

Title: Emerging Pathogens: Can they be STOPPED?

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Abstract

Emerging pathogens are a very real concern for south Florida. Students are aware of pathogens such as HIV, Influenza, West Nile virus, etc. Daily in the news students are confronted by pathogens and this concern can be used to motivate and invite students to enter careers which may find the solution to these concerns. Students will learn proper protocols for mixing chemicals, setting up and running Biotech labs. They will learn how to clone plant and bacteria, perform gram staining, microscope techniques, run electrophoresis, and PCR.

Our students have been invited to use biotechnology equipment and facilities from the University of Florida and Palm Beach Community College. Our desire is to introduce not only the AP/IB students to biotechnology but our general student population as well. Students will have the opportunity to visit biotech companies in order to get a vision of futures in this exciting field.

Mission statement

- ✓ To introduce students to Biotechnology and to demonstrate its relevance by incorporating a unit on the dangers of emergent pathogens and the need for preventive measures.
- ✓ To motivate and train students in the developing field of biotechnology by teaching them appropriate lab techniques, introduce them to applications by industry and challenge them to careers in the field of Biotechnology.
- ✓ To excite students about career opportunities by visiting Universities and Community Colleges and actually perform research in their Biotechnology Laboratories.

Description of teaching unit

My proposal focuses on AP Biology but also looks to the needs of our regular student body. I propose to introduce biotechnology in 9th-10th grade biology classes, 10th-11th grade chemistry classes and in an after school biotechnology club.

Biology students will extract DNA from strawberries, work with Broward County Extension Office in order to detect plant pathogens with Agdia ImmunoStrip Tests, and perform Gel electrophoresis along with a complementary virtual lab.

Objectives: Students will observe extracted DNA and learn two methods of analyzing the nucleotides. (Agdia ImmunoStrip Tests and Gel electrophoresis). From these procedures extrapolation can be made to emerging pathogens and possible methods of detection.

Chemistry students will introduce plasmids containing the gene for green fluorescence into E. coli and then extract the protein using chromatography. (Bio-Rad's pGLO kits) They will research the pGLO protein and use the foldit computer program to discover how hydrophobic and hydrophilic portions of the polypeptide affect its folding. Protein modeling kits will also be used.

AP Biology students will use a microscope to identify cultures as bacteria, fungus, animal cells (mosquito larvae) or algae cells. They will streak plates, count and describe colonies and prepare gram stain slides in order to identify bacteria. Students will perform on-line research of strategies to eliminate emerging pathogens without harming humans and our environment.

Outcomes

- Students will be able to identify cell types by their identifying structures determining whether the pathogenic agent is a virus, bacterium, fungi or other vector.
- They will be able to analyze cell structure and determine vulnerabilities of pathogens determining likely pharmaceutical agent (vaccine, antibiotic, etc.) that will target pathogen without harming humans.

Follow up lab will extract microbial DNA from soil for PCR amplification. I will be working with Palm Beach Community College on this protocol.

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Subject: Biology, 11th and 12th grade Advanced Placement

Objectives: Students will –

- collect and culture samples,
- examine under microscope, and identify as plant, animal, fungi, or bacteria.
- If bacteria, students will perform gram staining and research the significance of gram staining of cell walls.
- They will further research methods of treating the emerging pathogens.
 - Bacteria - gram +, gram – Animal vector, i.e. mosquito – plasmodium
 - Fungi Virus – DNA, RNA

Strand F: Processes of Life

1. The student describes patterns of structure and function in living things.

4.1 that the body processes involve specific biochemical reactions governed by biochemical principles.

4.7 that organisms respond to internal and external stimuli.

2. The student understands the process and importance of genetic diversity.

4.2 The student knows that every cell contains a “blueprint” coded in DNA molecules that specify how proteins are assembled to regulate cells.

4.3 The student understands the mechanisms of change (e.g., mutation and natural selection) that lead to adaptations in a species and their ability to survive naturally in changing conditions and of increase species diversity.

Strand G: How Living Things Interact with Their Environment

1. The student understands the competitive, interdependent, cyclic nature of living things in the environment.

4.1 The student knows of the great diversity and interdependence of living things.

Use hands-on labs to teach strategies of identifying and dealing with emerging pathogens .

Materials:

Cultures of yeast, mosquito larvae, soil bacteria, algae

Computers with internet access

Microscopes - oil immersion

Bleach for sterilization of work area

Petri dishes with nutrient agar, Gram stain kit

Expected outcomes

- Students will be able to identify cell types by their identifying structures determining whether the pathogenic agent is a virus, bacterium, fungi or other vector.
- They will be able to analyze cell structure and determine vulnerabilities of pathogens determining likely pharmaceutical agent (vaccine, antibiotic, etc.) that will target pathogen without harming humans.

Procedures:

30 min. Use microscope to identify unknown culture as a plant, animal, fungus, or too small to determine.

30 min. Use sterile techniques to streak nutrient broth Petri dishes, tape, and place upside down in incubator.

1 hour - Describe distinguishing features of colonies, use sterile technique and prepare a microscope slide for gram staining. Use a microscope to determine shape and color. (red – gram negative, purple – gram positive)

1 hour - Perform on-line research to determine vulnerability of pathogen and describe a method of treatment without killing humans or damaging environment.

Virus

Bacteria

- gram positive
- gram negative

Fungus

Mosquito – egg, larvae, pupa

Assessment:

Lab write up with detailed analysis of possible treatment or preventative measures.

Resources/references

[Bacteria Growth and Culture Bacteria Growth and Culture](#) (Michael Blaber)

<http://www.spcollege.edu/hec/vt/VTDE/ATE2639LGS/gramstain.htm>

Campbell Biology for research on cells

Gram stain kits come with instructions

Computer with internet access for on-line research.

Future Lab: Methods for microbial DNA extraction from soil for PCR amplification

Indication of expertise of the PI and specific contribution(s)

I have been involved in cancer research at Dight Institute of Human Genetics, University of Minnesota doing biochemical assays and tissue culture. I have taught the sciences for the past 27 years. I have taught the Biological Sciences as an adjunct professor at the Community College level, AP/IB Biology, and IB Chemistry at the High School level. I co-directed a summer research program for University students at NASA's Biological Control Systems for two summers. I have taught biotechnology at Johns Hopkins University Center for Talented Youth for five summers. And I am presently Science Department Chair as well as an instructor of AP Biology and Honors Chemistry

I have obtained and trained students with equipment donated by business partners: lab glassware from an Animal Research Lab, SEM Microscope, HPLC, GC, and UV/VIS Spectrophotometer from US Navy and Industry.

I was a 2008 Bio-Link research fellow in Biotechnology at Berkeley, CA and participated in a summer institute studying emerging pathogens at the UF HHMI Interdisciplinary Center for Ongoing Research/Education Summer Institute.

As Department Chair I have worked with time-lines, budgets and training students as well as staffing and am looking forward to initiating this Biotechnology program at our high school.

Literature cited

Geospiza, FinchTV used to identify sequences, Todd Smith, Ph.D., Chairman and CEO, Geospiza, Inc.

Foldit, Solve protein puzzles for science, Principal Investigators: Zoran Popovic, David Baker, David Salesin

Budget and justification: \$200

FAU and/or Palm Beach Community College Bus Field Trip

Guest Speakers

Bio-Rad's pGLO lab kit