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. [SP5] 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. [SP5] 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. a) [SP5] 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.

b) [SP2, SP6] Compare these frequencies to the expected frequencies calculated in Q2. Make a claim about whether the seedling population is in Hardy-Weinberg equilibrium at Day 7. Justify your reasoning.

c) [SP2, SP6] Identify which genotypes, if any, appear to be selected for or against.

4. a) [SP5] Calculate the observed frequencies of all three genotypes at Day 21.

b) [SP2, SP6] Compare these frequencies to the expected frequencies calculated in Q2 and the observed frequencies at day 7. Make a claim about whether the seedling population is in Hardy-Weinberg equilibrium at Day 21. Justify your reasoning.

c) [SP2, SP6] 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.

a) [SP2, SP3, SP6] Propose a hypothesis to explain the data for Days 7 and 21.

b) [SP6] Based on this hypothesis, predict how the frequencies of the C^G and C^Y alleles will change after Day 21.