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Beadle Plasticus Evolution

Teacher Information

Summary

Students model the effects of two different environments on the frequencies of characteristics in a simulated *Beadle* population.

Core Concepts

- Some characteristics give individuals an advantage over others in survival and reproduction.
- The proportion of individuals in a population that have advantageous characteristics will increase.
- The variation found in organisms within a population increases the likelihood that at least some members of the species will survive under changed environmental conditions.

Time Required

Three 40-minute class periods

Kit contains

- Bag of beads labeled "*Beadle plasticus* in Forest Environment"
- Plastic container labeled "Environment"
- Plastic container labeled "Mating Area"
- Brown smooth fabric
- Green furry fabric
- Small plastic plate labeled "Did NOT Survive and Reproduce"

Teacher Provides

- Access to calculators to determine frequencies (optional)

Suggestion

Students can tear off the last page of the lab (the graph and data table) to make it easier to record their data.

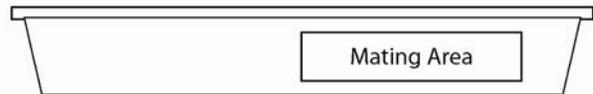
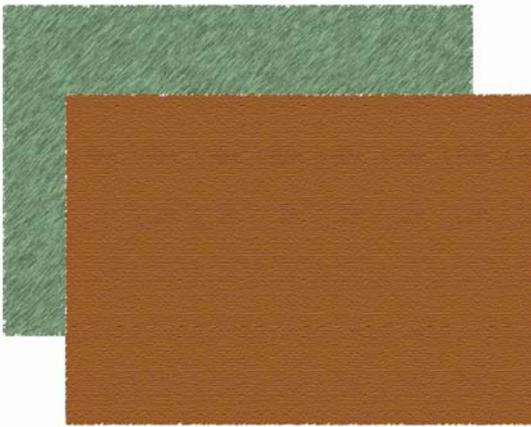
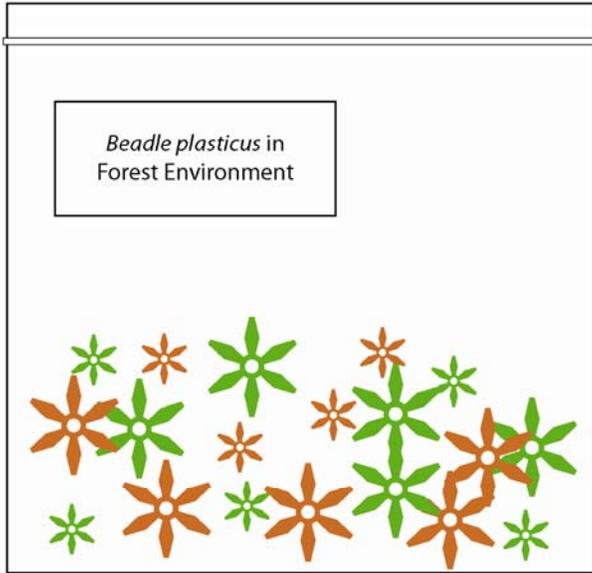
Warning: Choking Hazard

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Kit Contents Quick Guide



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Beadle Plasticus Evolution:

In this lab you will investigate the changes in a population of *Beadle plasticus*, represented by the beads in the bag. A population is a group of organisms (living in the same area at the same time) that belong to the same species. Members of the same **species** can interbreed (mate) and produce fertile offspring.

The *Beadle* population you will study originally lived in a **forest environment**.



1. Observe the *Beadle plasticus* population (beads) found in the bag labeled "*Beadle plasticus* in Forest Environment." All of the *Beadles* (beads) in this population belong to the same species. They can interbreed (mate with each other) and produce fertile offspring.
2. The members of the *Beadle plasticus* species are not identical to one another. Members of the *Beadle* population show **variation** in their size and color. There are four different varieties (types) of *Beadles* in the population. List the four different varieties (types) of *Beadles*.

Part 1: Model Population Changes in a Desert Environment

A natural disaster has destroyed the original forest environment. Some *Beadles* from the original forest population move into a **desert environment**. You will model what happens to the different varieties of *Beadle plasticus* in the desert environment.

1. Place the brown fabric in the bottom of the plastic container labeled “Environment.” This fabric represents the sand in the **desert environment**.
2. There are four different varieties (types) of *Beadles*. Count out five of each of the four varieties of *Beadles* (beads) and spread these on the fabric in the desert environment. Use your hand to gently rub the beads around on the fabric.
3. There should be 20 *Beadles* in the desert population (five of each of the four varieties). Use the equation in the box below to calculate the **frequency** of each of the four different varieties of *Beadles* in the population. Express your answer as a decimal number. Round to the nearest hundredth.

$$\text{Frequency of } \textit{Beadle} \text{ variety} = \frac{\text{Number of individuals of this } \textit{Beadle} \text{ variety}}{\text{Total number of } \textit{Beadles} \text{ in the population}}$$

4. Record the frequency of each *Beadle* variety in Column 1 of the Data Table. **The Data Table is on the last page of this lab.** You may tear this last page off to make it easier to record your data.
5. Check your work by adding the frequencies of each variety of *Beadle* in Column 1 of the Data Table. The total should be approximately equal to 1.0.
6. Predators: There are birds in the desert that prey on *Beadles*. These birds have large beaks and prefer to feed on large *Beadles* that are easily seen on the surface of the sand. Capture three **large, easy to see** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
7. Temperature: The high temperatures in the desert environment can kill *Beadles*. Large *Beadles* cannot burrow into the sand to escape the heat. Therefore, fewer of the large *Beadles* will survive. Remove three **large** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”

8. Disease: The *Beadles* are affected by a deadly bacterial disease that spreads rapidly through the desert population. Green *Beadles* are susceptible to this bacterial disease and brown *Beadles* are resistant to this disease. Remove three **green** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
9. Reproduction: When the *Beadles* reproduce, they prefer to mate with other *Beadles* that are the same size.
 - Move the surviving *Beadles* from the “desert” to the “Mating Area” (the clear container).
 - Pair each of the *Beadles* with another of the same size. The pairs may be the same color or different colors.
 - Unpaired *Beadles* die without reproducing. Place the unpaired *Beadles* onto the plate labeled “Did NOT Survive and Reproduce.”
 - Each pair of parent *Beadles* produces two offspring that are the same size and same colors as the parents. Use beads from the bag to represent the *Beadle* offspring.
 - Return the parent *Beadles* and their offspring to the “desert environment.”
10. Food Supply: The food supply in the desert can only support a population of 20 *Beadles*. Count the number of *Beadles* and determine how many *Beadles* will starve to death. Close your eyes and randomly remove the number of *Beadles* that starved to death. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
11. Predators: The birds with large beaks continue to prey on *Beadles* that are easily seen on the surface of the sand. Capture three **large, easy to see** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
12. Temperature: The high temperatures in the desert environment can kill *Beadles*. Large *Beadles* cannot burrow into the sand to escape the heat. Therefore, fewer of the large *Beadles* will survive. Remove three **large** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
13. Disease: The *Beadles* are affected by a deadly bacterial disease that spreads rapidly through the desert population. Green *Beadles* are susceptible to this bacterial disease and brown *Beadles* are resistant to this disease. Remove three **green** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
14. Remove the brown fabric from the “Environment” container but leave the surviving *Beadles* in the container.

15. Count the number of each variety of *Beadles* remaining in the desert population. Record the number of each variety of *Beadles* in Column 2 of the Data Table.
16. Count the total number of *Beadles* remaining in the desert population. Record this number in Column 2 of the Data Table.
17. Use the equation in the box below to calculate the frequency of each *Beadle* variety in the population. Express your answer as a decimal number. Record the frequency of each *Beadle* variety in Column 3 of the Data Table.

$$\text{Frequency of } \textit{Beadle} \text{ variety} = \frac{\text{Number of individuals of this } \textit{Beadle} \text{ variety}}{\text{Total number of } \textit{Beadles} \text{ in the population}}$$

18. Check your work by totaling the frequencies in Column 3. The total should be approximately equal to 1.0.
19. Return all the *Beadles* to the plastic bag. You will use these *Beadles* again for Part 2.
20. Use the information from the Data Table to graph the frequencies of each variety of desert *Beadle* on the Bar Graph.
- The striped bars that have already been drawn on this graph represent frequency of each *Beadle* variety in the forest population.
 - To represent the frequency of each *Beadle* variety in the desert population, draw bars in the column (on the right) next to the striped bars. Color the bars that you draw black.
21. Which variety of *Beadle plasticus* is best adapted to survive and reproduce in a desert environment? Support your answer with specific data from your Data Table or Bar Graph.
22. Predict what the desert *Beadle* population might be like after 50 generations. Support your prediction with evidence from your Data Table or Bar Graph.

Part 2: Model Population Changes in a Grassland Environment

A natural disaster has destroyed the original forest environment. Some of the *Beadles* from the original forest population move into a **grassland environment**. You will model what happens to the different varieties of *Beadle plasticus* in grassland environment.

1. Place the piece of green fabric in the bottom of the plastic container labeled "Environment". This fabric represents the grassland environment.
2. There are four different varieties of *Beadles*. Count out five of each of the four varieties of *Beadles* and spread these on the fabric in the grassland environment. Use your hand to gently rub the *Beadles* around on the fabric. There should be 20 *Beadles* in the grassland population (five of each variety).
3. Predators: There are birds in the grassland that prey on *Beadles*. These birds have small beaks and feed on small *Beadles* that are easily seen on the surface of the grass. Quickly capture three **small, easy to see** *Beadles*. Place these onto the plate labeled "Did NOT Survive and Reproduce."
4. Temperature: The low temperatures in the grassland environment can kill *Beadles*. Small *Beadles* lose heat rapidly and may not survive. Remove three **small** *Beadles*. Place these onto the plate labeled "Did NOT Survive and Reproduce."
5. Disease: The *Beadles* are affected by a deadly viral disease that spreads rapidly through the grassland population. Brown *Beadles* are susceptible to this viral disease and green *Beadles* are resistant to the disease. Remove three **brown** *Beadles*. Place these onto the plate labeled "Did NOT Survive and Reproduce."
6. Reproduction: When the *Beadles* reproduce, they prefer to mate with other *Beadles* that are the same size.
 - Move the surviving *Beadles* from the "grassland" to the "Mating Area."
 - Pair each of the *Beadles* with another of the same size. The pairs do not need to be the same color.
 - Unpaired *Beadles* die without reproducing. Place the unpaired *Beadles* onto the plate labeled "Did NOT Survive and Reproduce."
 - Each pair of parent *Beadles* produces two offspring that are the same size and same colors as the parents. Use beads from the bag to represent the *Beadle* offspring.
 - Return the parent *Beadle* and their offspring to the "grassland environment."

7. Food Supply: There is an unlimited supply of food for the *Beadles* in the grassland environment. The parents and all of their offspring can obtain the food that they need to survive and reproduce.
 8. Predators: Birds with small beaks continue to feed on *Beadles* that are easily seen. Capture three **small, easy to see** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
 9. Temperature: The low temperatures in the grassland environment can kill *Beadles*. Small *Beadles* lose heat rapidly and may not survive. Remove three **small** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
 10. Disease: The *Beadles* are affected by a deadly viral disease that spreads rapidly through the grassland population. Brown *Beadles* are susceptible to this viral disease and green *Beadles* are resistant to the disease. Remove three **brown** *Beadles*. Place these onto the plate labeled “Did NOT Survive and Reproduce.”
 11. Remove the green fabric from the “Environment” container but leave the surviving *Beadles* in the container.
 12. Count the number of each variety of *Beadles* remaining in the grassland population. Record the number of each variety of *Beadles* in Column 4 of the Data Table.
 13. Count the total number of *Beadles* remaining in the grassland population. Record this number in Column 4 of the Data Table.
 14. Use the equation in the box to calculate the frequency of each *Beadle* variety in the grassland population. Record the frequency of each *Beadle* variety in Column 5 of the Data Table.
- Frequency of *Beadle* variety = $\frac{\text{Number of individuals of this } \textit{Beadle} \textit{ variety}}{\text{Total number of } \textit{Beadles} \textit{ in the population}}$
15. Check your work by totaling the frequencies in Column 5 of the Data Table. The total should be approximately equal to 1.0.
 16. Return all the *Beadles* to the plastic bag.

17. Use the information from the Data Table to graph the frequencies of each type of grassland *Beadle* on the Bar Graph. For each of the varieties, draw a **diagonally striped** bar to the right of the bars that you drew in Part 1.

18. Which variety of *Beadle plasticus* is best adapted to survive and reproduce in a grassland environment? Support your answer with specific data from your Data Table or Bar Graph.

19. Predict what the grassland *Beadle* population might be like after 50 generations. Support your prediction with evidence from the Data Table or Bar Graph.

Part 3: Evolution and Natural Selection

1. Compare the desert environment and the grassland environment by completing the following chart. *Hint: Look back at the instructions in Parts 1 and 2.*

	Desert	Grassland
Color of environment		
Predators		
Temperature		
Disease		
Food supply		

2. According to Darwin's Theory of Natural Selection, some characteristics have adaptive value, giving individuals an advantage. Individuals with adaptive variations are more likely than others to survive and reproduce. The proportion (frequency) of individuals that have adaptive variations will increase.
 - State one example of a *Beadle* variation with adaptive value in the **desert** population.
 - State one example of a *Beadle* variation with adaptive value in the **grassland** population.
3. Did the desert environment cause adaptive variations or did it select adaptive variations? Explain your answer using information from this lab activity.
4. In your own words, explain how this modeling activity illustrates the process of natural selection.

Data Table

Varieties of <i>Beadle plasticus</i>	Column 1 Frequency in Forest Population	Column 2 Number in Desert Population	Column 3 Frequency in Desert Population	Column 4 Number in Grassland Population	Column 5 Frequency in Grassland Population
Small brown					
Large Brown					
Small green					
Large green					
Total					

Bar Graph: Frequencies of Varieties in *Beadle plasticus* Populations

