Chris Ashley
RET 2008

Geo-environmental Engineering
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Civil and Environmental Engineering/CenSSIS
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Lab Description:

I am working with Susan Agger in Professor Alshawabkeh's geo-environmental lab. Susan and I were assigned to work with a new grad student named Laura who is visiting from Milan, Italy for one year. Our goal is to model contaminated groundwater in sand or silt and then measure the effect of running an electrical current through the groundwater. The purpose of running the current through the groundwater is to concentrate the contaminants (whatever they may be, such as cadmium, mercury, etc.) in one area so that the contaminated groundwater can be treated or cleaned.

We are modeling groundwater by saturating a sample of sand or silt in a waterproof "H"-shaped container, running a current through the soil, and measuring the change in voltage and electrical conductivity over time. We had as much as three "H" shaped containers up and running at one time.

Lesson Subject: Environmental Science **Lesson Length:** 90 minutes

Grade: High School senior elective course

Topic: Water Quality

MA State Standards: Earth and Space Science, High School

SIS1: Make observations, raise questions, and formulate hypotheses

- Observe the world from a scientific perspective
- Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge

SIS2: Analyze and interpret results of scientific investigations

- Present relationships between and among variables in appropriate forms
- Represent data and relationships between and among variables in charts and graphs
- Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis
- State questions raised by an experiment that may require further investigation

2008 AP Environmental Science Standards:

Section VI: 3 Water Pollution

Types; Sources, causes and effects, cultural eutrophication; groundwater pollution; maintaining water quality; water purification; sewage treatment, septic systems; Clean Water Act and other relevant laws

Essential Question: Is the Charles River at our field site polluted?

Connections to RET:

The basis of our research at Professor Alshawabkeh's lab is founded upon water pollution, specifically, groundwater pollution. We are trying to determine a more efficient, cost-effective means of extracting contaminated groundwater, specifically in silt or clay, for it to be treated. As part of our pollution unit in my environmental science elective course, we will study water pollution. This lesson will have students measure a number of parameters in the Charles River at the school's field site in Newton, Massachusetts. This enables me to connect sources of water pollution and how scientists determine whether or not water is polluted in my environmental science class.

Materials:

-Waterproof boots
-Ammonia test
-Conductivity meter
-Dissolved oxygen meter
-pH strips
-Thermometer
-Turbidity meter
-Lab notebook

Introduction to Lesson:

Prior to the lesson students will have studied nutrient cycles and the basics of the different sources of for each type of nutrient. This lesson will be the first lesson of the pollution unit. The day before the lab I will open up a class discussion by asking, "How do we know when water is polluted?" I anticipate that this should open up a lively discussion. Most students will know that there are certain "things" in the water that should not be there. I will ask the students to try to come up with a list of parameters we could test to determine if water is polluted. This list will be written on the board and the students will record it in their laboratory notebooks. After generating the list of parameters, I will inform the students that they will be testing the water quality at the field site and for homework they need to research the standards for our list of parameters to classify water as polluted or not.

Lesson Development:
Students will be recording a number of parameters at the field site. Below is a sample of what students will be given to help organize their data collection.

Name:_____ Date:_____ Time:_____

Current Weather Conditions(sunny, cloudy, rainy, etc.):_____
_____
Previous Day's Weather Conditions:_____
Estimated Wind Speed and Direction:_____
Air Temperature:_____ Surface Temperature of Water:_____
Ammonia Test Results:_____
Conductivity Reading:_____
Dissolved Oxygen Reading:_____
pH:_____
Turbidity:_____

General observations about conditions of river:(include comments on any trash, color of water, surrounding living organisms-including plants)_____
_____
_____
_____

Concluding the Lesson:
Before departing the field site students will write a brief reflection in their laboratory notebook. The students will be prompted to answer the following questions:

1. Were you prepared for today's lab? Is there anything you would have done differently to prepare?
2. What are your initial thoughts about the water quality of the Charles River at the field site?
3. Was there any part of the procedure or parameters you would change for today? Do you wish you had any additional tools/equipment?

Follow-up Assignment:
Students will record their findings in their laboratory notebooks and then use their data to answer the originally proposed question: "Is the Charles River at the field site polluted?" Prior to the field test, students will have written down a hypothesis as to whether or not they thought the river was polluted. They will submit a formal lab report with a title, introduction, hypothesis, methods, analysis, and discussion section. The students will be familiar with this format, as this will not be their first formal lab report.

Water Quality Lab Rubric

Rating Scale: 4=Excellent 3=Above Expectations 2=Meets Expectations 1=Below Expectations 0=Missing

Note that not all sections are worth the same number of points.

Section of Lab Report	Score	Comments
Title: Lab report has descriptive, creative title	3 2 1 0	
Hypothesis/Introduction: Clearly stated in the "if/then" or "cause/effect" format. Brief background knowledge is included regarding application of data and pollution of Charles River	3 2 1 0 2 1 0	
Methods & Materials: Methods provide a concise series of procedural steps that others could repeat. Standards for each parameter clearly indicated. Student used chemicals & equipment properly.	4 3 2 1 0 2 1 0 2 1 0	
Results: Clearly & concisely stated. Data Sheet completely & properly filled in. Graphs are included ***Graph Scoring Guide*** Title; independent on x & dependent on y axes; axes are labeled; appropriate interval on axes; legend included	4 3 2 1 0 3 2 1 0 4 3 2 1 0 4 3 2 1 0	
Discussion/Conclusion: There is a clear statement of whether or not the hypothesis was supported There is a summarization of trends or patterns in the data. Specific relevant data points are included. There is an explanation of how the trends or patterns support or refute the hypothesis. Possible sources of error are mentioned. What could be done to further clarify and support the results?	4 3 2 1 0 4 3 2 1 0 4 3 2 1 0 4 3 2 1 0 4 3 2 1 0	