

Action for Proposal for Implementation of Biotechnology Instruction at Fort Lauderdale High School

Valerie Ruwe
Fort Lauderdale High School

Abstract

As part of the Next Generation Strategic Plan, the Florida Public Education goal ensures that students are prepared to enter the 21st century workforce with the most opportunities. Florida has invested tax dollars to generate biotechnology jobs in Florida; as a result there is a need to prepare students to enter these jobs. The jobs range from simple industry certification to those requiring college degrees. As a result of the variety of entry-level position biotechnology is a career path that can meet the needs of all level students. By introducing an extensive biotechnology curriculum at Fort Lauderdale High School, students will have an opportunity to begin preparing themselves to become part of the 21st century workforce.

Rational

The implementation of biotechnology curriculum at Fort Lauderdale High School will prepare students to be successful members of the 21st century. This meets the goal of the Florida's Next Generation Strategic Plan. According to the Florida Department of Education (2009) the mission of the plan is the following:

“Increase the proficiency of all students within one seamless, efficient system, by providing them with the opportunity to expand their knowledge and skills through learning opportunities and research valued by students, parents, and communities, and to maintain an accountability system that measures student progress toward the following goals: Highest student achievement, Seamless articulation and maximum access, Skilled workforce and economic development, and Quality efficient services.”

All of these goals can be met by this action plan. Meeting the goal of **highest student achievements** is that plan involves the implementation of an inquiry-based curriculum. Students will demonstrate all levels of blooms taxonomy by engaging them with a lab-based curriculum. By creating objectives based on standards and blooms taxonomy students will have opportunities to expand their knowledge of biotechnology and be able to apply that knowledge to novel situations (University of Central Florida, 2009).

Seamless articulation and maximum access will be achieved by offering the curriculum to a variety of level classes. By not limiting the curriculum to higher achieving students and ensuring all level students are exposed you are allowing maximum access to all students. This also provided the potential that students of all socioeconomic background will have the opportunity to continue their learning at a post secondary institutions.

Creating a skilled workforce and economic development can be achieved by preparing student who can to enter post secondary institutions to continue a career in

biotechnology. By creating a classroom environment that exposes students to the 21st century job skills you will be preparing them to enter the 21st century workforce. (Partnership for 21st Century Skills, 2009, p. 27-28).

This program will be of the **highest quality and efficient**. By collaborating with the University of Florida's Center for Precollegiate Education and Training (CPET) many resources will be easily accessible. To ensure high quality as part of the program other teachers in the school will be trained on the curriculum.

Goals and Objectives

The overall goal of this project to implement a biotechnology curriculum at Fort Lauderdale High School that will help prepare students for the 21st century workforce. The project has two components student training and teacher training. The first component is the teacher training. Valerie Ruwe the teacher who attended the University of Florida HHMI Interdisciplinary Center for Ongoing Research/Education (UF HHMI ICORE) summer institute will provide professional development opportunities for fellow science teachers in the area of biotechnology. These professional development opportunities will allow other science content area teachers to apply biotechnology to their curriculum. The second component is student training on the skills needed in order to be successful in the biotechnology industry. Students will learn techniques and skills needed to be successful in biotechnology and explore careers in biotechnology. As result of this interactive curriculum students will eventually pursue a career in biotechnology.

Methodology and Implementation

Professional Development Implementation: Professional Development of Teachers will occur on the six professional study days through out the course of the year. Teachers will be trained how to use the equipment and resources made available through this grant and being supplied by the UF's CPET. During the training teachers will work collaboratively to see how they can implement the technology into there areas of science.

Student Learning Implementation: The student learning Implementation has three level of student instruction. Beginning Level, Advanced Level, and Application of Biotechnology Level.

- Beginning Level Instruction (Biology Core and/or Honors, Grades 9-10, FCAT Reading Level 1-5)

This will be a biotechnology thematic unit with the overall curriculum. Content instruction will be based on the Mission Biotech Curriculum and Game Play. Students will learn about emerging pathogens and the biotechnology used to isolate and treat these pathogens. As part of the curriculum student will be able to play and simulate working a biotech laboratory. Within in this simulation students will have the opportunity to explore all levels of jobs in there area of biotech. Upon completion of the curriculum students will perform the laboratory simulations provided by CPET. They

will complete the southern blot simulation, ELISA and/or the microassay simulation. Depending on the course the microassay may have environmental component, pathogen, and/or immunological component. This will provide students with an opportunity to further explore these topics. Then students begin an exploration in careers in an area of biotechnology that they enjoyed most. Upon successful completion of the curriculum student will move on to the next phase and explore emerging pathogens in laboratory.

- Advanced Level (AP/AICE Biology, Grades 11-12, FCAT Reading Level 3-5).

Upon completion of the genetic thematic unit students will begin the biotechnology thematic unit. The pathogen selected to study will be the tomatoes spotted wilted virus (TSWV). This curriculum instruction will be based on the Biotech in the Classroom. This will use biotechnology reagents and equipment. Some of this will be loaned by UF's CPET. The UF's CPET staff will come to the high school to work with students. Some will have to be purchased with grant funds. The laboratory curriculum will include the following procedures: DNA extraction, PCR, Laboratory Protocol, and Immuno Strip Assay. The final expectation is that student will continue their education in biotechnology through a biotechnology course where they can tackle research.

- Application of Biotechnology Level (Grades 11-12, FCAT Reading Level 1-5)

This class will design for students who have completed the advanced or basic level of biotechnology instruction. It will be an inquiry-based class. It will begin with basic laboratory techniques, quality control, basic laboratory procedures, and student direct research. The Laboratory techniques portion will teach students to use common laboratory equipment, laboratory safety, and how to communicate scientific data. Quality control will explore scientific research in the biotechnology industry using the Biotech Cheese curriculum provided by the Center for Excellence for Regenerative Health Biotechnology (CERHB). The Laboratory procedures will include: microscopy, DNA extraction, Gel electrophoresis, ELISA, spectrometry and Chromatography. Research topics will be centered on emerging pathogens, environmental management, and world health. The program will have students find a biotechnology technique to explore their research. Techniques may be protein extractions that can be sent to Dr. Chen, NOAA Phytoplankton Monitoring Network (PMN) to monitor phytoplankton in our estuary, or any other future possibilities. The career exploration will consist of grant funded field trips, video conferencing opportunities, and guest speakers.

Extended Learning Opportunities: To make sure that learning continues outside of the classroom a select a group of upcoming freshman and sophomores could be taken to the Junior Science, Engineering and Humanities Symposium (JSEHS). Through the program students will have learning opportunities with through summer programs that they can apply to.

Assessments

Prior Knowledge: Students prior knowledge will be assessed using a KWL.

During Instruction: Students will use quick writes and/or daily quizzes

After Instruction: Students will be given test composed of multiple choice and extended response.

Standardized Test: 11th Graders FCAT science, AP students Advanced Placement Biology Test, AICE students Cambridge International University Biology Papers 1,2, & 3.

Standards

Next Generation Sunshine State Standards:

SC.912.L.16.10: Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

SC.912.L.16.11: Discuss the technologies associated with forensic medicine and DNA identification, including restriction fragment length polymorphism (RFLP) analysis.

SC.912.L.16.12: Describe how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, polymerase chain reaction, ligation, and transformation) is used to construct recombinant DNA molecules (DNA cloning).

College Board Advanced Placement Standards

Science as a Process—Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.

Continuity and Change—All species tend to maintain themselves from generation to generation using the same genetic code. However, there are genetic mechanisms that lead to change over time, or evolution.

Science, Technology, and Society—Scientific research often leads to technological advances that can have positive and/or negative impacts upon society as a whole.

Cambridge International A & AS Level Biology

A: Knowledge with understanding

Candidates should be able to demonstrate knowledge and understanding of:

- 1 scientific phenomenon, facts, laws, definitions, concepts and theories;
- 2 scientific vocabulary, terminology and conventions (including symbols, quantities and units);
- 3 scientific instruments and apparatus used in biology, including techniques of operation and aspects of safety;
- 4 scientific quantities and their determination;
- 5 scientific and technological applications, with their social, economic and environmental implications.

B: Handling information and solving problems

Candidates should be able to handle information and solve problems, using oral, written, symbolic, graphical and numerical forms of presentation. In particular, to:

- 1 locate, select, organize and present information from a variety of sources;
- 2 translate information from one form to another;
- 3 manipulate numerical and other data;
- 4 use information to identify patterns, report trends and draw conclusions;

- 5 give reasoned explanations for phenomena, patterns and relationships;
- 6 make predictions and hypotheses;
- 7 apply knowledge, including principles, to new situations;
- 8 demonstrate an awareness of the limitations of biological theories and models; solve problems.

C: Experimental Skills & Investigation

Candidates should be able to:

- 1 follow a detailed set or sequence of instructions;
- 2 use techniques, apparatus, measuring devices and materials safely and effectively;
- 3 make and record observations, measurements and estimates, with appropriate regard to precision, accuracy and units;
- 4 interpret, assess and report on observations and experimental data;
- 5 assess information, and make predictions and hypotheses;
- 6 design, plan and carry out experiments and investigations, and identify any problems;
- 7 choose appropriate techniques, apparatus, measuring devices and materials assess methods and techniques, and suggest possible improvements.

Budget Items

CPET Visit (Cost Covered by CPET)

- ImmunoStrip Assays
- Getting the DNA Out-DNA Extraction
- Making Lot of Copies-DNA Amplification
- Visualizing the DNA-Gel Electrophoresis
- ELISA antibody Test

CPET Simulations (Cost Covered by CPET)

- Microarray Simulations
- Southern Blot
- Elisa

Required for Purchasing

E-Gel® 1.2% with SYBR Safe™ Starter Kit Cat. No. G6206-01	\$110.00 (4)
Thermocycler	\$3,000.00 (1)
Safe Imager™ 2.0 Blue Light Transilluminator	\$1200.00 (1)
Fisher Science Education* Variable Micropipets	\$135.00 (2)

References

Florida Department of Education (FLDOE).(2009). *Next Generation Strategic Plan*. Retrieved from http://www.fldoe.org/strategic_plan/

Mandall, Tamara. (2009). *Florida's Statewide Biotechnology Program of Study Opening Doors to Careers in Biotechnology*. Retrieved from http://www.cord.org/uploadedfiles/NCPN09P_Mandell.pdf

Partnership for 21st Century Skills. (2009) The Milestones for Improving Learning and Education Guide. Retrieved from http://p21.org/documents/MILE_Guide_091101.pdf

University of Central Florida (UCF). (n.d.) *Bloom's Taxonomy*. Retrieved from <http://www.fctl.ucf.edu/TeachingAndLearningResources/CourseDesign/BloomsTaxonomy/>

Essential Question: Students understand the impact of biotechnology on individuals, society, and the environment.

Grade Level: 11-12

Course: AP/AICE Biology

Time Line: 4 weeks

Schedule: 90-minute block everyday

Resources: ICORE, Campbell's Biology 7th Edition

Day 1: EQ: Explain how mutation can occur during the formation of gametes

- Chapter 13 PowerPoint
- Chapter 13 Study Guide
- Chapter 13 Quick Write

Day 2: EQ: Relate the transmission of genetic information between organisms.

- Chapter 14 PowerPoint
- Chapter 14 Study Guide
- Chapter 14 Quick Write

Day 3: EQ: Differentiate between different types of inheritance patterns.

- Chapter 15 PowerPoint
- Chapter 15 Study Guide
- Chapter 15 Quick Write

Day 4: EQ: Students understand the molecular basis of inheritance.

- Chapter 16 PowerPoint
- Chapter 16 Study Guide
- Chapter 16 Quick Write

Day 5: EQ: Students understand the process of transcription & translation.

- Chapter 17 PowerPoint
- Chapter 17 Study Guide
- Chapter 17 Quick Write

Day 6: EQ: Students understand the genetics of viruses & proteins.

- Chapter 18 PowerPoint
- Chapter 18 Study Guide
- Chapter 18 Quick Write

Day 7: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Mission Biotechnology

- Biotechnology Quick Write

Day 8: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Mission Biotechnology
- Biotechnology Quick Write

Day 9: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Mission Biotechnology
- Biotechnology Quick Write

Day 10: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Mission Biotechnology
- Biotechnology Quick Write

Day 11: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Biotechnology Labs
- ICORE Visit

Day 12: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Review of Labs
- Lab Reports

Day 13: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Review Day

Day 14: EQ: Students understand the impact of biotechnology on individuals, society, and the environment.

- Assessment

Florida Next Generation Standards:

- SC.912.L.16.1
- SC.912.L.16.2
- SC.912.L.16.4
- SC.912.L.16.3
- SC.912.L.16.5
- SC.912.L.16.9