470134-766

AP® Biology Investigation #2:

Evolution: Hardy Weinberg

Meets Revised College Board AP Biology Standards

ward's science+

WACP470132-868

table of contents

+Us

Ward's in-house scientists are always on call to assist you with your AP Biology questions. Our AP experts can provide personal solutions and product advice for your curriculum. Email sciencehelp@vwr.com or call 800-962-2660 to get started.

abstract

This lab focuses on developing a mathematical model for biological populations using a spreadsheet program. Students initially investigate the prevalence of at least one human phenotype in the classroom population and use this as a basis for model testing. Students build mathematical models based on the Hardy-Weinberg equilibrium to analyze bottlenecks, genetic drift, and the effects of selection in the evolution of populations.

required prior knowledge

Students should:

- be able to make and record good observations.
- understand the differences between genes and alleles.
- be able to explain Mendelian genetics.

activity learning objectives

In this investigation, students will construct a computer model to explain the Hardy-Weinberg equilibrium. Students will also record phenotypic traits of classmates to compare to the computer model. Students will use their data and observations to help them answer the following question:

Can a mathematical model be used to accurately predict a population's phenotype?

.

materials checklist

*(For a list of replacement items, visit: www.**wardsci.com**, and click on the AP Biology tab for this kit/item #.)*

materials included in kit:

- Index cards, 2 pkgs.
- Taste paper, control, 1 pkg./100.
- PTC taste-test paper,1 pkg./100.
- Instructions (this booklet and student guide copymaster)

materials needed but not provided:

- Lab notebook
- Calculators
- Coins
- Computer with a spreadsheet program (such as Excel) to build model
- Mini-poster and mini-poster supplies
- Other materials as determined by students' experiment design

This lab activity is aligned with the 2012 AP Biology Curriculum (registered trademark of the College Board). Listed below are the aligned Content Areas (Big Ideas and Enduring Understandings), the Science Practices, and the Learning Objectives of the lab as described in AP Biology Investigative Labs: An Inquiry-Based Approach (2012). *This is a publication of the College Board that can be found at:*

http://media.collegeboard.com/digitalServices/pdf/ap/APBioTeacherLabManual2012_2ndPrt_lkd.pdf

Big Idea	**1**	The process of evolution drives the diversity and unity of life.
Enduring Understandings	**1.A1**	Natural selection is a major mechanism of evolution.
	1.A2	Natural selection acts on phenotypic variations in populations.
	1.A3	Evolutionary change is also driven by random processes.
	1.C3	Populations of organisms continue to evolve.
Science Practices	**1.2**	The student can describe representations and models of natural or man-made phenomena and systems in the domain.
	1.4	The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively.
	1.5	The student can re-express key elements of natural phenomena across multiple representations in the domain.
	2.1	The student can justify the selection of a mathematical routine to solve problems.
	2.2	The student can apply mathematical routines to quantities that describe natural phenomena.
	5.3	The student can evaluate the evidence provided by data sets in relation to a particular scientific question.

(continued on next page)

standards alignment

Learning Objectives	**1.1**	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.
	1.3	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.
	1.4	The student is able to evaluate data-based evidence that describes evolutionary changes in the genetic makeup of a population over time.
	1.6	The student is able to use data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and effects of selection in the evolution of specific populations.
	1.7	The student is able to justify data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and the effects of selection in the evolution of specific populations.
	1.25	The student is able to describe a model that represents evolution within a population.
	1.26	The student is able to evaluate given data sets that illustrate evolution as an ongoing process.

time requirements

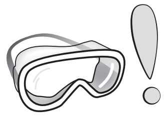
The time constraints on this lab revolve more around students' mathematical preparation and competence rather than the activities of the lab. If students have spreadsheet programs available outside of the classroom, this lab can be done as an assignment followed by class discussion to better accommodate variable math preparedness.

The lab can be done without a spreadsheet program, but it will take considerably longer for students to generate and analyze the data.

	TIME FRAME	TEACHER TASK(S)	STUDENT TASK(S)
Pre-Lab Prep			Students should review the basics of Mendelian genetics and obtain access to a spreadsheet program prior to the start of this lab.
Activity 1	45 minutes		Investigate allele frequency thru a Punnett square and spreadsheet program.
Activity 2	45 minutes		Test for, and determine frequency of chosen trait.
Activity 3			Design experiment to investigate evolution affecting allele frequency.

safety precautions

general safety:



- The teacher should 1) be familiar with safety practices and regulations in his/her school (district and state) and 2) know what needs to be treated as hazardous waste and how to properly dispose of non-hazardous chemicals or biological material.
- Consider establishing a **safety contract** that students and their parents must read and sign. This is a good way to identify students with allergies (e.g., latex) so that you (and they) will be reminded of specific lab materials that may pose risks to individuals.
- Students should know where all **emergency equipment** (safety shower, eyewash station, fire extinguisher, fire blanket, first aid kit etc.) is located.
- Require students to remove all dangling jewelry and tie back long hair before they begin.
- Remind students to **read all instructions, SDSs and live care sheets** before starting the lab activities, and to ask questions about safety and safe laboratory procedures. The SDSs and the most updated versions of live care sheets can be found at www.**wardsci.com**. Updated SDSs can also usually be found on each chemical manufacturer's website.
- In student directed investigations, make sure that collecting safety information (like SDSs) is part of the experiment procedure.
- As general laboratory practice, it is recommended that students **wear proper protective equipment**, such as gloves, safety goggles, and a lab apron.

at the end of the lab:

- Before disposing of any chemicals in the trash or down the drain, review local regulations or consult with local authorities.
- All laboratory bench tops should be wiped down with a 10% bleach solution or disinfectant to ensure cleanliness.
- Remind students to wash their hands thoroughly with soap and water before leaving the laboratory.

5100 West Henrietta Rd • PO Box 92912 • Rochester, NY 14692-9012 • p: 800 962-2660 • f: 800 635-8439 • wardsci.com