SIMULATING NATURAL SELECTION

BACKGROUND INFORMATION

Prior to the Industrial Revolution in England, light colored peppered moths rested safely on the bark of light colored trees, unable to be seen by their predators. In the mid-nineteenth century, however, trees that had light colored trunks became darkened by soot. Simultaneously, the number of light colored moths decreased, whereas the number of dark moths increased. How did this change occur? In this laboratory investigation, you will make a model using beans to represent the moths or other organisms in similar situations.

PROBLEM

What happens to harmful genes over time?

MATERIALS *(per group)*

small brown paper bag
400-mL beaker
250 g pinto beans
50 large lima beans
50 red kidney beans
stopwatch or clock with second hand

PROCEDURE

1. After reading the investigation carefully, enter your data in the data table.
2. Examine and note the differences and similarities among the three types of beans.
3. Fill the beaker about three-fourths full with the pinto beans. Then pour the beans into the paper bag.
4. Add 50 lima beans and 50 kidney beans to the paper bag. The lima and kidney beans represent organisms. The pinto beans represent the environment in which the organisms are hiding.
5. Have one member of your group time you for 3 minutes. During the 3 minutes, remove one bean at a time from the paper bag. Without looking, try to remove as many lima and kidney beans as you can. Use the shapes of the beans to identify them.
6. Record the number of lima beans and kidney beans that you removed in the appropriate place in the data table.
7. To determine the number of lima beans and kidney beans that remain in the paper bag, subtract the number of lima beans removed from the starting number. Do the same for the kidney beans.
8. Add the numbers of remaining lima and kidney beans together. Record this information in the appropriate place in the data table.

9. To find the frequencies of lima beans and kidney beans that remain in the paper bag, divide the numbers of each of the remaining beans by the total number of remaining lima and kidney beans. Round these numbers off to the nearest hundredths place. Record this information in the appropriate place in the data table.
10. The frequencies of each of the beans that remain in the paper bag represent the distribution of genes in the population. To determine the starting number of lima beans and kidney beans that are present in the next generation, multiply the frequency of each bean by 100. Record the information in the appropriate place in the data table. Add lima beans and kidney beans to the bag to restore the same starting number for the next generation.
11. Repeat steps 5 through 9 until the information in the data table is complete for five generations.

OBSERVATIONS

Data Table

Generation	1	2	3	4	5
Total number of lima and kidney beans	100	100	100	100	100
Total number of lima beans					
Total number of kidney beans					
Number of lima beans removed					
Number of lima beans remaining in bag					
Number of kidney beans removed					
Number of kidney beans remaining in bag					
Total number of beans remaining in bag					
Frequency of lima beans remaining in bag					
Frequency of kidney beans remaining in bag					

1. What was the ratio of lima beans to kidney beans? _____
2. Based on your data, was one type of bean removed from the bag more frequently than the other? If so, which type? _____
3. What happened to the frequencies of the lima beans in the population over five generations?

   _____

   The frequencies of the kidney beans? _____

   _____
4. What happened to the total number of beans that remained over five generations? _____

Name _____ Class _____ Date _____

ANALYSIS AND CONCLUSIONS

1. Which beans represent the beneficial genes in a population? The harmful genes? How do you know?

2. Explain why the frequency of remaining genes changes in each generation?

3. What do you think happens to harmful genes over time?

CRITICAL THINKING AND APPLICATION

1. Construct a graph that shows the relationship between the total number of beans remaining in the bag and the frequency of kidney beans remaining in the bag. What does this indicate about the effect of beneficial genes on population size?

2. Does this model support the theory of natural selection or Lamarck's idea that living things strive for complexity and pass on acquired characteristics? Explain.

3. Most harmful genes are recessive. Why do you think this is so?