

Title: Past and Present- Is it in the Air or Water? A Historical and Modern Look at Disease Pathogens in a Florida Port Town. An Interactive Case Study.

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Abstract: This action plan proposes that students to use prior knowledge and interests related to the case to construct new knowledge, use critical thinking skills and lab skills. They will put their learning into context, in the format of a case study, expanding independent and cooperative learning skills with the analysis of data collected through experimentation to solve a problem occurring in their community.



Rationale:

Tarpon Springs is a community that started as a small port town on the Anclote River. Settlers lived near or on the water and many made a living associated with the water; fishing, importing, exporting, shipping, sponging, recreational usage and much more. On Epiphany, the bayou is still blessed by the Greek Orthodox Archbishop and Greek males dive to retrieve a tossed wooden cross for which they will receive a year's blessing and good fortune.

Historically, the Tarpon Springs area has had Yellow Fever, Cholera, Polio, Influenza, and Small Pox in public reports since 1881. In 1889, in a Feb. 14 letter published in the New England Medical Monthly, Mary J Safford, the first female physician in Florida, who nursed infectious disease cases in the Union army during the Civil War, was advocating for the creation of a crematorium for cholera cases. In the Cicada Cemetery, Frederic Meyer was interred in 1869 after dying from yellow fever. The Meyer family went on to become the light house keepers on Anclote Key. September 23, 2011, the sentinel chickens off Keystone road had 15 cases of St. Louis encephalitis and 3 cases of West Nile virus. The Stauffer Chemical Superfund site is located on the Anclote River and has polluted the deep ground and surface water. The past is rich with examples of pathogenic diseases; the future now is presenting new challenges.

The AP Environmental Science students will be challenged to investigate and identify a new emerging pathogen. AP Biology students may come in also the confirm research with PCR or additional testing. Students will use data provided by the teacher about patients, environmental conditions, locations within the community and data collected by testing water samples, to analyze data then confirming patient illnesses using biotechnological testing techniques to determine if an emerging pathogen or chemical water pollution are making patients ill.

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

- AP Environmental Science Course Syllabus: Pollution 25- 30 %
 - Water Pollution
 - (Types; sources, causes, and effects; cultural eutrophication; ground water pollution; maintaining water quality; water purification; sewage treatment/ septic systems; Clean Water Act and other related laws.)
 - Impacts on the Environment and Human Health
 - Hazards to Human Health
 - (Environmental risk analysis; acute and chronic effects; dose- response relationships; air pollution; smoking and other risks)

Objectives:

- Students will identify point and nonpoint pollution sources.
- Students will understand major water pollutants and their sources; students will identify water quality through quantitative testing procedures.
- Students will understand how common diseases are transmitted to humans through contaminated water and airborne vectors.
- Students will investigate and demonstrate how to purify surface and ground drinking water by visiting a local water treatment plant, South Cross Bayou and building a water filter.
- Students will investigate how sewage treatment reduces water pollution and removes some pathogens.
- Students will understand what types of biological and chemical hazards we face and how to reduce infectious disease and chemical toxicity.

This unit may be as short as three or four weeks but with the field trip to the water treatment plant may be longer. Classes are 50 minutes long and may be joined to complete some of the longer procedure and field trips.

Key Questions:

- What disease pathogens have been present in Florida's/ our community's past and the effect on our community?
- What are the Stauffer Chemical plant and its current EPA status? What is the significance to this community?
- What are emerging pathogens and what are some examples of emerging pathogens?
- What are re-emerging pathogens?
- How are emerging pathogens delivered to susceptible humans?
 - Environmentally?
 - Transmitted by disease vectors?
- How are biotechnological techniques used in the identification of the pathogens and public health?

Science Subject: Biology: Microbiology, Epidemiology, Environmental Science: Water Quality

Grade and Ability Level: 9th through 12 grades, honors, or Advanced Placement. May be adapted in length and grade level and ability.

Science Concepts: Emerging pathogens, water quality and disease, disease vectors, epidemics

Overall Time Estimates: Three-four Weeks and a field trip

Learning Styles: Visual and Kinesthetic learning style with differentiated instruction techniques and gradually release of information. Active learning will be supported by hands on lab activities, modeled simulations, and a presentation of student group learning to the whole class.

Vocabulary:

Pathogen	Yellow fever	Malaria	Tuberculosis
Emerging Pathogen	Cholera	Gel Electrophoresis	Polio
Disease vector	Dengue fever	PCR	Influenza
Superfund site	E.coli	Elisa	West Nile fever
Water quality/pollution	coliform	Dot Blot	St. Louis Encephalitis
Toxicity	re-emerging pathogen		immune response

Lesson/Unit Summary:

This active case study will explore past epidemics and pathogens with modern emerging pathogens in a local community .The unit will investigate environmentally and vector transmitted illness in a gradual release format through case file notebooks and investigation groups, reducing whole class printing. There will be different conditions, symptoms and outcomes for different groups. Data will be researched and collected in guided inquiry, literature review and simulations to determine what illness their assigned patient has. Students will present their findings to their class by media, Power Point presentations at their

community town hall. As a culminating activity, the class will take a field trip to South Cross Bayou Water Treatment Plant.

Student Learning Objectives with Standards:

The student will be able to

- SC.912.L.14.6 Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspective of both individuals and public health.
- HE.912.c.1.3 Evaluate how environmental and personal health are interrelated.
- SC.912.L.14.52 Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.

Materials: For 2 classes

Essential: EL (Equipment Locker) IS (In Stock Provided by Teacher)

- 3 ring notebooks for investigative notebooks **IS**
- Mini Mosquito Breeders/ Mosquito Hatcheries **IS**
- Mosquito ID Cards **EL**
- Detecting Water borne pathogens through colorimetric methods **EL**
- Dengue curriculum **EL**
- Medical Mystery of Epidemic Proportions-Cholera **EL**
- Outbreak! Source? E.coli0157:H7 & Carolina Bio DNA # 211204 **IS**
- Disposable pipettes **IS**
- Disposable gloves **IS**
- Disposable clear plastic cups
- Sterile water **IS**
- Pipetting stations **EL**
- Gel Electrophoresis E Gel **EL**
- Computer laptop cart
- SciEd Green Low-Cost Water Monitoring Kit **IS**
- Sodium Hydroxide **IS**
- Phenolphthalein **IS**
- 0-14 pH strips **IS**
- 1.5 mL microtubes **IS**
- Buffer pH 10.00 **IS**
- Calcium Chloride Dihydrate **IS**
- Nitrocellulose paper
- UV light pen **IS**
- UV marker pen **IS**
- Mosquito/copepod kit, Florida Medical Entomology Lab, <http://fmel.ifas.ufl.edu>, No Cost for Kit, <http://fmel.ifas.ufl.edu/kits/intro.shtml>

Background Information:

All communities in Florida have experienced epidemics of various pathogens during the history of the state, but students are not aware of when or where has happened in their community or what emerging pathogens could happen in the future; they live in their own world and need to be aware of their community. The chosen example port community of Tarpon Springs is real and has experienced cases

of yellow fever, cholera, polio, small pox, influenza and tuberculosis as a few examples in the past. Students are still surprised when historic information points out the evidence of these illnesses. The pathogens that transmit these illness can be transmitted person to person or in the environment as water borne, air borne insect vectors, or stored in the soil. Recent environmental conditions will play an important part in the movement of the **emerging pathogens**, relatively new disease causing organisms to an area that are causing health problems in humans in the present. Recently, tuberculosis as an example, is an infectious bacterial disease that has **re-emerged** in the state of Florida, reminding us that historical outbreaks could return.

Pathogens may be viral, bacterial, protozoan, fungal or helminths, and cause human diseases that may or may not be lethal. These pathogens can be transmitted by infected people coming to the port community through person to person contact, through contaminated water or by insect vectors. Environmental conditions can increase distribution of these pathogens by changing insect distributions and population size; after TS Debby in 2012, when the Anclote River basin flooded and left standing water for weeks, the number of insect vectors, specifically mosquitoes, increased by 35%. Flooding and rain can move water borne pathogens into the path of humans. Walking through flood waters with contaminants can initiate an emerging pathogen outbreak. Because of the recent flooding, we cannot rule out the possibility that some of the symptoms and illnesses could be caused by toxic contamination in the water and soil.

The student's goal in their lab groups is for them to take on the role of investigator to determine what pathogen has caused an illness in their community. They will use researched evidence, simulated evidence and authentic evidence in the form of collected data through guided inquiry to come to their final conclusion. In addition to traditional chemical techniques and protocols to test what is in the communities water we will use biotechnological techniques PCR, Elisa, Gel Electrophoresis and Dot Blot, in specific protocols, to identify and confirm the pathogen by immune response of antibodies formed in the patients in the case study. The investigative groups will not receive the same clues, symptoms or data and there will be several different emerging pathogens present at the end of their active case study. After testing their samples and researching their symptoms and patient data, they will create a media release and Power Point for a town hall meeting and presentation.

Advanced Preparation:

Begin Mosquito egg incubation two to three weeks early

Print and collate investigative notebooks

Request equipment from the equipment locker

Send letter to parents/administration for permission to watch video Contagion

Field trip components- South Cross Bayou Water Treatment plant. Pre Field trip prep.

Post resources as pdfs on course Moodle: Emerging Pathogens and What You Need to know about Infectious Disease.

Water tests with collected sample with Chapter 13 Water Pollution for chemical and environmental analysis and again by group sites for testing for water borne pathogens. Group water samples- Use an unopened commercially prepared water bottle which is assumed sterile before opening, empty the contents- do not drink from bottle- into a clean reusable water bottle and consume. Label with group name, letter, date of collection, site of collection. Need at least 3.

Ch 13 Water quality test results for chemical and environmental toxicity and contamination from group samples. The objective is to determine if patient illnesses are of a chemical origin.

Lesson Timeline: Procedure and Discussion Questions

Sixteen days based on 50 minute class periods

Day 1 – Intro Active Case Study

Form Groups and create group structure for the investigation.

Give each group an investigative notebook with group organization assignment- who is in group, who is responsible for each role in the group, design a group cover for investigative notebook and rubric for assessment.

View Video *Contagion* (Initial Inquiry, recognizing the problem) - 10 mins

Exit ticket- Could the scenario in the movie *Contagion* really happen?

HW: "Living in the Environment": reference Chapters 12, 13 and assigned chapter 17 Read pgs 439-447

Day 2 Data Collection/ PowerPoint 15 minutes What is an Emerging Pathogen and contagious disease? (students should take reference notes)

Handout #1 Community Outbreak History & Patient First Information (the patient information should vary from group to group) Read and locate the patient on the area map.

Exit ticket- What are our protections against contagious diseases?

Day 3 How are Pathogens transmitted? Power Point

How are these pathogens transmitted?

Is it environmental or an emerging pathogen?

Simulate an Epidemic/ How fast is person to person transmission- Class activity (NaOH & Phenolphthalein & disposable pipettes& 1.5ml tubes).

Handout #2 Stauffer Super Fund site information. EPA findings.

Exit ticket: How do you protect yourself from emerging pathogens?

HW: Emerging and Re-Emerging Pathogens spreadsheet of symptoms and causes for Investigative notebook.

Day 4 Lesson from Dengue Curriculum: What is Buzzing in Your Backyard? Lab 50 minutes

Handout #3 Dengue Fever.

Day 5 Web Quest <http://www.nature.com/scitable/spotlight/dengue-fever-15917128>

Complete Questions in group in Investigative Notebook

Day 6 Is it Toxic? Is it in the Water?

Water Testing continued from Chapter 13, Self Check- answer in Investigative Notebook

Handout #4 Data From EPA Stauffer Superfund site and students will use previous testing data.

HW: Pre- lab for next day, answer in Investigative notebooks.

Day 7-8 Is it in the water? Use group water samples.

Detecting Water Borne Pathogens Through Colorimetric Methods lab

Day 8 Outbreak! Source? E.coli0157:H7

Handout #5 Updated Patient Information

Day 9 Outbreak! Source? E.coli0157:H7

Day 10 Watch the video *Contagion*

Day 11 Medical Mystery of Epidemic Proportions-Cholera

Day 12 Medical Mystery of Epidemic Proportions-Cholera

Day 13 Dot Blot Lab Procedure, Confirmation of Patient Diagnosis and Pathogen Present in the community.

Handout #6 Updated Patient Information

Day 14-15 Conference Prepare for media presentation and Town hall meeting on **Day 16**, present your group's diagnosis and plan for eliminating the pathogen from the community.

Visit to South Cross Bayou Water Reclamation Facility: Field Trip

Forum Town Hall Meeting: Culminating Activity

Data collection technique and or student assessment.

- Pre and posttests. Ch 13 & 17 Exam
- PowerPoint and "press release" from each team after presentation to whole class describing the illness their patients has, its causes, symptoms and treatments. Must use 1 science journal as reference with a short presentation summary in their PowerPoint. There will be several different patients.
- Investigative Notebook- group notebook with grading rubric containing maps, testing results, patient information, historical epidemic information, contagious disease criteria, etc.
- Lab observation rubric- for teacher observation.

ICORE summer institute elements specifically included:

Topics:

In the air-Mosquito and Fly Research Unit- Dr. Connolly for mosquito disease transmission and identification, arboviruses, Malaria

In the water-Dr. Johnson- Emerging Pathogens Institute- Vibrio

Labs/ Activities: Designer Plates- to train students., Dengue Curriculum, Medical Mystery of Epidemic Proportions, Outbreak, Dr. Lawrence's Water Microarray Simulation Kit, Mosquito ID, Detecting water-borne pathogens through Colorimetric methods, and Contagion- Dot Blot- Self created with instructions from Drew Joseph, Charles Lawrence, Ph.D., and Houda Darwiche, Ph.D. – Dot Blot, ELISA and Microarrays.

In Comparison:

In the previous year, the unit Water Quality was limited to class room lecture and the testing of the water quality in the school's retention pond and the student's individual Eco-column without any reference to pathogens or community components. After attending ICORE summer workshop in 2012, I am better prepared to teach a student active inquiry based unit, including components, such as the study and identification of mosquitoes, which I never would have considered including before. I will be using many new labs and simulations while creating a relevant case study model for studying water quality

Literature cited:

Herreid, Schiller, & Herreid, Science Stories: Using Case Studies to Teach Critical Thinking, NSTA Press, 2012

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Miller & Spoolman, Living in the Environment, 16th ed., Brooks/Cole Cengage Learning

Public Health Reports, Volume23, May 22, 1908

Dengue Curriculum, Julie Boker, University of Florida, CPET

What You Need to Know About Infectious Disease, National Academies Press at http://www.nap.edu/catalog.php?record_id=13006e

Lawrence, Charles D., MPH, Ph.D., Emerging Pathogens, University of Florida, CPET

<http://ocp.hul.harvard.edu/contagion/http>

5E Science Daily Lesson Plan

Detecting Water Borne Pathogens through Colorimetric Methods

Lesson Planning

Benchmark(s)/Standard(s): *What is the next benchmark(s) on my course curriculum guide or FCIM calendar?*

SC.912.L.14.6 Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspective of both individuals and public health.

Essential Question(s): *How will I reword the lesson objective(s) into a question(s) using student friendly terms?*

What disease pathogens are present in our community's water?

Materials/Resources: *What do I have or need to teach this lesson objective(s)?*

Pre Assignments:

1. Group water samples- Use an unopened commercially prepared water bottle which is assumed sterile before opening, empty the contents- do not drink from bottle- into a clean reusable water bottle and consume. Label with group name, letter, date of collection, site of collection. Need at least 3.

2) Pre lab Assignment- see six questions in notes at end- assigned at end of day 6, to be completed in Investigative Notebook, prior to start of lab.

Water Quality Testing: Detection of Coliforms and *E. coli* using colorimetric reagents- lab instructions

Edvotek Kit 951

Lab Materials:

Each group requires the following:

- Tube of coliform detection broth (7 ml)
- Sterile water for negative control (1 ml)
- Control for coliforms sample (1 ml)
- Control *E. coli* sample (1 ml)
- Water sample from the environment (~3 samples) these were collected by at specific test sites and are the samples for their part of the case study.
- 6 screwtop tubes
- 6 sterile pipets
- Indole reagent (100 μ l) and sterile pipet
- Safety goggles

- Disposable gloves

Incubator/ Sterile water/ Investigative group notebook with map of Anclotte River Basin.

Lesson Agenda: *How will I deliver this lesson to help my students answer the essential question(s)?*

- Day 7 –
 1. **Engage:** provide each investigative group with a copy of the lab , show photos of TS Debby flooding the community , short discussion of pre lab assignment to indicate if students have come prepared.
 2. **Explore:** Begin Lab Water Quality Testing: Detection of *Coliforms* and *E. coli* using colorimetric reagents- Set up 6 test tubes, per instructions. Make a prediction- which will turn blue and which will fluoresce? Place in incubator for overnight. Clean up and set aside to read the results tomorrow.
 3. **HW:** Research Internet- Find two documented examples of *E.Coli* or *Coliform* recent contamination of local waters.
- Day 8 –
 1. **Explore:** Continue/Finish Lab/ Read and record the results , determine if *E.Coli* or *Coliform* are present. Place result on map of Anclotte River Basin.
 2. **HW:** Research- what are the symptoms of exposure to *E.Coli* and *Coliform*? How do we control these pathogens in our water supply? (in Investigative Notebook)

Engage: *How will I motivate students with a “hook” and a link to prior knowledge in order to introduce a new concept?*

Use the context of our case study for relevance and view photos of the recent TS Debby flooding.

Explore: *How will I provide hands-on experience for my students to build common background knowledge and begin to develop their own understanding?*

Water Quality Testing: Detection of Coliforms and *E. coli* using colorimetric reagents- lab procedure.

Explain: *How will my students receive scientific explanations and definitions of key vocabulary for what they have explored?*

Reading the lab procedure and background , student research , case study

Elaborate: *How will I provide my students with the opportunity to elaborate on their understanding of a concept by applying what they have learned or exploring further?*

End of unit Conference and Town Hall.

Closure/Summarizer: *How will I help my students reflect on the key ideas they have learned during the lesson and answer the Essential Question?*

Culminating Activity: Town Hall presentation

Evaluate: *How will I know if my students can answer the essential question(s)? How will I incorporate Checks for Understanding throughout the lesson?*

Observation by teacher- lab group rubric check list. Unit assessment after culminating activity: Conference/ Town Hall presentation and discussion.

Notes: This lesson plan is only a portion of the unit interactive case study, Past and Present- Is It In the Air or Water? A

Historical and Modern Look at Disease Pathogens in a Florida Port Town, gradually releasing information and guided inquiry for students.

Pre Lab Assignment – Day 6

Include the following question answers from the lab information in the group’s Investigative Notebook, to build information for the culminating Conference and Town Meeting presentation:

1. What are the major causes of water pollution?
2. How do contaminants enter a community’s water system? Consider recent environmental influences.
3. What are the EPA guidelines to protect our drinking water? List 4.
4. Explain non point pollution and give examples.
5. Explain the role of *Cyanobacteria* as an indicator of water quality.
6. Summarize the design of this lab. State the safety concerns.

Budget and budget justification: \$200

Item	Company	Unit Cost	Extension	Ship	Total	
Detecting water-borne pathogens through colormetric methods	UFL Eq. Locker	\$20.00			\$20	
Gel Electrophoresis- E-Gel	UFL Eq. Locker	\$183.00			\$183	2 classes