

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

## Natural Selection on Single Gene Traits

### Chapter 16 - Breeding Bunnies, How Does Evolution Work?

#### Introduction

In this activity, you will examine natural selection in a small population of wild rabbits. Evolution, on a genetic level, is a change in the frequency of alleles in a population over a period of time. Breeders of rabbits have long been familiar with a variety of genetic traits that affect the survivability of rabbits in the wild, as well as in breeding populations. One such trait is the trait for furless rabbits (naked bunnies). This trait was first discovered in England by W.E. Castle in 1933. The furless rabbit is rarely found in the wild because the cold English Winters are a definite selective force against it.

#### Tools:

50 Black Beans                      50 White Beans  
3 Labeled Cups                      1 Paper Bag

#### Directions:

1. In this lab, the dominant allele for normal fur is represented by  $F$  and the recessive allele for no fur is represented by  $f$ . Bunnies that inherit two  $F$  alleles or one  $F$  allele and one  $f$  allele have fur, while bunnies that inherit two  $f$  alleles have no fur.

**2. Complete the hypothesis section on your data sheet (the three questions above the data chart).**

3. The black beans represent the allele for fur and the white beans represent the allele for no fur. The paper bag represents the English countryside, where the rabbits randomly mate. Black Bean =  $F$  and White Bean =  $f$

4. Label one cup  $FF$  for the homozygous dominant = 2 Black Beans  
Label a second cup  $Ff$  for the heterozygous dominant = 1 Black and 1 White Bean  
Label a third cup  $ff$  for those rabbits with the homozygous recessive. These will die and therefore not count in the generation totals. = 2 White Beans

5. Place 50 black and 50 white beans in the paper bag and shake up (mate) the rabbits. Please note that these frequencies have been chosen arbitrarily for this activity.

6. Without looking at the beans, select two at a time, and record the results on the data form next to "Generation 1." For instance, if you draw one black and one white bean, place a mark in the chart under "Number of  $Ff$  individuals." Continue drawing pairs of beans and recording the results in your chart until all beans have been selected and sorted. Place the "rabbits" into the appropriate dish:  $FF$ ,  $Ff$ , or  $ff$ . (Please note that the total number of individuals will be half the total number of beans because each rabbit requires two alleles.)

7. The  $ff$  bunnies are born furless. The cold weather kills them before they reach reproductive age, so they can't pass on their genes. Place the beans from the  $ff$  container aside before beginning the next round.

8. Count the  $F$  and  $f$  alleles (beans) that were placed in each of the "furred rabbit" dishes in the first round and record the number in the chart in the columns labeled "Number of  $F$  Alleles" and "Number of  $f$  Alleles." (This time you are really counting each bean, but don't count the alleles of the  $ff$  bunnies because they are dead.) Total the number of  $F$  alleles and  $f$  alleles for the first generation and record this number in the column labeled "Total Number of Alleles."

9. Place the alleles of the surviving rabbits (which have grown, survived and reached reproductive age) back into the container and mate them again to get the next generation.

10. Repeat steps five through nine to obtain a minimum of five generations and a maximum of ten generations. When working with your partner, make sure to rotate the jobs of recording results and selecting beans.

11. Determine the gene frequency of  $F$  and  $f$  for each generation and record them in the chart in the columns labeled "Gene Frequency  $F$ " and "Gene Frequency  $f$ ." To find the gene frequency of  $F$ , divide the number of  $F$  by the total, and to find the gene frequency of  $f$ , divide the number of  $f$  by the total. Express results in percentage form. The sum  $F$  and  $f$  frequencies should equal 100 for each generation.

#### Breeding Bunnies: Gene Frequency Data

##### Hypothesis Section

1. How does natural selection affect gene frequency over several generations?

2. Clearly state your hypothesis for this lab simulation regarding rabbit survival.

3. State what you would predict (if your hypothesis is true) about the frequency of  $F$  alleles and  $f$  alleles in the population of rabbits after 10 generations, where  $ff$  bunnies are selected against (do not survive).

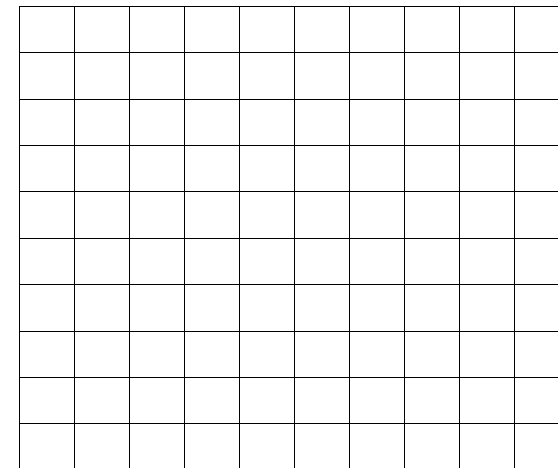
Data Table	A	B	C	D	E	F		
Generation	Number of $FF$ Individuals	Number of $Ff$ Individuals	Number of $ff$ Individuals	Number of $F$ Alleles Count Black Beans	Number of $f$ Alleles Count White Beans	Total Number of Alleles Col D + Col E	Gene Frequency of $F$ $Col D/Col F$ $*100$	Gene Frequency of $f$ $Col E/Col F$ $*100$
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

**Discussion Questions**

1. What was your original hypothesis?
2. Based on your lab data, do you need to change your hypothesis? Explain.
3. Compare the number of alleles for the dominant characteristic with the number of alleles for the recessive characteristic.

4. Compare the frequencies of the dominant allele to the frequencies of the recessive allele.
5. In a real rabbit habitat new animals often come into the habitat (immigrate), and others leave the area (emigrate). How might emigration and immigration affect the gene frequency of  $F$  and  $f$  in this population of rabbits? How might you simulate this effect if you were to repeat this activity?
6. According to the results of this lab, how do lethal alleles remain in a population? What is the likelihood that a lethal allele would be removed from a population? Explain.

Create a line graph of your allele frequencies. Prepare a graph with the **horizontal axis** as the **generation** and the **vertical axis** as the **frequency**. Convert the frequency to percentages for graphing ease (multiply the frequency by 100). Use a **solid line for  $F$  frequency** and a **dotted line for  $f$  frequency**.



Generation