birds with different beak shapes and sizes eat different types of food. The dimensions of the Big Bird beaks relative to the beaks of the major competitor finch species on Daphne Major are shown in Figure 1.

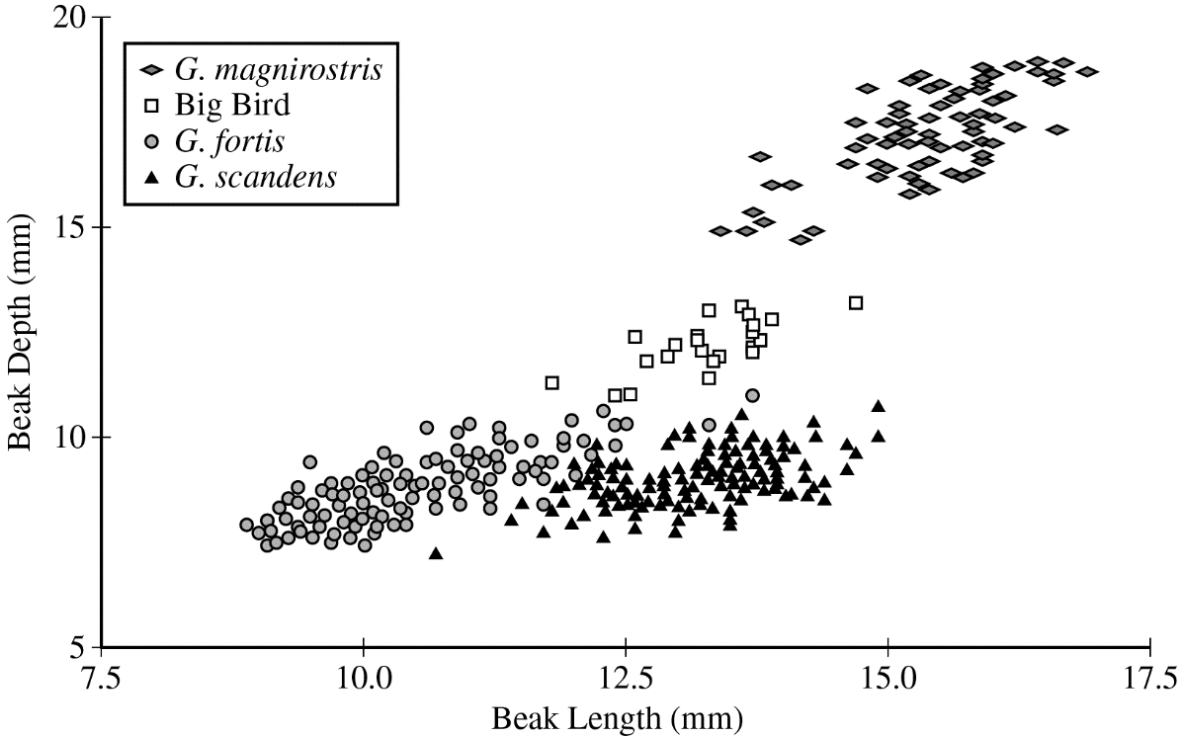

Figure 1. The dimensions of the beaks of the Big Bird lineage and of its major competitor species in 2012 on Daphne Major. Each symbol represents the beak dimensions of a single bird.

(a) The Big Bird lineage became reproductively isolated from *G. fortis*. **Describe** one prezygotic mechanism that likely contributed to the reproductive isolation of the Big Bird lineage from *G. fortis*. **1 point**

Accept one of the following:

- Beak shape/size or song or behavior or mechanical/chemical differences or time of mating or location on the island or primary food source differs between the Big Bird lineage and *G. fortis*.
- Description of another mechanism that prevents males and females from different populations from encountering each other/recognizing each other as potential mates.

(b) Based on the data in Figure 1, **explain** why the Big Bird population has been able to survive and reproduce on Daphne Major. **1 point**

- The birds have a beak size/shape that differs from the beaks of the competitor finches on the island. Thus, they probably do not compete with the other finch species for food but instead, eat food that the other finches do not consume.

(c)	A virus infects and kills all *G. magnirostris* on Daphne Major but does not affect the other finch species. Assuming food type and availability stay the same, **predict** the most likely change in the beak phenotype of the Big Bird population after six more generations. Accept one of the following predictions: • Option 1: The (mean) beak size will increase (in the population). • Option 2: The (average) beak (in the population) will be longer and deeper. • Option 3: The frequency of large beaks will increase (in the population). • Option 4: The (mean) beak size will stay the same (in the population).	**1 point**
(d)	Provide reasoning to **justify** your prediction in part (c). Accept one of the following: • Justification for options 1, 2, and 3: There will be directional selection for larger beaks because larger seeds are more accessible. • Justification for option 4: There is little genetic diversity because all birds are descended from a single pair, and the birds are only six generations from the founder.	**1 point**
	Total for question 4	**4 points**

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

A. One prezygotic mechanism that isolated Big Bird from G. fortis is mating rituals. As Big Bird formed into a new species, their mating patterns may have shifted so G. fortis did not recognize them.

B. The Big bird population has been able to survive and reproduce on Daphne Major because their beak size and shape is unique. Big Bird's unique beak size and shape allows it to occupy a unique ecological niche, where it is not in constant competition for food.

C. I predict that Big Bird's beak phenotype will increase in length and depth after six generations.

D. Big Bird's beak will increase in size because it provides a selective advantage. By having a larger beak, Big Bird will be able to expand their ecological niche into ~~the~~ G. magnirostris's former niche. This will increase food supply, so natural selection will favor the Big Bird variations with larger beaks.

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

A) One prezygotic mechanism that lead to the reproductive isolation is a diffrant mating ritual between the two birds. Diffrant speeies and animals all contain their own mating ritual that opposing sex animals seek for to mate. The birds of paradise do dances to attract the females while ~~flaming~~ peacocks let own their great big feathers up.

B) The Big Bird population was able to survive and reproduce because it was consuming foods ~~that~~ it was able to eat and reproduce efficiently with other Big Birds. The Big Birds beak ~~lenghth~~ length is very similar to G. scandens that are around 12.5 - 15. This beak length enables Big Birds to eat the same food as G. scandens.

C) The phenotype of big Birds beak length and depth increase.

D) The virus will kill all the G. magnirostris which increases the availability of a new food for the birds. Big Birds will larger beak lengths and Depth would have acess to more food increasing their liklyhood of reproducing, and giving their phenotype to their offsprings. ~~Ther~~ their offspring would have less compitition for seeking ~~dood~~ food and likely to share there genitics and phenotype to their offspring. Having a bigger depth and length for beakes is an genetic advantage that increases the likyhood for natural selection.

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

a) The Big Bird lineage mates at different times than the G. fortis.

b) The beak depth and length of the big bird lineage is an average of the other species, meaning they have a mix of all the favorable traits of each species on the island.

c) The beak phenotype would shift more to the deeper and longer side, [redacted]

d) If the G. magnirostris lineage is wiped out, their food source is left availible to the other species, forcing the phenotype to change and be more fit to eat that food source.

Question 4

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

Overview

This question described the establishment of a hybrid lineage of finches, dubbed "Big Bird," on the Galápagos island Daphne Major. Data on beak length and depth were presented in a scatterplot graph (Figure 1).

In part (a) students were asked to describe a prezygotic mechanism that contributed to the reproductive isolation of the Big Bird lineage from *Geospiza fortis*, one of the species of finches that lives on Daphne Major. Responses were expected to demonstrate an understanding of prezygotic mechanisms (EVO-3.F.3 in Topic 7.10).

In part (b) students were asked to explain why the Big Bird population has been able to survive and reproduce on the island. Responses were expected to demonstrate an understanding of niche partitioning (ENE-4.B.3 in Topic 8.5).

Part (c) posited a disruption caused by a virus that infects and kills all *G. magnirostris* on Daphne Major but does not affect the other finch species. Students were asked to predict the most likely change in the beak phenotype of the Big Bird population after six generations.

In part (d) students were asked to justify the predictions they made in part (c). Responses were expected to demonstrate an understanding of natural selection in response to selective pressures in the environment (Topic 7.2).

Sample: 4A
Score: 4

The response earned 1 point in part (a) for describing "mating rituals" as a prezygotic mechanism for reproductive isolation. The response earned 1 point in part (b) for explaining that "their beak size and shape is unique," which allows them to "occupy a unique ecological niche," and, therefore, Big Bird is "not in constant competition for food." The response earned 1 point in part (c) for predicting the Big Bird's beak length and depth will increase. The response earned 1 point in part (d) for justifying that Big Birds with larger beaks have "a selective advantage."

Sample: 4B
Score: 3

The response earned 1 point in part (a) for describing "a different mating ritual" as a prezygotic mechanism for reproductive isolation. The response did not earn a point in part (b) because there is no connection between beak differences and a unique food source for the Big Bird population. The response earned 1 point in part (c) for predicting that Big Bird's beak length and depth would increase. The response earned 1 point in part (d) for justifying that Big Birds with larger beaks are selected for because they have "access to more food."

Sample: 4C
Score: 2

The response earned 1 point in part (a) for describing temporal isolation, "mates at different times than the G. fortis." The response did not earn a point in part (b) because it does not describe a beak size that differs from the beaks of the competitors on the island and instead describes the beak depth and length as "an average of the other species." The response earned 1 point in part (c) for predicting that the Big Bird beak phenotype would "shift to the deeper and longer side." The response did not earn a point in part (d) because, although it justifies that the *G. magnirostris* food source is left available, it inaccurately states this is "forcing the phenotype to change … to eat that food source."