

THE SETTING

Omaha

- The largest city in Nebraska (population ~825,000)
- The largest metropolitan center within 150 miles
- EPA Superfund site – lead contamination

The University of Nebraska at Omaha

- A metropolitan university
- Fall 2007 undergraduate enrollment – 12,127
- No graduate program in chemistry

PROBLEM STATEMENT

Students in introductory science courses, frequently gain very little practical understanding of the application of science to their lives, the interdisciplinary nature of science and the nature of scientific careers.

This is a problem for two reasons:

- First, these introductory courses are the only science courses that the vast majority of students take. Additionally, when choosing between introductory science courses, students gravitate toward reputedly less threatening courses, the majority of which don't have associated labs.
- Secondly, science-phobic students have negative attitudes toward science – apparently shaped in grade school at least in part by the students' exposure to science-phobic teachers. We need to confront these attitudes and poor understanding of science with more active, involving experiences in order to break this self-perpetuating cycle.

OUR GOAL

To provide opportunities for students to do science by integrating relevant, interdisciplinary, environmental research into our introductory geology and chemistry courses

- The primary objectives are to improve student
 - attitudes about science
 - understanding of the experimental nature of science
 - perceptions of the application of science and its interdisciplinary nature
- We also anticipate that this work will increase
 - the number of majors
 - student independence, responsibility, and self motivation
 - retention of students in partnering science courses

PROJECT STRUCTURE

Project 1: Drinking Water

Why?

- Much time an effort is spent every day by scientists to ensure its high quality.
- Its composition is variable: geology, location, delivery, time, etc.
- Omaha relies on multiple sources of drinking water

Project 2: Analysis of Lead in Soils

Why?

- Lead is toxic.
- ~14 square miles of land in/near Omaha has been contaminated with lead; including homes, schools and public parks
- There are multiple sources of lead contamination

What do the Geology students do?

- Collect samples – typically from their residences
- Study the chemical composition data
- Looking for geologic and geographic correlations

What do the Chemistry students do?

- Work in pairs/teams to analyze the sample composition
- Every chemistry student prepares a sample and uses the instrumentation
- Data analysis
 - Average replicate measurements
 - Make comparisons within the team/group and to control samples

Reciprocal Student Presentations

- Prepared by 8-10 volunteers separately from each class
- Provides for peer evaluation and feedback
- It allows students with strengths in communication (such as pre-service teachers) to participate more
- Increases student understanding, classroom participation and performance
- Required 10-12 hours of preparation

Vertical Integration

- Standards are run and instruments calibrated by upper level chemistry students - this information is shared with each chemistry lab section
- Students in Geochemistry class help students in introductory courses develop their understandings/presentations



Environmental Research Topics



Interdisciplinary Collaboration

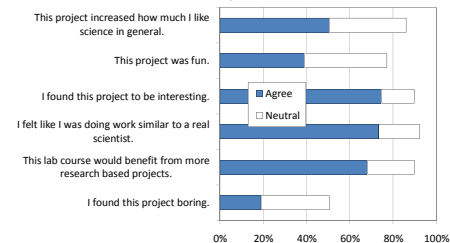


Advanced Instruments

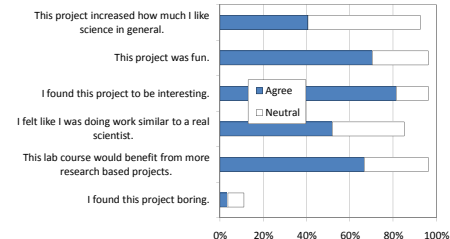


Introductory Science Courses

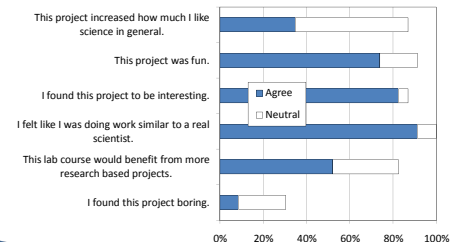
Chemistry Students



Geology Students



Education Students



STUDENT COMMENTS

Positives

- It was an experiment that directly related to me so it was more interesting
- Interaction with both classes
- Being able to connect the two sciences and to learn more things about each because otherwise we learned facts but not their significance.
- It gave me more perspective on what scientists actually do, it puts you in that position and makes you think about how important the job is.
- It was interesting to see the differences around town.

Negatives

- Presentation preparation too time consuming
- Presenting students learned a lot more about the research
 - "I think that a lot of people (not doing the presentation) missed out on a very important part of class."
- Needs to be made more clear why students are doing this project
- Risk of students perceiving this experiment as 'black box' work
 - "with the ion-o-meters, we squirted something into it and got a picture out of it...I had no clue."

PROJECT CHALLENGES

- Coordinating schedules of multiple courses and students volunteering to prepare presentations
- Maintaining effective communication between instructors & students
- Data collection and distribution (student buy-in and weather)
- Competition for classroom time

POSSIBLE FUTURE STUDENT RESEARCH

- Analysis of ceramic pottery shards excavated from Bethsaida, Israel
 - Traditionally analyzed by neutron activation, this type of analysis is now more commonly done by ICP-MS
- Phytoremediation studies and geochemical prospecting
 - Metal uptake by plants
 - Calibration of remote sensing data of plant uptake of toxic metals
- Acid and mineral analysis of rain water
- Geochemistry of existing sample suites

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