

You give me fever!

Denisse Conway  
Palm Beach Central High School  
Wellington, Fl

Abstract:

Many high school students are not currently exposed to biotechnology in the classroom. This action proposal will emphasize the application and limitations of equipment, resources and adequate teacher knowledge of current biotechnology. It will also grant students access to scientific equipment, various lab skills and techniques which can be applied in a college setting or the workforce.

Students will then learn about viruses, the means by which they are transmitted and how the immune system launches a response to the invasion. Students will learn various biotechnology techniques such as dot blot, ELISA and gel electrophoresis. As an extension of the above labs, the mosquito life cycle will be examined.

I would like to expose my students to the multiple applications scientists use to verify their results. For example, it is common practice to use a test strip, such as an immunostrip out in the field. The immunostrips are a quick, easy and inexpensive diagnostic tool; however it can be inaccurate at times. To ensure accurate results the sample would have to be further tested.

Rational:

Students will have the opportunity to study the effects of yellow fever through historical recounting, and possibly, current events in the instance a mosquito borne pathogen such as nipah or dengue emerge during our study. All the potential measures taken to combat said outbreak could be used in conjunction with our yellow fever component. The unit will start with the novel Fever 1793 by Laurie H Anderson, which features elements of the largest outbreak of yellow fever in the United States. I want to emphasize the importance and our interconnectedness to previous outbreaks and pathogens. It is difficult for students to conceive the likeliness of a yellow fever outbreak of this magnitude during their lifetime.

Therefore, our starting point will be that students learn of an outbreak on the news and discuss the real possibility that it may exist close to home. We then detail the importance of responding to such an outbreak, the attempt to accurately identify the cause or antigen in question, limit the scope of its propagation, and the role of a vaccine in this process. A vaccine, which may or may not exist, be available or effective in checking the outbreak. In undertaking this study of pathogens, hopefully, science becomes more relevant to them.

In our labs, we will mimic the process of trying to identify who has been exposed to the yellow fever virus, verify who has the antibody in their serum and carried out an immune response to the virus. Tests are usually checking for the antibodies or antigens. This process is complicated by

the lifecycle of the virus which may be exceedingly short. Every outbreak being unique, the challenge is complicated by the many variables. These include its virulence, rate of spread, degree of contagiousness and effectiveness of vaccine. That is if it even exists, whether the vaccine is available or not, and in the necessary quantities. Additional medical treatments would be administered according to necessity.

The testing process is one that can be easily demonstrated in a lab which will be targeting a 10<sup>th</sup> grade honors biology class and/or regular class. We will start with a simple test such as a dipstick test and have students recognize a positive or negative result, such as in a pregnancy test with an instant reading. Students will then go through the process of retesting the sample in a more sophisticated manner, such as using the Dot blot or ELISA when looking for the presence of a protein or gel electrophoresis when analyzing DNA samples. Students will gain insight and higher knowledge through performing these in depth methods to identify possible pathogens. The study of emerging pathogens will afford students the unique opportunity to apply the scientific method while exploiting these biotechnologies and analyzing the data that experimentation yields.

This unit will benefit the students in a multitude of ways. They will have exposure to the most current scientific tools and techniques in biotechnology, while investigating the life cycle of mosquitoes. Through this study, I will be able to align Florida standards to concepts not previously covered in great detail which will help students with college readiness within the sciences. Previously, I had limited knowledge of emerging pathogens, primarily focusing on HIV and Ebola. With the knowledge I gained in this workshop, my students will be exposed to a wider range of emerging pathogens, their host and the global effects of the disease.

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

This unit will focus on the following NGSSS:

SC.912.N.1.1 – Define a problem based on a specific body of knowledge, for example: biology, chemistry... do the following:

1. Pose questions about the natural world
2. Conduct systematic observations
3. Examine tools and other sources of information to see what is already known
4. Plan investigation
5. Use tools to gather, analyze and interpret data
6. Pose answers explanations or descriptions of events
7. Generate inferences
8. Evaluate the merits of the explanations produced by others

SC.912.N.1.6 Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied

SC.912.L16.10 Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

SC.912.L14.6 Explain the significance of genetic factors, environmental factors, pathogenic agents to health from the perspective of both individual and public health.

SC.912.L.14.52 Explain the basic function of the human immune system, including specific and nonspecific responses, vaccines and antibiotics.

HE.912.C.1.3 Evaluate how environment and personal health are related

HE.912.C.1.8 Analyze strategies for preventions, detection and treatment of communicable and chronic diseases

SC.912.L.15.6 Discuss distinguishing characteristics of the domains and kingdoms of living organisms

Student Objectives:

Students will explain the relationship between science and society

Students will explain how life can be studied at different levels

Students will explain how scientist manipulate DNA and describe the benefits

Students will summarize the process of DNA fingerprinting and explain its uses

Students will differentiate between prokaryotes and eukaryotes

Student will analyze data of infected regions

Students will describe how pathogens effect the global population

Students will explain the relationship between antibodies and antigens and the role they play in the immune system

The students learning outcomes will be achieved through the completion of the following activities:

- Reading of the novel Fever 1793
- Raising mosquitoes – Dengue lesson one and two
- GLO germ used to illustrate the rapid spread of disease

- Medical Mystery – Yellow fever, using pH test strip and precipitate solutions (adapted from the Science take out activity)
- Antibody/antigen matching game to illustrate specificity of bonding through epitopes.
- Dot blot lab simulation
- Outbreak! Lab – Gel electrophoresis
- ELISA simulation – Dengue lesson three: What Ails You? The Investigation Begins

Use of equipment lockers and /or UF visit

- Class set of Fever 1793 novels
- Outbreak DNA kit
- Dengue curriculum kit- Antibody/antigen matching game

<b>Item</b>	<b>Source for Purchase</b>	<b>Cost</b>
1.5 ml microtubes	Fisher Scientific 02-681-290, 1 pack (500 tube)	\$45.33
Invisible pen	Invis-ID Blacklight.com, INVISIDMP	\$5.99
UV light	Invis-ID Blacklight.com, CHNVF4	\$6.99
Buffer pH 10	Fisher Scientific, SB116-500, 50 ml	\$39.76
Calcium Chloride Dihydrate	Fisher Scientific S75070, 500g	\$5.75
1% phenolphthalein, fisherschi.com,	Fisher Scientific, S71976, 100ml	\$6.50
ColorpHast strips	Fisher Scientific M95903, 1 pack of 100	\$24.35
Nitrocellulose sheets	Biorad, 1 pack of 10 sheets	\$58.00
DNA samples	Carolina Biological 1 mL of 1E2 & SX1	\$104.90
E-Gel® 1.2% with SYBR Safe™,	Invitrogen, G5218-01, 18 gels	\$183.92
		<b>TOTAL = \$481.10</b>