Melissa Brisbin
CATALySES: Emerging Pathogens
Summer Program 2019
Action Proposal & Lesson Plan - Final

Action Proposal
The Dengue Dilemma

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Abstract (150 words limit)
Students will use the first case report from the Key West 2009 dengue outbreak to complete an epidemiological report. This lesson begins with a patient's initial symptoms and visit to her primary care physician. After a return trip and visit to the emergency room, students will conduct initial testing for dengue. To do this students first match diagrams with text descriptions to understand the steps of an ELISA before testing the patient serum sample for the presence of dengue antibodies. Once students receive results indicating the presence of Dengue in the patient, they will analyze gel electrophoresis results to determine which serotype of dengue virus our patient is infected with. They will have positive controls for all four serotypes and compare them with the patient's cerebral spinal fluid sample taken early in the course of her infection. The students will determine that our patient is positive for serotype 1 (DENV1).

Quick Breakdown of Lesson Plan
Day 1 - WISE Version Parts 1 and 2
Day 2 - ELISA background & graph
Day 3 - ELISA Lab
Day 4 - Review Gel Electro results and class discussion on Case Ending

Rationale, description of teaching unit or module(s), including expected outcomes. 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

- Description of current teaching unit: This activity will follow Forensic analysis of bones and gel electrophoresis. In the Forensic analysis of bones students will measure bones to evaluate and assign gender, age, height, and ethnicity to narrow down a list of suspected victims. After that point they will complete gel electrophoresis post-PCR using two samples of DNA and restriction enzymes to ultimately identify the missing person. Before writing a case report on identifying the victim, students also research FBI analysis including other ways of identifying a person based on markers of infectious disease.
- Variation of action proposal to current practice: This would lead into the case report on Dengue and how doctors would evaluate living patients to determine infectious disease

using similar methods such as gel electrophoresis post-PCR and ELiSA. In the third year of my course program, students will perform an ELiSA so this is a good way to incorporate it into the second year. In my course students are continuously dealing with case reports of living patients to work to diagnose and implement treatment plans. This activity would be a perfect way to move from post-mortem analysis to living analysis. It also prefaces exploration of the nervous system, urinary system, and circulatory systems, which are affected in the patients' case report.

- Expected outcomes: There will be higher-level fluidity between units when moving between body systems (i.e. skeletal system to nervous system). Students will make connections between lab techniques and multi-purpose real-world applications (i.e. gel electrophoresis can be used to get information post-mortem or living). Students will be able to visualize individual case reports including chart set up of symptoms, body systems affected, tests performed, results, and diagnosis/referral. This examination of case reports is crucial to the core curriculum of this course and directly ties to the student's final project to create their own case report and assessment of a patient.

Data collection techniques and/or students assessments

- Analysis of student ELiSA results (positive or negative based on fluorescence)
- Assess student understanding through analysis of graph of immune response vs virus
- Evaluate student understanding through several small discussions throughout the lesson sequences and one final discussion of overall understanding and purpose

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

- The Dengue Dilemma locker rental from UF (ELISA)

CATALySES summer institute elements specifically included (UF connections)

- The Dengue Dilemma workshop and WISE interactive

Literature cited

This Action Proposal is a modification of an adaptation of a two-step nested RT-PCR assay described by Lanciotti et al. Five oligonucleotide primers are included in the one-step assay: one 5' primer that targets a region of the capsid gene conserved in all four dengue virus serotypes and four
3' primers, each of which is complementary to sequences unique to each serotype. These primers are positioned such that a differently sized product is generated from each type, as shown in Fig. 1A, lanes 1 to 4 (dengue-2, 119 bp; dengue-3, 290 bp; dengue-4, 389 bp; dengue-1, 482 bp).

Harris, E., Roberts, T. G., Smith, L., Selle, J., Kramer, L. D., Valle, S., ... & Balmaseda, A. (1998). Typing of dengue viruses in clinical specimens and mosquitoes by single-tube multiplex reverse transcriptase PCR. Journal of Clinical Microbiology, 36(9), 2634-2639.

Lanciotti, R. S., Calisher, C. H., Gubler, D. J., Chang, G. J., & Vorndam, A. V. (1992).

Rapid detection and typing of dengue viruses from clinical samples by using reverse transcriptase-polymerase chain reaction. Journal of Clinical Microbiology, 30(3), 545-551.

Budget and budget justification
$75 for UF locker rental (waived for first year)

Lesson Plan
The Dengue Dilemma

Science Subject: Human Body Systems (Year 2 of PLTW Biomedical Curriculum)

Grade and Ability Level: 10th & 11th grade, advanced studies

Science Concepts: virus, disease transmission, vectors, antibodies, antigens, DNA, proteins, replication, immune response

Overall Time Estimate: Four 45-minute class periods

Learning Styles: Visual, auditory

Vocabulary:

- Acute: sudden onset of disease; short duration
- Agarose: derivation of agar used as a medium for gel electrophoresis
- Antibody: protein produced by B cells in response to an antigen to neutralize the foreign protein (antigen); also called immunoglobulin.
- Antigen: any substance that is foreign to the body and stimulates an immune response
- cDNA: complimentary DNA; made via reverse transcription from a mRNA strand
- Dengue: an acute infectious disease that is characterized by headache, severe joint pain, and a rash and that is caused by a single-stranded RNA virus of the genus Flavivirus (species Dengue virus) transmitted by mosquitoes of the genus Aedes—called also breakbone fever. (From the Merriam Webster dictionary.)
- ELISA: Enzyme Linked Immuno Sorbant Assay – antigen/antibody assay
- Endemic: restricted to a particular location or region
- Epidemiology: a branch of medical science that deals with the incidence, distribution, and control of disease in a population
- Gel Electrophoresis: separating DNA or proteins by size through a matrix by applying an electrical current
- Polymerase Chain Reaction: in vitro synthesis of a specific portion of a DNA molecule through a cycling of

three steps: denaturation, annealing, and extension
- Primary Antibody: in ELISA, the first antibody bound
- RT-PCR: reverse transcription PCR. Using an RNA template to create a complimentary DNA (cDNA) strand that can then be amplified via polymerase chain reaction
- Secondary Antibody: in ELISA, the second antibody bound, increasing the sensitivity of the assay
- Viral Load: quantitative measure of virus present in a biological system
- Viremia: presence of viruses in the blood

Quick Breakdown of Lesson Plan

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Detailed Daily Lesson Plan

Note: Submission of only one day is required if lesson spans more than one day per CATLySES requirements

Day 1 - WISE Version Parts 1 and 2

Key Question: What are the steps to diagnosing dengue?

Lesson Summary: Students will use the online platform WISE to interactively review a case report from the Key West 2009 dengue outbreak and complete an online epidemiological report. This lesson begins with a patient's initial symptoms and visit to her primary care physician. After a return trip and visit to the emergency room, initial testing for dengue will be conducted by the students in the next lesson.

Student Learning Objectives with Standards:

The student will be able to…
1. Interpret a case report
2. Articulate that investigating a disease cause is a detailed process
3. Identify some of the intricacies in investigating a disease cause
4. Recognize it can be difficult to diagnosis an illness

SC.912.L.14.52 - Explain the basic functions of the human immune system, including specific/ nonspecific immune response, vaccines, and antibiotics.

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

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SC.912.L.18.1 - Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules.

SC.912.N.3.5 - Describe the function of models in science, and identify the wide range of models used in science.

Materials:

- Laptop with access to Internet
    - Students must create a WISE account
- Downloaded Case Report (PDF)
- Downloaded Epidemiological Log (PDF)

Advance Preparation:

- Teacher must set up a WISE account
    - Copy The Dengue Dilemma into your WISE lessons
        - Edit WISE activity to only include parts 1 and 2
        - Edit activity as desired

Procedure:

(5 minutes)

1. Guide students through creating a student account on WISE.
2. Post code on whiteboard for students to access your online classroom.

(30 minutes)

3. Tell the students this is the actual case report as recorded by the CDC. Ask students to read the case report silently.
4. Tell the students they are now an epidemiologist on the case. They need to review her history and record her symptoms, tests ordered, and results as they are available. They will continue to fill in the epidemiological report as they move through the unit and more information is learned.

(5-10 minutes)

5. Allow the students to work in pairs to complete as much of the chart as they can.
6. Circulate to check for understanding.
7. When all student pairs have finished, go through the epidemiological report together, calling on student pairs to give answers.

Teaching tip: The students do not have all of the information in this initial report. Remind the students that patients are not always forthcoming with information and this can hinder diagnosis. Additionally, the nurse or doctor who took the patient history may not have asked appropriate probing questions to solicit needed information. Also, while some students may be knowledgeable of dengue, they can only use the information that is actually presented to them rather than filling in the blanks or guessing.

Dengue Dilemma

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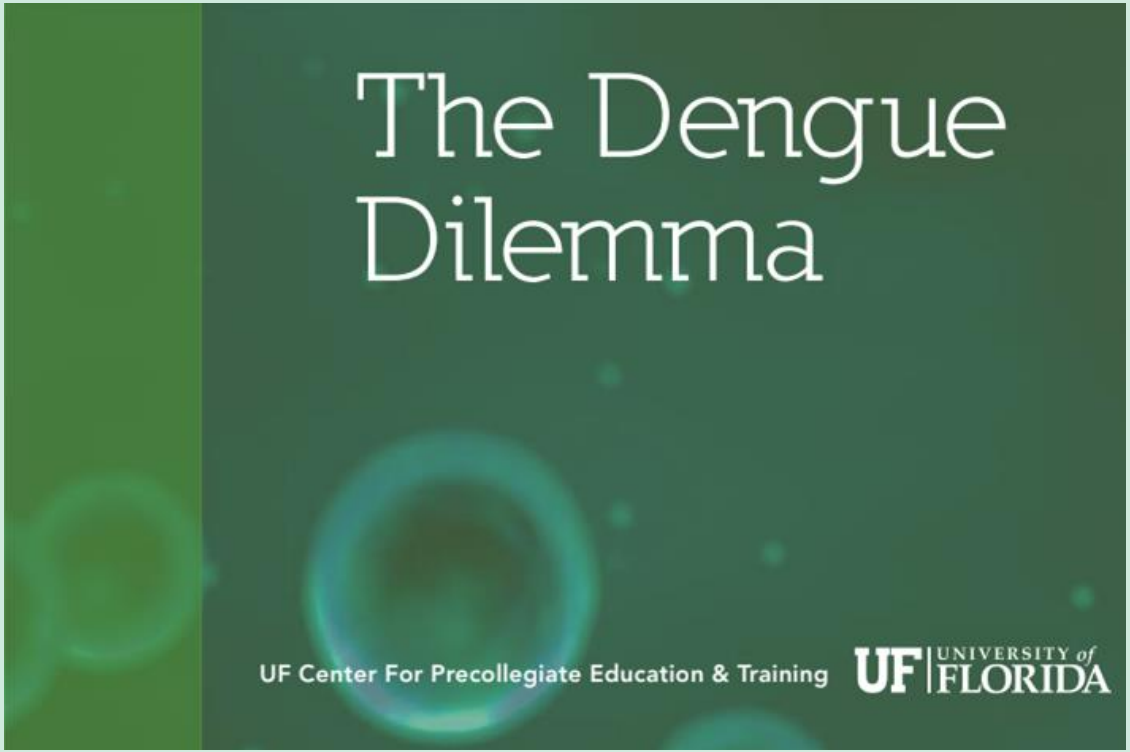
CATALySES Action Proposal 2019

Inspiration from CATALySES

The Dengue Dilemma

Workshop

WISE Interactive



Lesson Outline and Layout (4 Days)

Day 1 - WISE version (parts 1 and 2)

- ❏ Background, setup, PDF and vocab list
- ❏ Whiteboards → group discussion → random selection to share
- ❏ “Popcorn read” information, fill out Case report using “I Do, We Do, You Do” method → call on students to share (monitoring)

Day 2 - ELISA background & graph analysis

- ❏ Use WISE 3.1 video to watch as class and discuss (bellwork)
- ❏ Paper manipulative of ELISA steps → teacher check when done
- ❏ Backside of paper is graph → answer on whiteboard

Day 3 - ELISA Lab

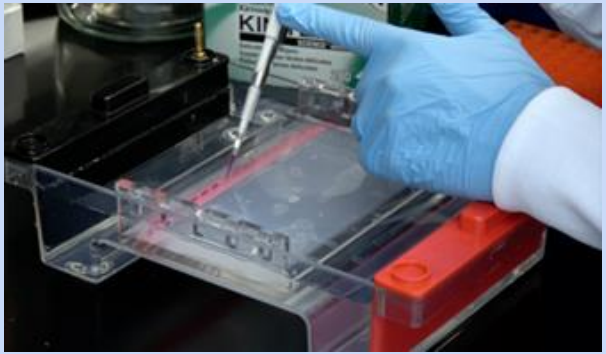
- ❏ Request materials from CPET locker
- ❏ Students will take a picture of their results, paste on PDF Case Report, answer analysis questions

Day 4 - Review Gel Electro results and class discussion

- ❏ Read and discuss how to run electrophoresis on RNA
- ❏ What do well contain?
- ❏ What serotype and why?
- ❏ What next (prevention, case closed)

Current unit, variation & expected outcomes

Previous



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