The Hardy-Weinberg Equation (00)

For each of the following problems in population genetics use the Hardy-Weinberg equation. Show all of your work and label each frequency, probability, and allele.

1. Suppose that in a breeding experiment, 7,000 AA individuals and 3,000 aa individuals mate at random. In the first generation of offspring, what would be the frequencies of the three genotypes (AA, Aa, and aa)? What would be the frequencies of the two alleles? What would be the values in the second generation?

2. Among African-Americans, the frequency of sickle-cell anemia (which, as you will recall is a homozygous recessive condition) is about 0.0025. What is the frequency of heterozygotes? When on African-American marries another, what is the probability that both will be heterozygotes? If both are heterozygotes, what is the probability that their first child will have sickle-cell anemia?

3. If q = 0.3 and there are Hardy-Weinberg proportions, what is the most common genotype and what is its frequency? What is the least frequent genotype and its frequency?

4. In a large, randomly mating population with no forces acting to change gene frequencies, the frequency of homozygous recessive individuals for the character extra-long eyelashes is 90 per 1000, or 0.09. What percentage of the population carries this trait but displays the dominant phenotype, short eyelashes? Would the frequency of the extra-long-lash allele increase, decrease, or remain the same if long-lashed individuals preferentially mated with each other and no one else?

5. In a population with two alleles for a particular locus, B and b, the allele frequency of B is 0.7. What would be the frequency of heterozygotes if the population were in Hardy-Weinberg equilibrium?

6. In a population that is in Hardy-Weinberg equilibrium, 16% of the individuals show the recessive trait. What is the frequency of the dominant allele in the population?

7. The frequency of A, the dominant allele for red flowers, is 0.8, and the frequency of a, the recessive allele for white flowers, is 0.2. In our starting population, the frequencies of genotypes do not conform to Hardy-Weinberg equilibrium: 60% of the plants are AA and 40% of the plants are Aa (at this point, the population has no plants with white flowers). Assuming that all conditions for the Hardy-Weinberg theorem are met, prove that genotypes will reach equilibrium in the next generation.

8. Tay-Sachs disease is caused by a recessive allele. The frequency of this allele is 0.1 in a population of 3,600 people. What is the frequency of the dominant allele, and how many of the 3,600 people will be heterozygous for the condition?

9. In a population of 2,000 earthworms, there is a condition governed by a recessive allele where the worms do not have any setae. Setae are tiny hair-like projections needed by the worm to move through the ground. 500 worms were found not having setae. What percent of the population were heterozygous for the setae? What was the actual number of earthworms containing setae?

10. In *Drosophilia*, the allele for normal length wings is dominant over the allele for vestigial wings. In a population of 1,000 individuals, 360 show the recessive phenotype. How many individuals would you expect to be homozygous dominant and heterozygous for this trait?