Final Report

Sharyl Majorski
Saginaw Chippewa Tribal College
Mount Pleasant, MI

How the grant was incorporated into the Chemistry 105 Curriculum:

The mini grant was extremely beneficial for incorporating an environmental component into the introductory chemistry laboratory curriculum. One of the things that the beginning chemistry class was lacking was a research component – this grant helped fill that void with the purchase of a HACH Phosphate Water Testing Kit along with a Nitrate Water Testing Kit. Students were able to conduct an actual research project that will continue for semesters to come. Although this was the first year of implementing such a project, it was met with such great success and enthusiasm that it will be a definite project in the future as well. The research project looks to determine if the North Branch of the Chippewa River negatively impacts the main branch of the Chippewa River in regards to nitrates and phosphates. This is a real concern in mid-Michigan with there being much agricultural land along both sides of the North Branch. Residents fear that the fertilizers and animal manure may be getting into the water and causing problems since the water is noticeably murkier after the North Branch converges into the main branch of the Chippewa River. Incorporated into the lesson is the value of sustainability of our fresh water supply. Being located in Central Michigan, home of the largest fresh water supply, the grant allowed fellow Michigan residents (the students at SCTC) to take an active role in the importance of monitoring the natural fresh water supply for such things as nitrates and phosphates. The water analysis included both lecture and hands-on experimentation for the project. An emphasis was placed on nitrates, in particular, with the potential health hazard of methemoglobinemia that could ultimately take the life of an infant if found in high enough concentrations within the drinking water.

Research Project CHEM 105 – Fall 2009

The project began with a pre-test to determine what, if any, was the background of knowledge that the students had. Results averaged to be a 40% with students not knowing most of the answers. There were pH calculation problems as well as definitions of things such as alkalinity, hardness, buffers, etc.

Having quickly evaluated the pre-test results, it was decided to begin at a very basic level. Hence, the initial lecture was on the basics of chemistry of water and the importance of knowing what is in water. It was during this time that pH was covered as well as nitrates, phosphates, dissolved oxygen, hardness, alkalinity and carbon dioxide. Acid rain was also discussed in lecture, as was the ways that waterways could become more acidic. It was also during this time that the students were posed with the research problem and were asked to identify sites to be tested. A Mount Pleasant, MI map was provided to the students and the general feeling of the class was to test the water before the North Branch, along the North Branch and downstream from where the North Branch meets the Main Branch of the Chippewa River.

The initial laboratory session started with the learning of the basic instrumentation by simply using tap water. As students became proficient with the laboratory techniques, they were then able to sample the "real" water samples that had been obtained from the various sites. Over the course of the 3-week project, students ran 9 tests for each site. This included 3 tests on the near side of the shore for testing, 3 tests from the center of the river and 3 tests from the far side of the shore. Students correctly hypothesized that the highest phosphate and nitrate levels would be along the shorelines of the North Branch (the shorelines next to farmland). Although nitrate and phosphate levels were higher in the North Branch, the levels quickly dropped when the main branch was tested. The students analyzed the data and had to come up with a way to report their findings. It was decided that a good way to present data was to write a short research report as well as present a poster on the findings at the Saginaw Chippewa Tribal College Assessment Conference at the end of the semester. For most of the students, this was their first scientific paper to be written. It was the first time any of them had used Excel for graphing. One of the students commented: "Wow, I never knew how helpful a computer could be, graphing is so cool and easy with it. I just want to get a computer now. I used to think they were just a waste of money – not any more!"

A clip from the CHEM 105 Syllabus showing where the project fit into the semester:

November 5 Pre-Test on Water Analysis,
Not in Lab Manual: Water Analysis of the Chippewa River

Week 11: Read Handouts

November 10 **Exam 3,** Acids & Bases and Salts, Acid Rain

November 12 Not in Lab Manual: Water Analysis of the Chippewa River

Week 12: Read Chapter 12

November 17 Kinetic Molecular Theory, Properties of Condensed States, Surface Tension, Viscosity

November 19 Not in Lab Manual: Water Analysis of the Chippewa River

Week 13: Read Chapter 9, 10

November 24 Presenting Scientific Research, Design of a Poster,
Post Test on Water Analysis

November 26 Thanksgiving Recess

Week 14: Work on Project.

December 1 Work on Final Project for Assessment Fair and Review for Final Exam☺

December 3 Assessment Fair

Week 15: Study for final exam.

The post-test proved that the students had indeed learned much from the experience with the average score being a 94% overall. It should be noted that the class size was very small and may change in different semesters when the classes change.

An explanation (if applicable) of how the mini-grant funds contributed to your project:

The mini-grant contributed greatly to the mini-research project by allowing the purchase of the HACH Phosphate Testing Kit and the HACH Nitrate Testing Kit. Although the purchases did not arrive when we needed them, I was able to borrow the supplies and reagents from a nearby university and will be able to pay them back when the supplies come in. We have a lot of red tape to go through when ordering supplies at our school but are expecting the materials any day! The local university was able to help us out this year. Our kits will actually be much nicer than what we borrowed. We are getting digital kits while the ones we borrowed were analog (and very old). We still did appreciate being able to borrow them though☺.

The number of faculty who benefitted (either through participation or by receiving a description of your project for their own use)

Although I was the only faculty to benefit thus far, in future semesters the kits will be quite heavily used (again, this is because they took forever to arrive). They will also be used in the Environmental Science Class, in a math class (for statistics) and during a Summer Enrichment Program for Native American Youth. It is estimated that 30-50 students will use the kit a year. The chemistry class this year was extremely small with only 4 students in the class, in part since there were a lot of people in last year's class. Typically, there are about 12 in a class. The environmental science class typically has about 12 students a semester as well. They will be using the kits in the spring 2010 semester as well as in future semesters.

A summary of the overall results (did students seem to take a lot out of the material, will you be able to refine/expand the project for future use, etc):

Overall, they mini-research project was a great success. Not only did students enjoy using the kits, they enjoyed seeing a practical side to what they were learning in the classroom. The fact that it was a "real research project" made them feel that their data mattered. I noticed that students were much more focused on getting accurate data rather than trying to rush through. They also took great pride in recording their data. It was nice to see them so concerned when nitrate values looked high along the banks. I had to remind them that the water there wasn't drinking water and had to go through the ground, which would filter ions out. They took a lot of pride in conducting the project and were eager to learn how to present their findings. I was surprised to see how little the class knew in report writing. I felt this too was a great thing to put in the curriculum (although

at the beginning I had no idea they had never written reports). Most of my students had not graduated from high school rather they had received their high school equivalency through testing. The computer usage for both writing the report and for graphing the data was extremely valuable for the students. Simply put, they were amazed at what a computer could do and how easy it was to do it. The mini-research project will definitely be used in future classes. As soon as the semester is over, I will look over the papers and refine the project for future classes.

Assessment of the Research Project:

A pre-test and a post-test were given on water analysis. The scores went from a 40% to a 94% for the same test with only a couple of questions changed. Students were NOT given the original tests back so that they would not just study from it. Questions ranged from pH calculations to how to set up a research project and what the implications from high nitrates in the water are.

Student Opinion Surveys reflected that the students really enjoyed the research aspect and that they had to somewhat plan what was done. The laboratory experiments were not all spelled out for them and they had to think for themselves. They strongly favored more experiments like it but felt the basic cookbook type of experiments were also critical for learning some of the basics such as measurement.

The grading rubric for the written report is included:

Written report with cover sheet:

Name:

Title: *What is the effect of the North Branch on the main branch of the Chippewa River?*

I. Introduction (5 pts)

A. Statement of Problem
B. Variables studying and possible effects

II. Site Description (2 pts)

A. Pictures and Maps
B. May use materials from library and/or internet to mark where sampled water

III. Methods (5 pts)

A. Detailed information on how you did sampling
B. Detailed information on equipment used

IV. Results (5 pts)

A. Data
B. Graphs
C. Tables

V. Discussion (4 pts)

A. Comparison of sites
B. Comparison of other sites (use books, internet, people)

VI. Sources of Error (2 pts)

VII. Conclusion – Summary (5 pts)

A. Briefly restate why analysis was done
B. Indicate variables and impact
C. Recap data and comparisons
D. Draw conclusions!

VIII. References (2 pts)

A. Class notes
B. Books
C. Internet sites