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## IN DEED

## A SERVICE-LEARNING PROJECT IN GENERAL CHEMISTRY

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The integration of classroom learning with service to others has been steadily gaining acceptance as an important teaching tool in Jesuit colleges and universities.<sup>1</sup> Service learning has caught on especially in the humanities and social sciences, disciplines in which it is not at all difficult to trace connections between course content and contemporary social needs and problems. The match between service learning and the sciences, however, has been more difficult to make.<sup>2</sup> At the University of Detroit Mercy (UDM), we have been wrestling with the challenge of bringing a service-learning component into the first-year general chemistry lecture at the university, with what we think are encouraging results.

Out-of-class group learning is, of course, nothing new in science education. We regularly require groups of students in our lecture classes to perform literature searches and to present reports on their findings, as a way of expanding course content and diversifying the student's approaches to the

subject. The challenge we set for ourselves was to devise a small pilot program of out-of-class learning that would meet these traditional pedagogical goals while also serving people in the Detroit area, in the spirit of UDM's mission.

In the program we devised, students were given the option of going out to teach chemistry to ninth and tenth graders at Melvindale High School. The university students committed to three sessions with their secondary school students. At the first session, the UDM students presented a series of chemical demonstrations, and explained the chemical principles involved. In subsequent class meetings, the ninth and tenth graders performed the experiments they had previously seen, with the UDM students acting as instructors, guides, and mentors.

The content of the UDM students' chemical demonstrations was taken entirely from the principles taught in their lecture. The second semester of the UDM introductory level chemistry course includes solution chemistry, acids and bases, thermody-

namics, kinetics, reaction equilibria, and electrochemistry. The UDM students who chose to participate in the service-learning project were given the following experiments as examples of these principles: 1) *hydrating guar gum*—this forms a colloidal substance in water; 2) *liquid nitrogen*—immersing balloons in it illustrates equilibria between gasses at various temperatures; 3) *subliming dry ice*—allowing it to sublime in a closed balloon illustrates an equilibrium and a phase change; 4) *silver reduction from solution*—an example of an electrochemical

<sup>1</sup> See, for example, Patrick Byrne's article on the PULSE program at Boston College, "Paradigms of Justice and Love," *Conversations*, no. 7 (Spring 1995).

<sup>2</sup> But see D. F. MacInnes, "Students as Teachers: Learning Chemistry through Teaching," *CHED Newsletter and Abstracts*, Spring 1997, paper 020, and M. S. Cracolice, "Integrating Service Learning into the College General Chemistry Curriculum," *CHED Newsletter and Abstracts*, Spring 1997, paper 022.

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galvanic cell; 5) *copper plating*—a battery is used to copper plate metal objects from a copper sulfate bath; 6) *the electric pickle*—running current through a pickle shows how electrons can be excited; 7) *red cabbage juice*—the juice is an acid base indicator that undergoes vibrant color changes.

Because everyone learns better when learning is a pleasure (and because science suffers, unfairly, from the stigma of being all work and no play) we also prepared our students to enliven their presentations with a couple old chemistry teachers' tricks. Before demonstrating the effect of liquid nitrogen on a balloon, for example, the UDM students showed the rather more comic effect it has on a banana or a pickle. (It freezes the water in them, so that they shatter when removed from the nitrogen and dropped on a table top.) This, as we expected, was a real crowd pleaser. The electric pickle demonstration had a similar effect simply because of the results—when electricity is run through the pickle, one half of it glows a vibrant yellow.

Even before the subsequent contact sessions, it seemed evident the experience was a success. Our students returned commenting that the ninth and tenth graders really enjoyed the demonstrations, and were responsive and eager to learn. The UDM students also commented that they felt they had learned a great deal more from presenting demonstrations based on the principles they were studying than they would have by simply doing a research paper. One student report stated, "We found ourselves looking back through the chemistry book the night before making sure that we knew all the information." Another wrote, "If you are able to teach something to someone else, then you must know what you're talking about." Feedback from the high school was equally positive.

In designing the project, we also anticipated two potential problems: 1) that we might be charged with diluting the academic rigor of the course; 2) that our students might see the project as just one more hoop to jump through; that is, that they would

not see it as service, nor participate in a spirit of service. To address the first concern, we required that the UDM students meet with their professor to perform with him the experiments they would present at the high-school level. This dry run allowed them to see how demonstrations should look, to see what results they should give, and to discuss the underlying principles behind the demonstrations. On the high-school end, we had the check of the teacher's presence in the room at each of the UDM student's sessions. The UDM students knew that their grades for this activity were dependent on two reports—a report they would write at the conclusion of their classroom interactions, and a report by the secondary school teacher evaluating their presentations to, and interactions with, the high-school students. Our second concern we addressed by making the project voluntary. Students could opt to do a more traditional out-of-class project that would involve no service to the community. In addition, we required that the students' final report include, not just a simple

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recitation of the chemical principles they presented, but also a reflection on what the project taught them, a summation of what they presented, thoughts about how they and the high school students interacted, and their feelings and comments about having become the teachers. We tried to remind them throughout the semester that the aim was twofold: to learn more chemistry by becoming the teachers, and to provide a service to the Detroit community.

Our initial attempt at introducing a service-learning component into a general chemistry class at the university level appears to have been even more successful than we had hoped. The university students who participated found it a rewarding learning experience. They strengthened their own knowledge of chemical principles, and learned something about helping their community by getting younger students interested in science. The ninth- and tenth-grade students appear to have become excited enough about the idea to have begun work on their own version of the pro-

gram: the ninth- and tenth-graders are now preparing to teach elementary school students. The faculty involved in this project intend to expand it for the coming year and are currently seeking funding for that purpose.

It appears that service learning can play a meaningful role in chemistry education at the university level. While such learning must be watched to ensure no loss of academic rigor, the benefits of enhanced learning, coupled with service and outreach to the community, make the endeavor quite worthwhile.



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