

Fast Science: Mendel to Molecular Utilizing *Brassica rapa* as a Model Organism in a Traditional High School Setting

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Abstract

Students often learn the parts of biology (genetics, molecular biology, structure, function, reproduction, etc.) but don't recognize the connections from the whole organism to the molecular level. Using a single species, *Brassica rapa*, as a model organism to study a variety of biological processes in a traditional high school setting would show students some of those connections. *B. rapa* would be introduced initially in the alternative AP Biology Lab on Genetics. A video game, **Mission Biotech**, would be used to introduce the field of biotechnology, its techniques and applications. Modifying the molecular biology lab (AP Lab 6B) using *B. rapa* for the DNA fingerprinting unit would be the connection. Students would also learn about an emergent plant pathogen and the use of immunoassays to test for the presence of Tomato Spotted Wilt Virus (TSWV) in their plants.

Rational

Time and money are often limiting factors in the modern science classroom. Due to the many demands on the science teacher it becomes a factor in the complexity/number of lab activities that can be completed in the school year. The use of a single model organism to demonstrate basic biological concepts throughout the year would be both time and cost efficient. More importantly students would see the connection of the parts of biology from the macro to the molecular level by the use of a single organism. The Wisconsin Fast Plant, *Brassica rapa*, is a good model for this type of study due to its rapid life cycle (seed to flower in 35-40 days). Seeds could be harvested, stored and used later in the academic year as needed. An additional advantage is the number of different plant strains that are readily available permitting a variety of plant populations for groups of students to study.

Incorporating new pedagogical technology in the form of video gaming was also included with the use of the Mission Biotech program to introduce students to the field of Biotechnology and the procedures used by the Biotech industry to answer questions.

Description of teaching unit or module(s), including expected outcomes

1. Lecture on viruses to include emergent pathogens, using the tomato spotted wilt virus (TSWV) as a model.
2. Using the Alternative Lab 7 Genetics from Carolina Biological Supply, students would grow *B. rapa*. The plants will be tested for the presence of TSWV following the protocol referenced below. Students would maintain plants and harvest plant material for DNA extraction and fingerprinting later.
3. Mission Biotech will be implemented as directed by Dr. Sadler of the UF College of Education.
4. After completing the Mission Biotech students would extract DNA from the harvested plant material and use it to obtain a DNA fingerprint for their plant.
5. In May students will apply what they have learned to write a research proposal for their end of semester assessment.

Expected outcomes

AP Biology students will:

- Demonstrate an understanding of the connection between macro and micro levels of biology
- Understand virus structure and how viruses work
- Be able to perform, understand and explain the science that is the platform for the working of the *Agdia ImmunoStrip Test* to identify the TSWV.
- Understand the procedure and use of gel electrophoresis for separation of mixed samples
- Understand the process of scientific investigation
- Gain an understanding of the technology that is currently being used in laboratories and industry to provide answers to questions that are important to society as a whole.

Data collection techniques and/or student assessments

Pre and post tests will be used before and after implementation of the Mission Biotech to assess student learning. Students will submit informal lab reports and take quizzes to check for understanding of basic concepts as they move through the unit. At the end of the course (post AP Bio exam) students, working in groups of 2-3, will develop a question and a write a proposal on how they would answer the question.

ICORE summer institute elements specifically included (UF connections)

Mission Biotech would be used to teach the students about the field of Biotechnology, DNA extraction and gel electrophoresis techniques. This would be done in the computer lab at school during class prior to the molecular genetics unit.

Protocols outlined in “Biotech in the Classroom” will be modified as needed and used for immunoassay for presence of TSWV (Experiment 1) and the extraction of DNA from mutant and wild-type *B. rapa* plants (Experiment 2). E-gels will be used for DNA analysis of the different plant strains (Experiment 4).

Literature cited

1. Biotech in the Classroom: Laboratory Manual (2010) by J. Bokor
2. Technical sheet for Agdia ImmunoStrip Tests <http://www.agdia.com/cgi-bin/catalog.cgi/39300>
3. AP Biology Lab Manual for Students (2001) Lab 7 Genetics of Organisms

Budget and budget justification

Lab Supplies:	Quantity	Cost
Wisconsin Fast plants (<i>Brassica rapa</i>)	1	\$205.00
Genetics kit: AP Lab 7		
Agdia Immuno Strips	2 pks/25	\$210.00
E-gels	2pks	\$123.75
Total		\$348.75

Any difference in funding will be covered by the PI.