

Undergraduate Environmental Technology Instrumentation Project: Analyzing the Cape Cod Aquifer

**Douglas W. Bill, Mary Jane Curran, and Catherine M. Etter
Cape Cod Community College at West Barnstable, MA**

Abstract

The NSF instrumentation grant has enabled Cape Cod Community College to purchase one ion chromatograph and seven groundwater simulators that have been implemented into the Spring/Fall 2000 environmental and soil science lectures and lab exercises. We have just begun to collect and analyze the student responses after using this equipment during these classes. Over 200 students have used the ion chromatograph. Over 50 students have used the groundwater simulators. The instructors and students have learned a lot from the experience. However, we have many suggestions for improvement in student instrumentation activities. Modifications to the lab exercises have improved instrumentation usage and student knowledge, skills, and problem solving abilities. Community projects have used this instrumentation too. Community pollution concerns are being investigated with this instrumentation. Local employers have requested students trained with this instrumentation to apply for employment. High school students, college students and high school teachers view groundwater plume demonstrations and water analyses on this instrumentation. This instrumentation will continue to enhance our student's learning experience, improve student employment opportunities, and benefit our community water monitoring programs for many years to come.

Introduction

Cape Cod Community College (CCCC) is located in a unique environment where students can observe the interaction of the geosphere, hydrosphere, atmosphere and biosphere. This project sought to address the hydrologic boundaries of the Cape and to point out the sensitivities associated with the Cape's sole source aquifer now threatened by the pollution discovered at the Massachusetts Military Reservation, (MMR), a SuperFund site located on Cape Cod. CCCC and two neighboring MA institutions have led the charge to develop an education program which includes degree options, certificate programs and internships to prepare students for jobs at the MMR and other Cape locations.

The acquisition of seven Groundwater Simulators III (GSIII) to be used in two courses gives small teams of students a rigorous, hands-on experience in science in conjunction with a local perspective as to how the sole source aquifer has been impacted by the conditions at the nearby Superfund site. Science, math and technology concepts are introduced by examining current

issues for which students have some personal context. The GS-III is used to illustrate surface and groundwater flow conditions. Students actually see the effects from precipitation, surface runoff and infiltration. They observe the vertical and horizontal migration of groundwater through a porous medium. They are able to differentiate recharge and discharge zones as water is introduced to the system. The GS-III is also used to identify and illustrate many different groundwater flow concepts, usually invisible to the student because they occur beneath the surface layer. Students observe the effects of gravity and hydraulic pressure when a dye is introduced to the system. They better understand porosity and permeability, when flow rates through varied soil types are compared. Students observe underground obstructions which retard, restrict, or change the direction of flow. This particular groundwater simulator also illustrates the difference between an unconfined aquifer and a confined aquifer. In determining flow rates, the International System is used in conjunction with simple algebraic formulas. These flow rates vary depending on which of three different soil types are used (fine, medium and coarse grain sand), on the recharge rate, or both.

The addition of the Ion Chromatograph (IC) allows upper level students to train on three different pieces of state-of-the-art instrumentation, (Spec 20 and UV/VIS are already used) and compare the results from these different instruments. Students analyze samples for the same compounds using the three different instruments comparing procedures, interferences, method limitations, detection limits, and different operating principles. In addition to the comparisons and training in operation of all three instruments, the ion chromatography enables students to analyze compounds, such as Fluoride and Bromide, for which students cannot test with pre-existing equipment and within current laboratory time constraints. Acquisition of the ion chromatograph has permitted students to use smaller sample sizes and less chemical reactions, thus reducing laboratory waste generated by other current methods. The IC allows students to collect and manipulate instrument data via an interface to a Windows-based computer. The implementation of EPA Method 300 for the IC will expose students to relevant and accepted workplace practices. Most laboratories on Cape Cod use the IC for water analysis. Instructors currently use all of these instruments in the Environmental Science classes and the Environmental Instrumentation course.

These powerful hands-on instrumentation experiences stimulate interest among current and prospective students and will generate increased enrollment. The program has gained a reputation for state-of-the-art instrumentation training and problem solving techniques. Assessment of student response and success with these exercises is carefully measured. Questionnaires completed by the intern supervisors and students determine how well the students have been prepared. Advisory committee members review the relevance of the laboratory exercises and teaching techniques from the industry point of view. All of the new evaluation activities followed the implementation guidelines described in the publication Executive Guide: Effectively Implementing the Government Performance and Results Act. Dissemination has occurred within the network of Massachusetts community colleges and nationally through the Partners in Environmental Technology Education (PETE) conferences, publications and Internet

database. Community Water Monitoring Programs are increasingly using this equipment for demonstrations, training, and analyses.

Bibliography

1. *Defining Environmental Technology: Technician-Level Occupations in the Field*, James Collier, Principal Investigator, ATEEC, 1996.
2. *Instrumentation to Apply the Scientific Method in Undergraduate Environmental Science Laboratories*, Truckee Meadows Community College, (an NSF-ILI Project Proposal), 1995.

DOUGLAS W. BILL

Douglas W. Bill, is an adjunct faculty member at Cape Cod Community College. Since 1993, he has been the principal instructor of the Introduction to Earth Science course. He owned and operated an environmental consulting firm (Mahoney & Douglas, Ltd.) located on Cape Cod. Projects that he has participated in include the assessment and remediation of many oil/hazardous material contaminated sites at residential, commercial, and industrial properties. He has also designed and conducted a sludge stabilization project at the Massachusetts Military Reservation on Cape Cod. This project included the chemical precipitation of metals and the dewatering of 1.3 million gallons of sludge. On June 2, 1998, the local chapter of the Service Corps of Retired Executives (SCORE) identified Mahoney and Douglas as the Small Business Owner of the Year. Their clients have included the State of Massachusetts, U.S. Department of Agriculture – Rural Development, Town of Bourne, MCI International, and the Prudential Insurance Company

MARY JANE CURRAN

Mary Jane Curran, Environmental Technology Coordinator came to CCCC in 1994 to establish and coordinate the Environmental Technology Collaboration with Mass Maritime Academy and U MA Dartmouth and to develop several education options for students at CCCC. She manages the internship program and serves as adjunct faculty for the internship course, MC 261. She serves as CCCC's representative with many local non-profit organizations. Before coming to CCCC, Mary Jane coordinated collaborative efforts among the New England Aquarium, the Boston Museum of Science and Boston public schools. She also was active in community outreach and mentor training for Boston Partners in Education. She has a BA in Biology from Regis College and an M Ed in computers from Lesley College.

CATHERINE ETTER

Catherine Etter is currently an instructor at Cape Cod Community College and a doctoral student at Salve Regina University in Newport, RI. She received her B.S. in Biology from Providence College in Providence, RI. and Masters in Biology from Harvard University in Cambridge, MA. She has 20 years of profession experience as a chemist/ scientist/environmental quality control specialist. She has successfully participated in pollution prevention, small-scale chemistry and micro-scale chemistry workshops.