

Lab 8: Population Genetics and Evolution¹

Overview

In this lab you will:

1. learn about the Hardy-Weinberg law of genetic equilibrium, and
2. study the relationship between evolution and change in allele frequency by using your class to represent a sample population.

Objectives

Before doing this lab you should understand:

1. how natural selection can alter allelic frequencies in a population
2. the Hardy-Weinberg equation and its use in determining the frequency of alleles in a population, and
3. the effects on allelic frequencies of selection against the homozygous recessive or other genotypes.

After doing this lab you should be able to:

1. calculate the frequencies of alleles and genotypes in the gene pool of a population using the Hardy-Weinberg formula, and
2. discuss natural selection and other causes of microevolution as deviations from the conditions required to maintain Hardy-Weinberg equilibrium.

Introduction

In 1908 G.H. Hardy and W. Weinberg independently suggested a scheme whereby evolution could be viewed as changes in the frequency of alleles in a population of organisms. They argued that if a population met five conditions that there would be no changes in allele frequencies from generation to generation. Those five conditions are as follows:

1. The breeding population is large, reducing the effect of chance on changes in allele frequencies
2. Mating is random with respect to the gene in question. Individuals show no mating preference for a particular phenotype.
3. There is no mutation of the alleles.
4. No individuals enter or leave the population by migration (no immigration or emigration).
5. There is no selection. In other words, the alleles of the gene in question do not affect mating or survival, so every genotype has an equal chance of surviving and reproducing.

Hardy and Weinberg also described the distribution of alleles and genotypes within a population mathematically. The following variables are used, and each is expressed in decimal form:

p = frequency of the dominant allele
 q = frequency of the recessive allele

Note that $p + q$ must always equal 1. The analysis does not work if there are more than 2 alleles of the gene being studied. (It can be done, but the math is much more complicated.)

In a population, p is also the likelihood of a dominant allele being passed on to an offspring, and q is the likelihood of a recessive allele being passed on. Thus, we end up with the following conclusions:

p^2 = frequency of homozygous dominant individuals in the population
 $2pq$ = frequency of heterozygous individuals in the population

¹ Adapted from the College Board AP Biology Student Lab Manual, 2001 edition.

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Jin-Ying Zhang



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