

A Final Report to The Associated Colleges of the South

**For a course developed for non-science majors titled
“Chemistry Connections”**

**Through a grant from the W. M. Keck Foundation of Los Angeles for the
Reform of Introductory Science Courses for Non-Science Majors Program**

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Project Activities

Chemistry Connections was a new course offering at Southwestern University for non-science majors during the Fall 2006 semester. The course was developed around a group of topical modules that each lasted approximately three weeks. The modules were: Basic Chemistry, Art and Archeology, The Environment and Geochemistry and Natural Resources. In each module we addressed how chemistry is utilized by practitioners in these selected areas, how research is conducted or problems are solved. Information was presented in a discussion format with the lecture format greatly deemphasized. The course was team-taught by Dr. Willis Weigand and Dr. Kerry Bruns.

Students were evaluated by several different methods. A written exam was given at the conclusion of each module, and a final exam was administered at the end of the semester. All exams were composed of multiple choice and short answer questions. Students were also required to give a 15-20 minute presentation to the class on a topic related to one of the modules covered during the semester. Other assignments for students to complete outside of class were: one 3-5 page referenced paper of their own selection, but covering some aspect of a module in which they were interested; one poster with the same criteria as the paper and a Sunprint (a cyanotype). We conducted labs during the semester that addressed issues in each module and the class took two field trips. One trip was to the Ransom Center on the University of Texas campus to explore the history of photography and the other trip was to Inner Space Caverns in Georgetown, Texas, to observe cave formation and some aspects of local geochemistry.

Some of the lab activities were adopted from lab exercises we use in other courses offered by the Chemistry Department at Southwestern. A new water quality lab was developed around the Vernier Software and Data Collection equipment provided by the grant. The water quality lab included measurement of the pH, turbidity, conductivity, and dissolved oxygen content of selected water samples from the local area. Another new lab exercise developed for the Art and Archaeology module was for students to make a zinc plate etching (Intaglio Printmaking), in which students observed the reaction of zinc with acid to produce line etchings in plates that could be used for making prints on paper.

Twenty-one (21) students enrolled in the course and all of the students completed the course with satisfactory grades (C- or better). Students from the School of Fine Arts, and the Divisions of Humanities and Social Sciences within the College of Arts and Sciences were represented in the class. Surveys of student perceptions of science were conducted before and at the conclusion of the course along with Southwestern University's standard course evaluation.

Outcomes

The SaM-VI: Science Component surveys suggested some interesting qualitative evaluations. A quantitative analysis has not been completed on this survey; however, a qualitative analysis may be appropriate. The qualitative results somewhat matched the results of the Southwestern course evaluation. Students perceived that their critical thinking skills were improved after taking this course. But they also indicated they were less confident of their academic ability and their ability to think creatively. They also indicated that because of time issues they didn't have enough time to study for science. Internet information was utilized extensively in this course; students indicated on the survey their interest in reading about science on the internet was increased. It is difficult to determine from the SaM-VI survey if students' attitudes toward studying or learning about science was changed during the course of the semester, and we would have to say there was no conclusive change in that regard. Comments on the standard Southwestern University course evaluation correlated with the (perceived) high demand on students' time shown in the SaM-VI survey.

The instructors did not try to identify faulty paradigms held by students when they began the course, although discussion of some faulty paradigms came up during class meetings. Similarly, the instructors did not attempt to identify any faulty paradigms held by students at the conclusion of the course.

Lessons learned

Class meetings during the course had a strong discussion format. Both surveys suggested that the students did not have a high confidence in their ability to discuss science issues and therefore the students found the discussion format to be difficult. As instructors, we found that at times, discussion was not forthcoming. In subsequent offerings a deeper background on science at the start of individual modules may be helpful to the students so that they are more comfortable with a discussion format.

The time issues in the course are somewhat more problematic to address. We did not believe that the graded assignments were significantly greater than other courses offered at Southwestern. However, since this course was not in the students major, the perception was that the assignment load was very heavy. We indicated in the syllabus that some of the graded assignments, (presentations, paper, poster, Sunprint) were due no later than the last day of class. We could have made intermediate due dates for those assignments and possibly had them due earlier in the semester so that work would not be delayed until the end, and there would have been more time for students to meet with instructors for comments and corrections. We asked students to give their presentations to class at the end of each module, but it was difficult to get

students to give presentations at the end of the first two modules. Many students chose to wait until the last module to make their presentations, and this created a problem with accommodating the large number of students needing to give their presentations in such a short time. While a reduction in the number of assignments may not be desired, a more rigorous time schedule should be implemented for the assignments.

A text (Chemistry for Changing Times, 10th edition by Hill and Kolb) was required for the course but was not specifically used for all of the modules. For the Art and Archeology module and the module including geochemistry, a significant amount of information was taken from other sources. Outside information was obtained from Chemical and Engineering News, the primary literature, newspaper and science magazine articles and books on reserve in the library. Videos were also used to disseminate information. The lack of a text that covered all the modules may have caused the students to be less inclined to read the course materials and to search out information for themselves. The students did not check out any of the books on reserve or access any of the “e-reserve” articles. More extensive copying of the information sources used in the discussions may have made it easier for the students to access the information in lieu of a comprehensive textbook.

Budget

The disbursement of grant money is summarized in the attached report from Southwestern University's business office. We anticipate using some of the unexpended balance to attend the Texas Academy of Science annual meeting at Baylor University to report on this project.

No additional extramural funding has been sought to sustain this course, however, support to continue offering the course will be available through our departmental budget and through the Dean's office. The Dean and others in the university's administration have been supportive and encouraging for our department and other departments within the Natural Sciences Division to develop and improve courses designed for non-science majors.

Impact and Follow-up Plans

We believe that using this type of modular format can be an effective approach to presenting scientific issues to non-science majors and for stimulating discussion relating to topics of social interest. It can provide the information they will need as informed consumers after graduation but at a level they can utilize. The distinct modules are also a way of presenting chemistry-related principles directly tied to careers that the non-science major may pursue. In subsequent course offerings, the assignment load may be slightly reduced, but we believe

the activities such as presentations and posters are valuable to students not only because they educate themselves about a topic they find interesting, but also because they become more comfortable presenting and discussing scientific ideas with other people.

Dissemination

Dissemination of information about the grant to the ACS from the W. M. Keck Foundation of Los Angeles and the course we developed on our campus was through announcements at division meetings. An announcement about this specific course was also made at a general faculty meeting, and several individual faculty members from outside the Natural Sciences Division inquired about the nature of the course. We invited Dr. Patrick Veerkamp, a ceramicist, to give a guest lecture on the chemistry of clay, glazes, and firing techniques during the Arts and Archaeology module, and students received that presentation well.

A poster was presented at the Science Reform Workshop in October 27, 2006 at Birmingham Southern College to inform other persons within the Associated Colleges of the South about this project, although information about the course was incomplete at that time. A poster will be presented at the Texas Academy of Sciences meeting March 1-3, 2007, at Baylor University in Waco, Texas, summarizing the findings of this project. We will continue to offer this course in addition to the other courses for non-science majors we already offer within the Chemistry and Biochemistry Department at Southwestern University.