Lab-wide Learning Outcomes for Sickle-Cell Alleles

Knowledge-Based Outcomes

Upon completion of *Sickle-Cell Alleles*, students should be able to:

1. Explain why deleterious alleles may persist when there is a heterozygote advantage.
2. Demonstrate a basic understanding of how changes in an allele's frequency depend on selection strength, population size, and the initial number of carriers of that allele.

Skills-Based Outcomes

Upon completion of *Sickle-Cell Alleles*, students should be able to:

1. Predict how frequencies of genotypes and alleles will change under different environmental conditions when there is a heterozygote advantage.

Sickle-Cell Alleles, Part 1: Sickle-Cell Disease and Malaria

Knowledge-Based Outcomes

Upon completion of *Part 1: Sickle-Cell Disease and Malaria*, students should be able to:

1. Describe the difference between an allele and a gene.
2. Define allele frequency.
3. Define fitness as the ability to survive and reproduce, and predict how differential fitness among genotypes leads to changes in allele frequencies over generations.
4. Describe in general terms the mechanism of natural selection.

Skills-Based Outcomes

Upon completion of *Part 1: Sickle-Cell Disease and Malaria*, students should be able to:

1. Calculate the frequency of one allele in a two-allele system given the frequency of the other allele (i.e. demonstrate understanding that allele frequencies add up to 1.)

Sickle-Cell Alleles, Part 2: The Interplay of Evolutionary Forces

Knowledge-Based Outcomes

Upon completion of *Part 2: The Interplay of Evolutionary Forces*, students should be able to:

1. Describe in general terms the mechanism of genetic drift.

Skills-Based Outcomes

Upon completion of *Part 2: The Interplay of Evolutionary Forces*, students should be able to:

1. Draw three graphs illustrating the effect of population size on genetic drift, and explain why alleles generally become fixed faster in smaller populations, all else being equal.

Sickle-Cell Alleles, Part 3: Making Predictions: Hardy and Weinberg

Knowledge-Based Outcomes

Upon completion of *Part 3: Making Predictions: Hardy and Weinberg*, students should be able to:

1. State what each term in the Hardy-Weinberg equation represents, and describe how genotype frequencies are expected to change over time when a population is at Hardy-Weinberg equilibrium.
2. Understand the role of the null hypothesis.

Skills-Based Outcomes

Upon completion of *Part 3: Making Predictions: Hardy and Weinberg*, students should be able to:

1. Use the Hardy-Weinberg equation to calculate the expected frequency of each genotype in a two-allele system, given the frequency of one allele.
2. Evaluate whether there is evidence for heterozygote advantage using Hardy-Weinberg equilibrium frequencies as the null hypothesis.