Evolution of a Soybean Population

One way to test whether evolution is occurring in a population is to compare the observed genotype frequencies at a locus with those expected for a non-evolving population based on the Hardy-Weinberg equation. In this activity, you will test whether a soybean population is evolving at a locus with two alleles, C^G and C^Y, that affect chlorophyll production and, therefore, leaf color.

Students planted soybean seeds and then counted the number of seedlings of each genotype at day 7 and again at day 21. Seedlings of each genotype could be distinguished visually because the C^G and C^Y alleles show incomplete dominance: C^GC^G seedlings have green leaves, C^GC^Y seedlings have green-yellow leaves, and C^YC^Y seedlings have yellow leaves.

Time (days)	Number of Seedlings			
	Green (C^GC^G)	Green-yellow (C^GC^Y)	Yellow (C^YC^Y)	Total
7	49	111	56	216
21	47	106	20	173

1. Use the observed genotype frequencies from Day 7 data to calculate the frequencies of the C^G and C^Y allele. (Remember that the frequency of an allele in a gene pool is the number of copies of that allele divided by the total number of copies of all alleles at that locus.)

2. Next, use the Hardy-Weinberg equation to calculate the expected frequencies of genotypes C^GC^G, C^GC^Y, and C^YC^Y for a population in Hardy-Weinberg equilibrium.

3. Calculate the observed frequencies of all three genotypes at Day 7. Remember that the observed frequency of a genotype in a gene pool is the number of individuals with that genotype divided by the total number of individuals. Compare these frequencies to the expected frequencies calculated in Q2. Is the seedling population in Hardy-Weinberg equilibrium at Day 7, or is evolution occurring? Explain your reasoning and identify which genotypes, if any, appear to be selected for or against.

4. Calculate the observed frequencies of all three genotypes at Day 21. Compare these frequencies to the expected frequencies calculated in Q2 and the observed frequencies at day 7. Is the seedling population in Hardy-Weinberg equilibrium at Day 21, or is evolution occurring? Explain your reasoning and identify which genotypes, if any, appear to be selected for or against.

5. Homozygous C^YC^Y individuals cannot produce chlorophyll. As seedlings grow and begin to run out of the food stored in the seed, the ability to photosynthesize becomes more critical. Propose a hypothesis to explain the data for Days 7 and 21. Based on this hypothesis, predict how the frequencies of the C^G and C^Y alleles will change after Day 21.