Biology Lab Investigation #5: Mechanics of Evolution
Which Island's New Population is Most Different from the Mainland's Population?

Introduction: All of the genes within a population are referred to as that population's gene pool. The abundance of each of these genes can vary due to the environment and different selective pressures. Sometimes, the abundance of each gene can be different from one part of a population to another. The Founder Effect is said to occur when the change in gene frequency is due to a part of a population becoming isolated from the greater population.

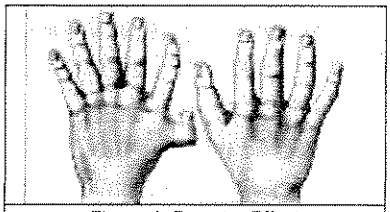

Figure 1. Founder Effect

The Founder Effect occurs when a small group of a population, representing only a small fraction of the genetic variation of that population, establishes a new population. This can occur when the group moves to a new location that is not already occupied by members of the same species, such as an uninhabited island. It can also occur when a population bottlenecks, meaning that some event, such as a volcanic eruption, causes the size of the population to decrease dramatically. The gene pool of the surviving population may not contain all of the different alleles present in the original population. This causes the gene frequencies of the resulting population to differ from those of the original population.

In order to calculate gene frequencies of a population, population geneticists use an equation called the Hardy-Weinberg Equation, shown below:

$$p^2 + 2pq + q^2 = 1$$

The frequency of the dominant allele is represented by p and the frequency of the recessive allele is represented by q. Since these are the only two alleles, the frequency of the dominant plus the frequency of the recessive allele must equal 100%, or in other words $p + q = 1$. Recall that the only way a person can express a recessive form of a trait is if they have two copies of the recessive allele (qq or q^2). However, if a person shows the dominant phenotype, he or she may be homozygous dominant (pp or p^2) or heterozygous (pq). The Hardy-Weinberg Equation allows us to predict the frequency of each genotype in the population.

Consider a scenario in which your class represents a mainland population. Due to certain circumstances, the mainland population must disperse to various islands. Your group represents the new population on one of these islands.

Your Task: Using your actual phenotypes as data, you will determine how the gene frequencies on your island and those on the other islands compare to the gene frequencies on the mainland.

The guiding question of this investigation is: ***Which island's new population will be most different from the mainland's population over time?***

Materials: You may use the following materials during your investigation:

- Index card
- Calculator with square-root function

The development of this laboratory activity was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A100909 to the Florida State University

Safety Precautions: There are no specific safety issues related to this lab. Be sure to follow all normal lab safety rules.

Getting Started: In order to calculate frequencies, you need to take the following steps:

1. Determine the number of people in the class with the recessive form of the trait. Divide this number by the total number of people in the class. Record your answer as a decimal, rounded to two decimal places, in the q^2 box in Table 1. Take the square root of this number (q). Record as a decimal, rounded to two decimal places, in Table 1.

2. Substitute the value of q in the equation below to determine the frequency of the dominant allele (p). $p = 1 - q$

3. Using the Hardy-Weinberg equation, calculate the frequencies of all three genotypes in your class.
$$p^2 + 2pq + q^2 = 1$$

Table 1. Frequencies of alleles & genotypes for the mainland population

Allele & Genotype	q^2	q	p	p^2	$2pq$
Frequencies (decimal)					

4. Use the equations to determine the allele frequencies and genotype frequencies for your group (island). Record in Table 2 below. Add data collected from the other islands.

Table 2. Frequencies of alleles & genotypes for each island

Allele & Genotype	q^2	q	p	p^2	$2pq$
Island ☺ Frequencies					
Island ☼ Frequencies					
Island ♠ Frequencies					
Island ♣ Frequencies					
Island ♥ Frequencies					
Island ♦ Frequencies					

As you work through this activity, think about how scientists develop a scientific theory. Also, think about the various social and cultural influences on science.

The development of this laboratory activity was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A100909 to the Florida State University