

LESSON 4 How Does Evolution Work?

[Back to LESSON 4](#)**Activity 1: Breeding Bunnies**

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.

Note: 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* and one *f* allele have fur, while bunnies that inherit two *f*s have no fur.

Procedures

1. Print the [Gene Frequency Data](#) form (pdf) and the [Discussion Questions](#) (pdf), or get them from your teacher. Fill in the [Background](#) section of the data form and specific predictions based on that hypothesis.
2. Your teacher may assign you to a working group and distribute the materials. If you are working alone, proceed on your own.
3. The red beans represent the allele for fur, and the white beans represent the allele for no fur. The container represents the English countryside, where the rabbits randomly mate.
4. Label one dish *FF* for the homozygous dominant condition. Label a second dish *Ff* for the heterozygous condition. Label the third dish *ff* for those rabbits with the homozygous recessive genotype.
5. Place the 50 red and 50 white beans (alleles) in the container 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 red 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 generations two through ten. If working as a team, make sure everyone in your group has a chance to either select the beans or record the results.
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 decimal form. The sum of the frequency of *F* and *f* should equal one for each generation.
12. If you are doing this activity at school, record your group's frequencies on the board so your classmates can see them.
13. Graph your frequencies. Prepare a graph with the horizontal axis as the generation and the vertical axis as the frequency in decimals. Plot all frequencies on one graph. First, plot your own data. Use a solid line for *F* and a dashed line for *f*. Then, if you are at school, plot the class totals. Use the same symbols for each group but a different color. If you are at home, you may wish to go through the activity again and see how your graphs compare.
14. Complete the Discussion Questions form with your group.

Adapted with permission from a 1994 Woodrow Wilson Biology Institute Laboratory "[Evolution and Gene Frequencies: A Game of Survival and Reproductive Success](#)," by Joseph Lapiana.

Activity 1: Breeding BunniesActivity 1: [Teacher Notes](#)Activity 2: [Flashy Fish](#)Activity 2: [Teacher Notes](#)**Materials You'll Need:**

- [Breeding Bunnies: Gene Frequency Data](#) form (pdf)
- [Breeding Bunnies: Discussion Questions](#) (pdf)
- 50 red beans
- 50 white beans
- 1 paper bag or deep bowl
- 3 dishes or containers
- labels
- pens

Evolution

Breeding Bunnies: Gene Frequency Data

How does natural selection affect gene frequency over several generations?

Clearly state your hypothesis (a tentative explanation or solution to the problem).

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).

Generation	Number of FF Individuals	Number of Ff Individuals	Number of ff Individuals	Number of F Alleles	Number of f Alleles	Total Number of Alleles	Gene Frequency of F	Gene Frequency of f
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								