Biology 362 - Principles of Genetics
Genetic Drift - Population Genetics – Bottleneck Experiment (continued)

Purpose: We will test the hypothesis that genetic drift is greater in small populations than in large populations.

This week we have two immediate goals:

1) Estimate the frequency of mutant flies in our population.

2) Choose parents for our next generation of flies.

Estimation of allele frequency.—We will estimate the frequency of the recessive allele *a* in our populations by counting the number of wild-type flies (*AA* and *Aa*) and the number of flies exhibiting the recessive trait (*aa*). Random mating among the flies during the last three weeks should result in genotypes frequencies among the offspring to conform to Hardy-Weinberg expectations. Hence, the frequency of recessive phenotypes among offspring should be q^2, where q is the frequency of the recessive allele.

1) Anesthetize your flies with cold.

2) Practice scoring phenotypes - wild-type and recessive phenotypes.

3) Count the number of each phenotype.

4) Calculate q = number of *aa* ÷ total number of flies

Set Up Next Generation of Flies.—*Each team will set up their own culture*. There will be two people per team. If you are doing large populations, then you need to start a fresh culture today with 24 flies (12 males; 12 females). If you are in a group doing small populations, then you will start a fresh culture with 4 flies (2 males; 2 females).

1) Prepare a vial with 0.9 units of food and 1.0 units of water.

2) Label it with your name, mutation, and population size.

3) Figure out a way to get a random sample of flies for your culture. It is essential that your sample is truly random. For example, your sample of 4 flies may have all wild types or all recessives or anything combination in between. Whatever phenotypic ratio results from your random selection you must stick with. It would not be fair to say, "Well, I got all recessives in my selection, so therefore I'll sample again." That would be cheating and would goof up the experiment.

So, how can you get a random sample of flies? Tools you can use include a random numbers table, coin toss, or the random numbers generator in Excel.

When you think you have a method to randomly select parents for your next generation, explain it to your instructor to be sure it is truly random.

4) Put your parents in the vial you have prepared and return it to the shelf in 308.

5) Release the remaining flies out the window. Remove the label from the old vial and put the vial in the box labelled "dirty vials to be washed."

What is this All About?—Genetic drift occurs when allele frequency in a population changes from one generation to the next because of random differences among individuals in reproductive success. For example, in Dall sheep in Denali National Park, less than half of newborn lambs survive to reproduce. Almost all of the mortality occurs in the first year of life. Which lamb lives and which dies depends largely on predators who take the first lamb they find. Hence, it is pretty much chance who survives to reproduce and who dies; it has nothing to due with having good genes or bad genes; it's just a matter of who gets spotted first. As a result, the survivors represent only a *random* sample of the original newborns. In a large population, this sample of survivors is large enough that it will generally be representative of the entire cohort at birth. But, in a small population, the few survivors might, by chance, deviate significantly from the original cohort. When these survivors go on to reproduce, the cohort of offspring they produce may be significantly different from the cohort they were born into. Because sampling error is greater in a small population than a large, genetic drift should be greater in small populations than in large populations.

When we will randomly select flies that survive to reproduce in our populations, we are essentially acting out the role of predators in the population of Dall sheep described above. The predators leave a random sample of survivors among the newborns each year; we select a random sample of flies in each generation to survive and reproduce.