

## **Lesson Plan for Rainbow Springs Water Quality Research Project – Mr. Rudy – Semester 1 - 2013**

### **Lesson Objective:**

*To provide an opportunity for students to actively participate individually, as a team, and on a common class project, incorporating academic research, classroom education, field research, laboratory skills at U- ICORE and construction of project media with data analysis report to model the experiences of the students project for presentation at environmental awareness events in Marion County in the Spring of 2014.*

### **1. Educational enrichment at Vanguard HS will include Units on: August 16, 2013 – November 1, 2013**

- a) Cell Structure and Function
- b) Bacteria and Viruses
- c) Scientific Process, laboratory procedure and safety
- d) Molecular Biology

### **2. Field Trip to Rainbow Springs State park, Rainbow Springs, Florida - (October 1-October 14)**

- a) Water samples will be taken from 4 locations ( in shallow water less than 6 inches in depth, water from both sides of the river and in slow and fast moving water) The students will make observations, generate questions and develop a hypothesis about the health of the Rainbow River.
- b) Aquatic plant samples will be taken at the same locations.
- c) Samples location and conditions data will be recorded for location, depth, clarity of water and temperature of water.
- d) Samples will be collected in screw top tubes by submerging the tube into the water.
- e) Plant samples will be cut using scissors to cut an approximately ½" sq. leaf sample.
- f) Samples will be stored in a refrigerator.
- g) Samples will be tested for Escherichia coli and coliform bacteria at Vanguard HS between October 14<sup>th</sup> and 25<sup>th</sup>.
- h) Aliquots will be sent to Dr. Chen at the Mass Spectrophotometry Lab at UF in Gainesville for Mass Spec analysis of proteins present.

### **3. Students will travel to UF-ICORE (between 11/4/13 and 15/13)**

- a) Students will perform protein gel electrophoresis technique to detect bacteria in the samples with the ICORE staff.
- b) The students will take a tour of the Mass Spec lab to understand what mass spectrophotometry does, how it is done and what information and data it provides.
- c) Upon complete of collection of samples, testing of samples and data collections, students will analysis the data and compare the data with their hypothesis to make their final conclusions.
- d) Project inquiry reports will be filled in and completed by 12/1/13.
- e) Posters modeling the project and the data analysis from the project will be completed by December 15<sup>th</sup>, 2013.

## ICORE Action Plan

Michael E. Rudy

### Title:

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**Abstract:** Students will be tasked to engage in background research on Emerging Pathogens. Research will include internet, academic, government and industry websites.

The class will make 2 field trips. The first field study will be to the Rainbow Springs State Park, in Dunnellon. They will record longitude and latitude coordinates using Argis GPS mapping software. Temperature and visual observations of the water will be recorded. Observations at sample sites will be made of the aquatic and terrestrial areas. The second field trip will be to University of Florida ICORE laboratory. In class at Vanguard, the samples will be tested by the students using Colorimetric Reactions to detect E. coli and coliform bacteria (Escherichia coli and Citrobacter freundii) present in the water samples. Protein extraction, protein gel electrophoresis will be performed by the students to identify proteins from the bacteria.

The final stage of the project will back at Vanguard HS. A data table, bar and linear graph will be constructed for comparing the presence of E.coli, Citrobacteria or both at various samples sites on the Rainbow River.

### Rationale:

This project provides multi-faceted activities and avenues to address Common Core and Biology NGSSS for my 10<sup>th</sup> grade students. Students will be exposed to local, current environmental concerns of contaminated natural springs in Marion County. This supports a statewide concern that impacts our state economically and culturally. The project provides an opportunity to see biology in action with hands on experience with biotechnology equipment, reagents and experimentation. This further exposes the students to a wide variety of career paths in the future within biology. The process incorporates interdisciplinary sciences and language skills which are part of the educational movement toward common core. Due to the nature and scope of this study I expect it to be enthusiastically embraced by the school and district administration

### References Cited:

Robert Swett, PhD. Associate Professor, University of Florida, Gainesville, FL, Department of Fisheries and Aquatic Sciences, ICORE 2013.

Benskin, Jonathan. "Student Bacterial Protein Extraction Protocol" In Draft 06/2013.

Chen, Sixue, PhD. Proteomics Module: Protein Extraction, separation, and identification" UF-CPET. ICORE 06/2013

### Teaching Module Description:

This aquatic bacterial project will span a 6-7 week period. It will begin after Labor Day and conclude the end of October. Key themes that will be focused on include the scientific process, cell structure, prokaryotes vs. eukaryotes, pathogens, molecular biology and ecology.

**Common Core Standards:**

**READING**

LACC.910.RST.3

LACC.910.RST.5

LACC.910.RST.7

LACC.910.RST.8

LACC.910.RST.10

**WRITING**

LACC.910.RST.1

LACC.910.RST.2

LACC.910.RST.5

LACC.910.RST.6

LACC.910.RST.7

LACC.910.RST.8

LACC.910.RST.9

LACC.910.RST.10

**MATH**

MACC.912.F.ID.3.7

MACC.912.N.Q.1.1

MACC.912.N.Q.1.3

**FLORIDA NGSSS – Nature of Science (FCA #1 - 4/5)**

SC.912.n.1.1

SC.912.N.1.3

SC.912.N.1.4

**FLORIDA NGSSS - Properties of Water (FCA#2 – 5/10/)**

SC.912.L.18.12

**FLORIDA NGSSS - Cell Structure and Function**

SC.912.L.14.3

SC.912.L.14.52

SC.912.L.14.6

SC.912.L.16.10

**FLORIDA NGSSS - Molecular Biology**

SC.912.L.15.1

**Learning Outcomes:**

1. Students will be able to conduct a completed lab investigation implementing the scientific process with the final report being 80% accurate in format.
2. Students will be able to differentiate between contaminated and non-contaminated water by identifying E. coli and coliform bacteria with Colorimetric Reactions, PCR and electrophoresis techniques.
3. The student will be able to independently operate and perform protein extraction, protein gel electrophoresis at the ICORE lab at UF. Samples will be sent to Dr. Chen for mass spectrophotometry prior to arriving at UF. Students will visit the mass spec lab to observe the mass spectrophotometer. A brief explanation on how the sample results were obtained by mass spec will be presented.
4. The student will be able to construct a linear graph, bar graph using the data collected to compare types of contamination at sample locations in the Rainbow River and Silver Springs.
5. The student will be able to use the data collected and graphic models to analyze and interpret the data for presentation to an audience.

6. The student will be able to predict expected outcomes and form conclusions from the data collected and analysis performed.

#### **Activities Used to Produce Learning Outcomes**

1. Giant microbe activity.
2. Classzone.com – Electrophoresis Virtual Lab Simulation
3. Web quest – Internet research on electrophoresis technology, protein extraction and water contamination in Silver Springs and Florida aquifer springs system.
4. ArcGIS GPS Mapping
5. Water Sampling and Data Recording
6. Small Group Interactive Discussions and Class Interactive Discussion
7. ArcGIS GPS mapping activity to plot water samples at specific sample sites.
8. Coliform Calamity / Coliform Conundrum Lab
9. Water temperature measurements at each sample site on the rivers.
10. Inoculate and incubate Petri dishes to grow bacteria. (E. coli, C. freudii)
11. Colorimetric Reaction lab. (Coliform Conundrum)
12. Protein extraction and protein gel electrophoresis techniques at UF.

#### **Project content techniques and student assessment:**

1. Students will take a pre-test to measure level of prior knowledge.
2. Class presentation and post Interaction within small group and teacher and class and teacher.
3. Project poster and lab report with data analysis, conclusions and predicted outcomes.
4. Post examination – 2 parts oral and written.

#### **UF Campus Visit**

1. Colorimetric Reactions
2. Protein extraction
3. PCR
4. Protein Electrophoresis
5. Tour of Research Laboratories

#### **ICORE Summer Institute Emerging Pathogen Connections (UF Connections)**

1. Dr. Morris's "Age of Pandemics" presentation.
2. Coliform calamity
3. Proteomics in the Classroom, Protein extraction – Jonathan Benskin, PhD CPET Curriculum Fellow
4. Dr. Sinxue Chen, PhD, "Omics of proteins" presentation.
5. Dengue Dilemma

#### **New Pedagogies:**

In the past lessons lacked significant hands on activities for a variety of reasons. Labs were done virtually on the class computers. The opportunity to do a field study and test sample materials in the ICORE lab and tour the Proteomic and Genomic Core facilities exposes my students to the opportunities available in the biotech industry.

## BUDGET

University of Florida ICORE visit will include 32 students – 8 groups of 8 students

1. Collection Sample tubes – 15ml screw cap tubes - CPET provides at cost of **\$10.00**

2. Colorimetric Reagent for Coliform Calamity Lab Investigation - from CPET – 3 classes - \$20.00/classes - **\$60.00** total cost.

3. Protein Extraction Activity – CPET will provide (Escherichia coli, Citrobacter freundii, and four other bacterial samples) Lysis Buffer, Running Buffer and Coomassie Stain - **\$50.00** for 30 students UF lab visit

4. Gel Protein Electrophoresis - \$12.00/gel – 1 gel for each group - \$12.00 x 8 groups = **\$96.00**

5. Dengue Dilemma Simulation at Vanguard HS - \$0.00

6. Cost Summary:

\$10.00- 15ml screw cap tubes

\$60.00 – Colorimetric Reagent Lab

\$50.00 – Protein Extraction Lab

\$96.00 - Gel Protein Electrophoresis

\$216.00

**Reagents and Consumables to be supplied by UF - ICORE**