

Reform of Introductory Science Courses for Non-Majors - Interim Report
Development and Implementation of Laboratory Modules to Accompany

Introduction to Environmental Chemistry

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Institution: Davidson College

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Amount Awarded: \$12,200

Original Goals and Objectives:

Goal: The goal of this project is to develop laboratory modules to accompany an introductory environmental chemistry course. These modules will provide students with exposure to the scientific method by presenting them with a question in an applied context, the analytical tools to obtain information useful in addressing the question and the challenge of drawing a conclusion based on the data obtained, where there is no right or known answer.

Objectives:

1. To develop hands-on activities in environmental sampling of air, water and soil.
2. To provide experience with laboratory techniques including gravimetric, titrimetric, spectroscopic, separations and electrochemical methods.
3. To develop students ability to analyze and interpret data.
4. To provide an opportunity to evaluate results in the context of a larger issue.
5. To encourage presentation of results to a general audience.

No changes have been made to or are anticipated for these goals and objectives.

In the first month of the project period, supplies were inventoried and necessary materials were ordered (as indicated in the budget report). The department additionally purchased an analytical balance and spectrometer for the laboratory. Katherine Cox, the student intern, and I spent five weeks working through the proposed laboratory experiments, simultaneously writing the first draft of the laboratory manual as well as preparing supply lists and prep sheets for each experiment. Only minor unanticipated problems were encountered in a few of the proposed experiments. The particulate collection was not successful due to filter pore size. Smaller pore sizes are not possible with the current equipment. I am exploring alternative options to be used with the air sampling pumps. A particulate collection and measurement exercise will, moreover, not require a full laboratory period. I have therefore decided to include a separations experiment: paper chromatography of dyes in food coloring. This experiment will be valuable in illustrating the theory of an important environmental analysis tool. Additionally, due to low concentrations of iron in the natural water samples in Davidson, I am replacing the quantitative spectroscopic determination of iron with quantitative spectroscopic determination of NO_x in air using passive air samplers. These samplers and the corresponding method have been used in an ongoing study of air pollutants by independent study students in my laboratory. The passive sampler is loaded with pretreated filters, mounted at the sampling site and retrieved at a predetermined time. The filters are extracted, treated with a color-producing agent and analyzed using visible spectroscopy. Standard preparation and calibration will be necessary.

We concluded our summer activities with tours to McGuire Nuclear Power Plant and Marshall Steam Station. Although each of these tours was educational and interesting, we decided that only McGuire would remain on the schedule. In addition to the Power Plant, the McGuire site also offers an Energy Explorium, Hydroelectric Dam and Environmental Laboratory. I am exploring the possibility of a guest lecture by a Duke Energy chemical engineer who would be able to talk about the scrubber technologies currently being employed at the Steam Station. Katherine has agreed to act as a teaching assistant for the course next semester. If the department is unable to cover this expense, I would like to cover with grant funds.

With many thanks to the ACS and Keck Foundation, I was able to attend the NSF Summer Workshop at Governors State University: "New approaches and techniques for teaching science: addressing environmental problems to stimulate undergraduate learning." This workshop proved to be an excellent professional development opportunity to converse with other faculty teaching similar courses across multiple disciplines. I was introduced to biological methods utilized in evaluating water quality, which were previously unfamiliar to me. Most useful in the developing course will be 3M Petrifilms; self-adhesive user-friendly Petri dishes. Discussions regarding assessment and introduction to available tools are proving to be of great value as I approach the assessment development phase of the project.

I am currently involved in finalizing the laboratory manual. Over the next couple of weeks, final supply/equipment orders will be submitted. In the spirit of an environmental course and saving paper, the laboratory modules will remain the property of the department and utilized each year. Grant funds will be used to purchase three ring binders with dividers (~200.00) and double-sided printing will be used. Experiments will be available electronically via the website for students interested in obtaining individual copies.

Finally, in the immediate future I will be applying for IRB approval for the use of the Science and Math Values Inventory and an environmental chemistry awareness survey.

BUDGET

				Approved	To Date	Pending
Laboratory Supplies				\$4100.00		
<i>Module 1: The Atmosphere</i>				<i>\$1300.00</i>		
Air Sampling Pump			\$500.00		0	2@510.0 + Impinger
Particulate Sampler			\$400.00		0	Obtaining estimates
pH probes – also needed for Module 2	8	\$50.00	\$400.00		49.68	350.00
<i>Module 2: The Hydrosphere</i>				<i>\$2000.00</i>		
Wet Chemical Analysis Kits			\$300.00		299.70	
Ion Exchange Resin			\$100.00		103.93	
Spectrophotometers or Colorimeters	2	\$800.00	\$1600.00		0	
*Water Purification materials (coffee grounds, mineral oil, garlic powder...)					20.00	
<i>Module 3: The Geosphere</i>				<i>\$300.00</i>		
Soil Analysis Kits			\$300.00		313.24	Sampler, Seives,
*Soil Thermometer					5.09	Therm. 55.00
<i>Module 4: The Biosphere</i>				<i>\$200.00</i>		
Brine Shrimp Bioassays			\$100.00		49.38	
Cysts, food, tank and aquarium pump						
Insecticide, Remediation Supplies			\$100.00		17.11	Anticipated
<i>Module 5: Energy</i>				<i>\$300.00</i>		
Fuel Burners	8	\$25.00	\$200.00		0	100.00
Voltmeters	8	\$12.50	\$100.00		20.00	120.00
*Other equipment for electrochemistry experiments (sand paper, alligator clips, batteries...)					14.05	

*Exploratory Field Trip Lunch			32.41	
Personnel		\$6800		
Student Intern Stipend, FICA and Housing allowance - Five weeks summer 2006	\$2300		2310.48	
Faculty Stipend - five weeks mentoring plus three weeks finalizing	\$4500		4500.00 100 [†]	
Travel		\$1300		
National Science Foundation Summer Workshop at Governors State University June 2006 Airfare and Ground Transportation	\$250		285.60	
*ACS Fall Workshop			35.03	
Student Intern presentation North Carolina Academy of Science Meeting Spring 2007 – East Carolina University	\$300		0	
American Chemical Society National Meeting Fall 2007 – Boston, MA Airfare, Ground Transportation, Lodging, Food and Registration	\$750			Will likely attend SERMACS instead.
Total Amount Requested		12,200.00	8150.00	4050.00

*Items not anticipated in original budget.

[†]Looking into the source of this charge.