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Data Integration Assignment

Data Source: Phenotypic plasticity of Wisconsin fast plants.
http://resources.fastplants.org//resources/phenotypicdatasets.pdf

Essential question: Can extreme selection change expression of a quantitative trait in a population in one generation?

Enduring Understandings

• 1A1: Natural selection is a major mechanism of evolution.

• 1A2: Natural selection acts on phenotypic variations in populations.

Learning Objectives

• The student is able to convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and conceptual understandings to investigate the cause(s) and effect(s) of this change (1A1 & SP 1.5, SP 2.2).

• The student is able to evaluate evidence provided by data to qualitatively and quantitatively investigate the role of natural selection in evolution (1A1 & SP 2.2, SP 5.3).

• The student is able to apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future (1A1 & SP 2.2).

• The student is able to evaluate data-based evidence that describes evolutionary changes in the genetic makeup of a population over time (1A2 & SP 5.3).

• The student is able to connect evolutionary changes in a population over time to a change in the environment (1A1 & SP 7.1).

NGSS practices:

Analyzing and Interpreting Data
Planning and Carrying Out Investigations
Obtaining, Evaluating, and Communicating Information
Engaging in Argument from Evidence
Constructing Explanations and Designing Solutions

NGSS Disciplinary Core Ideas:
LS4C: Adaptation
LS3A: Inheritance of Traits
LS1A: Structure and Function

NGSS Cross Cutting Concepts: Patterns, Cause and Effect

Since time and resources are an issue in high school classrooms, trying to measure natural selection is problematic. Wisconsin Fast Plants (Brassica) provide an easy transition into student generated explorations that look for possible advantages or disadvantages that selected traits may present in different environmental conditions. For teachers that do not have access to the equipment, the data set can provide a ready source of observations to be quantified. In my own classroom, my students grow their own plants. In the first round, the students identify and quantify several traits that vary in the population. Typical traits students select include plant height, number of trichomes, or stem color (purple or green). Students decide as a class which trait they will select for and then cross pollinate. Seeds are collected, planted, and then the second generation population data for the selected trait is compared to the first.

In AP Biology, Science Practice 2 is the appropriate use of mathematics. While objectives include demonstration of artificial selection and phenotypic changes, all data collected by the students is used to teach calculation of basic descriptive statistics: range, means and standard deviations to show variation in a population. After the second round of data is collected, rather than hand calculate the descriptive statistics for the second round, I teach the students how to enter and calculate the descriptive statistics in excel. We also create histograms for the first and second rounds of data. Math application is completed with a chi square analysis of observed vs. expected data observations of the traits to examine mean differences so that the students can determine whether to accept or reject the null hypothesis constructed after the first round. This lesson is interdisciplinary, addressing tenets of evolution and selection using math applications to explain the trends in variation after selection.