**Title:**Breakbone Fever, Is that a new dance?

**Name and correspondence information for PI:**

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**Abstract:**

The purpose of this action plan is to enable 12th grade IB Biology students to learn new biotechnology skills and utilize them to create and execute scientific research on the topic of emerging pathogens, specifically Dengue Fever. The unit will incorporate the student's previous knowledge of biology along with new knowledge and skills in biotechnology and emerging pathogens. The students will utilize their knowledge of the structure and function of viruses, prokaryotes and eukaryotes and apply it to the disease Dengue Fever. In gaining a better understanding of the interactions between human host and pathogen they will investigate the life cycle of the mosquito by finding water sources with mosquito larva, the presence of the pathogen by doing gel electrophoresis and ELISA tests, the transmission pattern of the virus and the global impacts by gathering and assessing current information, and how to test a factor that can affect egg hatching by designing and conducting an experiment.

**Rationale:**

Many of the 12th grade IB Biology students are interested in careers in the medical field. However, many of them have not been exposed to all of the various career paths in the medical field or the biotechnology and laboratory skills that are utilized.This action plan will allow the students to get a broader scope of the types of skills that are needed in the science laboratory and will emphasize the use of critical thinking skills that are so vital to scientific research.

Students have a good understanding of many of the high profile diseases, like HIV and Malaria, but they are not exposed to current or emerging pathogens that are being discovered around the world. The use of Dengue Fever as an example will allow them to take their previous knowledge and apply it to a new situation to see how pathogens, like viruses, can be similar and also unique in how they interact with their host.

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

**Objectives:**

2.2.1 Draw and label a diagram of the ultrastructure of Escherichia coli as an example of a prokaryote. (2.2.2, 2.2.3)

2.3.4 Compare prokaryotic and eukaryotic cells.

6.3.1 Define pathogen

6.3.2 Explain why antibiotics are effective against bacteria but not against viruses.

6.3.5 Distinguish between antigens and antibodies

6.3.6 Explain antibody production.

6.3.7 Outline the effects of HIV on the immune system.

6.3.8 Discuss the cause, transmission and social implications of AIDS

11.1.2 Outline the principle of challenge and response, clonal selection and memory cells as the basis of immunity.

11.1.3 Define active and passive immunity

11.1.4 Explain antibody production

11.1.5 Describe the production of monoclonal antibodies and their use in diagnosis and in treatment.

11.1.6 Explain the principle of vaccination

11.1.7 Discuss the benefits and dangers of vaccination.

F.1.8 Outline the diversity of structure in viruses including: naked capsid versus enveloped capsid; DNA versus RNA; and single stranded versus double stranded DNA or RNA.

F.3.1 State that reverse transcriptase catalyzes the production of DNA from RNA.

F.3.2 Explain how reverse transcriptase is used in molecular biology.

F.6.1 List six methods by which pathogens are transmitted and gain entry to the body.

F.6.3 Distinguish between endotoxins and exotoxins

F.6.4 Evaluate methods of controlling microbial growth by irradiation, pasteurization, antiseptics and disinfectants.

F.6.5 Outline the mechanisms of the action of antibiotics, including inhibition of synthesis of cell walls, proteins and nucleic acids.

F.6.6 Outline the lytic cycle of the influenza virus.

F.6.7 Define epidemiology

F.6.8 Discuss the origin and epidemiology of one example of a pandemic.

**Outcomes:**

The student will be able to draw and explain the differences in structure and function between a virus, prokaryote and eukaryote.

The student will be able todefine the terms: pathogen, epidemiology, and active and passive immunity.

The student will be able to demonstrate the proper technique for pipetting in various laboratory procedures.

The student will be able to demonstrate the proper technique for running a gel.

The student will be able to demonstrate the proper technique for ELISA test.

The student will be able to explain the process of antibody production.

The student will be able to design, conduct and evaluate an experiment uses *Aedesaegypti*.

**Activities**:

Following directions lab

Pipetting by Design Lab

Pipette Your Own Design Lab

Case Study: Resistance is Futile (HIV and Immune system)

Sequence cards (Humoral and Cell-Mediated Immunity)

HHMI Biointeractive

- Interactive Click and Learn "Stopping Mosquito Borne Disease
- Video "The Mosquito Life Cycle"
- Classroom Activity "The Mosquito Life Cycle"
- Animation "Structure of Dengue virus"
- Animation "Dengue virus life cycle"
- Animation "Dengue virus enters a cell"

Reading: Epidemic Dengue/dengue hemorrhagic fever as a public health, social and economic problem in the 21st century by Duane J. Gubler. (Trends in Microbiology, vol. 10 No.2 February 2002)

Detecting Dengue in the Lab and Field (Dengue Fever Curriculum)

- What's Buzzing in Your Backyard (Lifecycle and habitat)
- Neato Mosquito Learning Stations (Life cycle stages)
- What Ails You? The Investigation Begins (Diagnosing Dengue Case report)
- Steps of an ELISA (sequence cards)
- Testing for Dengue Antibodies (ELISA test (Bio-Rad))
- Gel Electrophoresis
- Different Tests for Different Stages
- Investigating in the Field
- The Vaccination Quandary

Mosquito Inquiry Lab (IA lab: Select a factor that affects mosquito hatching)

Contagion Movie

Plague (App game)

**Data collection techniques and/or student assessments:**

Pre-test

Lab Write-ups (IA Mosquito lab, Gel Electrophoresis, ELISA)

Post-test

**If applicable, use of equipment lockers and/or UF visit:**

Site visit from CPET staff for preplanning in-service training

Pipetting stations

ELISA (BioRadImmuno Explorer)

Mosquito hatching (Mini Mosquito Breeders)

Mosquito ID: ID cards, DVD, bloodsucking pest kit

**ICORE summer institute elements specifically included:**

Pipetting activity

Mosquito hatching

Detecting Dengue in the Lab and Field (Dengue Fever Curriculum)

Contagion movie

**How your proposal differs from what you normally teach, new pedagogies; how you previously taught this lesson or topic versus how you plan to teach it under your action proposal:**

This proposal differs from previous lesson plans in that it will combine biotechnology techniques with a story about Dengue Fever. Within this lesson new components will include a lab to introduce proper lab techniques with the micropipettes and the use of the ELISA technique. In the past I have discussed the ELISA technique and shown an animation on how it is done, but we have never conducted a lab in the classroom with this technique.The lesson will also include the use of mosquitos to do an IB Internal Assessment Investigation. In the past mealworms and pillbugs were utilized for animal behavior experiments, but we have not incorporated an organisms life cycle. The use of mosquitoes will tie into the Dengue Fever curriculum and allow the students to work on and investigate a problem that is relevant to Florida.

**Literature cited:**

Detecting Dengue in the Lab and Field.UF CPET Curriculum.

HHMI Biointeractive web site.www.hhmi.com/biointeractive

Gubler, Duane J. "Epidemic dengue/dengue hemorrhagic fever as a public health, social and economic problem in the 21st century. Trends in Microbiology. Vol. 10, No.2, February 2002.

Sanchez L, Vanlerberghe V, Alfonso L, Marquetti MC, Guzman MG, Bisset J, et al. *Aedes aegypti* larval indices and risk for dengue epidemics. Emerg Infect Dis [serial on the Internet]. 2006 May [*date cited*]. http://dx.doi.org/10.3201/eid1205.050866

http://www.denguevirusnet.com/life-cycle-of-aedes-aegypti.html

**Budget and Budget justification:**

| Item | Cost | Quantity | Total |
|---|---|---|---|
| E-Gel 1.2% with SYBR safe (18 pack, gels only) | 183.92 | 1 | 183.92 |
| Introduction to Gel electrophoresis 8 station dye kit (Caroloina Biological 21144) | 16.25 | 2 | 32.50 |
| Immuno Explorer kit REFILL (BioRad 116-2401EDU | 117.50 | 1 | 117.50 |
| GloGerm Contamination Kit (Flinn AP9080) | 22.80 | 1 | 22.80 |
| Total: | | | 356.72 |

The funds for the $156.72 over the budget allowance will be obtained from the yearly science budget allocated from the school district. The GloGerm contamination kit will be used for the following directions lab at the beginning of the lesson in order to make students understand and realize the importance of reading and following the lab procedure and good lab practices. The Immuno Explorer refill kit will be used in conjunction with the ELISA Bio-Rad locker lab so that it can be done with both classes. Finally, the E-Gels and dye kit will be used with the lesson 5 of the Detecting Dengue in the Lab and Field curriculum.