



Adding Pizzazz to the AP Biology Lab Curriculum

S. Kim, K. Moser, L. Southworth, and H. Wheeler
Department of Developmental Biology and Gunn High School

Abstract

Biotechnology is shaping our lives in many different ways, such as genetic engineering of plants and animals and using the human genome for personalized medicine. It is tremendously important to begin to teach genomic and biotechnology concepts to young students in order for them to properly understand how these new biological advances can inform and shape their world.

This pilot project will develop four new laboratory modules for High School AP Biology, including genetic engineering of bacteria, *C. elegans* genetics, DNA fingerprinting of different bacterial strains, and human genome mapping.

Project Goals

1. **Design lab experiments** that fulfill the learning objectives of the AP laboratory experiments and state standards, while using new and interesting organisms and methods.
- **Increase student interest** and attentiveness by providing access to new technologies.
- **Disseminate the curriculum** free of charge to schools in the Bay Area and throughout the nation.

First phase: Offer curriculum to the AP Biology class at Palo Alto High.

Second phase: Transformation and PCR curriculum will be available to Bay Area schools through three non-profit organizations that provide biotechnology equipment to schools.

Third phase: Each module will be offered to the College Board Advanced Placement Board, to be accessed by other AP Biology teachers nationally.

Project Design

I. Develop Four Lab Curriculum Modules

- (1) ***C. elegans* Worm Genetics.** Students observe genetic crosses and conduct statistical analysis of the data.

Phenotypes:



wild type



"dumpy"

- (2) **Bacteria transformation.** Students will genetically engineer a common *E. coli* bacteria, transforming it into three new strains that can:

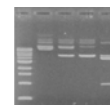
Glow in the dark



Smell like mint or banana



- (3) **PCR and gel electrophoresis.** Students act as health inspectors, using PCR to see which strain of "Salmonella" is infecting various food products.



- (4) **Genotyping.** Students test their DNA for various "fun" genetic markers.

WET EARWAX?

LACTOSE INTOLERANT?

FAST SPRINTER?

II. Prototyping Lab Modules At Gunn High School

Deliverables:

- Lesson Plan
- Assessments (grading criterion)
- Teacher Lab Plan (materials list, lab set up)
- Student Materials (background information, homework, lab worksheets)

III. Evaluate Lab Modules

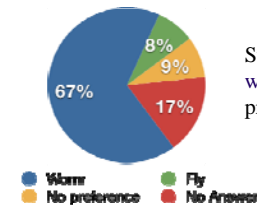
1. Based on **assessment questions** for each lab module and student interest surveys (developed in collaboration with Dr. Schultz, the education officer at SLAC).
2. **Pre/post tests of content knowledge** to determine whether the incorporation of hands-on lab experiments with curricular content improves concept learning.

Plans for 2009

Module	Status as of 2/01/09
(1) <i>C. elegans</i> genetics	Testing completed
(2) Transformation	Lesson Plan complete
(3) PCR lab	Testing Feb-May 2009
(4) Human Genetics lab	

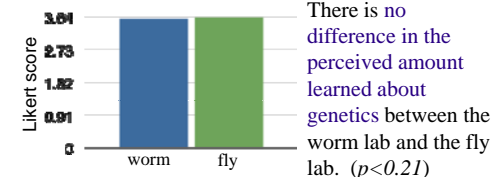
Preliminary Results - Worm Lab

"Which lab did you enjoy more?"



Students enjoyed the worm lab more than the previously used fly lab.

"How much did you learn about genetics?"



Education Challenge

- Bias due to expectation of particular results.
- Current worm module requires timely set up by experienced lab professionals.
- In worm module students need more training so that they can accurately determine phenotypes.

Future Directions

- **Make improvements** based on student evaluations.
- **Distribute the curriculum** to other schools in:
 - Our school district
 - The Bay Area
 - Nationwide.