ICORE Final Action Proposal

Comparison of Coliform Bacteria Levels with Respect to Drainage Basin Characteristics and Meteorological Data

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Abstract

The drainage basin of the St. Lucie River in Martin and St. Lucie Counties has been greatly modified in one of its two major branches to allow for flood control and greatly expanded land usage for agriculture and residential use. One effect of these modifications has been repeated eutrophication events often in conjunction with high coliform bacterial counts. The aim of this project would be to use coliform detection broth to test for the presence of both total coliform and E.coli bacteria. The north fork runs predominantly through residential land and the south fork runs through predominantly agricultural land and so for different reasons might both be subject to contamination by coliform bacteria, but of potentially differing strains. Samples would be taken during the rainy season and coliform counts would be compared to meteorological data.

Rationale

Port St. Lucie is populated by a great many students who have moved here from areas of the northeastern United States, live in newly erected suburban settings, and, as a consequence, have little knowledge of, or empathy for, their local environment. Many of them, when asked, cannot name the river that flows through the county and gives it the name. The local landscape has been radically altered by human engineering to make it possible for them to live here, but most have not been around long enough to appreciate these changes or their unintended consequences. It is the intent of this project to give the students a deeper appreciation of the local environment and the possible effects to human and ecological health that have resulted from these anthropogenic changes. Some of these effects may be exacerbated by even broader scale anthropogenic changes, i.e., increased global warming could lead to an increase in number and severity of tropical weather events which in turn could lead to further contamination of the river system. By looking at the river system at the microbiological level and comparing any observed changes to broader scale meteorological data they may be able to make connections among a diversity of scientific and societal concerns.

Description of Teaching Unit, Data Collection, Assessments and Expected Outcomes

The project will necessarily cross curricular boundaries that would ordinarily be widely separated in scope and sequence, but the plan is to address this project in the IB Biology curriculum where a little more latitude is possible. It is a two year course that is not constrained by an EOC, so despite the fact that biotechnology would ordinarily be taught in the winter and Ecology in the spring,

the biotechnological and ecological concepts relevant to the project could be introduced concurrently with the necessary microbiological concepts.

- A pre-assessment of both content knowledge and outlook will be administered in early September.
- Two 90 minute class periods will be devoted to introducing the overall aims of the project and the historical background of the KOE (Kissimmee-Okeechobee-Everglades) water diversion projects and their relationship to the current environmental health of the St. Lucie River. Initial planning for sampling will also be done at this time.
- Coliform/E.coli testing methodology will be introduced at the curricular juncture of biochemistry and cells via lecture and lab activities.
- Sampling sites and schedule will be arranged around student residential and transportation patterns. Field GPS units will be used to plot exact lat/long data on topographic maps. The maps with GPS established lat/long data will be used in the final report to indicate location of the sampling sites.
- Once the methodology is established coliform broth assays can be performed quickly in class on a repeated basis. Colorimetric, fluorometric and indole red data will be recorded. All students will be required to maintain a lab journal and keep an ongoing record of all methodology and data.
- Weekly sampling will be maintained for eight weeks with the aim of spanning the statistical height of the hurricane season. Rainfall and temperature data will be researched and recorded for the duration of the project.
- Water sample volume will be calculated so that there is sufficient volume to do the coliform broth assays and keep the remainder at room temperature in anticipation of further analysis.
- There is reason to believe that E.coli from the south fork of the river would be animal in origin and that from the north fork human in origin due to differences in land use. To determine if this is the case PCR and gel electrophoresis technology would need to be carried out. Whether such an assay is possible in our high school laboratory setting is unlikely at this point due to concerns about live human pathogens, but attempts will be made to reach out to the U of Fla Agricultural Research laboratory in our county to see if our students could test our samples there.
- Each student will be expected to maintain a log of all methodology and all data points and will be expected to write up a formal report at the conclusion of the sampling regime.
- Students, as a group, will be given the choice of producing a poster or power point that delineates methodology, summarizes data in both written and graphic form, analyzes both data and methodology and draws conclusions.
- A post-assessment will be given to measure presumed increases in content knowledge and changes in affective outlook concerning local and global environmental issues.

<u>Use of Equipment lockers and/or classroom visit</u>.

I would need the Edvotek 951 kit material as early in September as possible. I anticipate a sampling regime of two samples at each of four sites taken weekly for eight weeks. Taking in to consideration the

negative and positive controls for the initial testing would require a minimum of 51.2 ml of coliform detection broth, a corresponding small quantity of indole red and approximately 75 2 ml screwtop tubes (smaller number if these can be cleaned and reused without compromising results). To account for spillage, mistakes and the possibility of significant rain event(s) occurring after the end of the eight week testing period I would think 60 ml of coliform detection broth would be prudent. As I move in to the year there may be other lockers I might want to borrow for other learning objectives, but the only material I need directly related to my action proposal would be the coliform broth with the colorimetric/fluorometric content and the indole red reagent that comes in the kit. As we discussed I would be willing to test out the Colilert kit but it is not critically necessary to my action proposal.

ICORE summer institute elements included

Water Quality testing: Detection of Coliforms and E. coli using Colorimetric reagents
Dr. Lawrence's Simulation protocols (ELISA and water microarray)

Differences from normal pedagogy

_I have taught IB Biology for the last two years. Part of the requirements of this program is that the students perform what are termed "Internal Assessments". These are glorified science fair projects and they are required to do a total of three of them. I make them do four of them because the first one is actually for the science fair in the fall of their junior year. I do this just to get them used to doing a proper laboratory research project. The ones that count are actually in the spring of their junior year, the summer between junior and senior years and fall of the senior year. The quality of the projects I have been getting has been very low from their first attempts because they don't know what they are doing despite many years of being required to do science fair projects. This action proposal would take the place of that first practice internal assessment and we would do it as a group so that I can model the elements of a properly conceived and executed research project. It is my sincere hope that this change in pedagogical practice will result in some lights going off in their heads and perhaps spark a little interest in the way science is supposed to be undertaken.

Literature Cited

www.**everglades**plan.org/docs/nieposter_front.pdf, *"Journey through the KOE watershed" South Florida Water Management District. Accessed 6/20/12*

http://www.sfwmd.gov/portal/page/portal, "Summary Highlights of St. Lucie River Watershed Protection Plan Update. *South Florida Water Management District. Accessed 6/20/12*

L S Warren, R E Benoit and J A Jessee Rapid enumeration of Fecal Coliforms in water by a colorimetric beta-galactosidase assay. Appl. Environ. Microbiol. **January 1978** vol. 35 no. 1 **136-141**

S.C. Apte, G.E. Batley, **Rapid detection of sewage contamination in marine waters using a fluorimetric assay of β-D-galactosidase activity, Science of The Total Environment,** Volume 141, Issues 1–3, 25 January 1994, Pages 175–180

Edvotek manual, Water Quality EDVO-Kit #951 Testing I: Detection of Coliforms and *E. coli*

using Colorimetric Reagents

Budget

The major expense would be sufficient coliform broth to test all the samples. This would require the equivalent of 7 EDVO-Kit @ $20.00 each for a total of $140.00. Since you are now making your own coliform broth this cost might actually be lower due to economies of scale. I will use the mini-grant for the required black light and any other incidentals.