Meeting the Challenges of Teaching Chemistry for General Education Students: Summary of the Fall 2007 ConfChem Conference

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Meeting the Challenges of Teaching Chemistry for General Education Students: Summary of the Fall 2007 ConfChem Conference

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In recent years this *Journal* has published a number of articles discussing the importance of finding new ways to present chemistry to the vast majority of our students who are not science majors. In the fall of 2007, the Committee on Computers in Chemical Education *(1)* of the ACS Division of Chemical Education *(2)* held an online conference in which six presenters described a variety of approaches to teaching chemistry for nonmajors *(3)*. Themes that emerged from this conference were teaching chemistry in a cultural context, strategies to motive students, and techniques for improving students' learning. Several authors described courses that present chemistry in a broader social context. The authors all recognize that students have a curiosity about the world around them and use a variety of different approaches to channel that interest in their courses.

This conference was part of the ongoing ConfChem series *(4)* devoted to chemical education and research. Each Sunday, a paper was introduced for discussion. On Monday and Tuesday, participants could post questions to the authors. Later in the week, authors responded and general discussion ensued.

David Pratt and Peter Koehler described the role of chemistry in the first semester of a two-semester interdisciplinary "Science of Everyday life" *(5)* sequence offered at the University of Pittsburgh. The first semester focused on the broad theme of energy and included a broad variety of chemical topics. The authors concluded that "We have learned that it is possible to `reduce' science to a few essentials and to provide access to these essentials to college students majoring in the humanities and social sciences."

Vladimir N. Garkov at Mary Baldwin College reported on his "Chemistry in Cultural Context" course *(6)*. Along with application of chemistry, this course introduced students to the historic and philosophical underpinnings of science in the West. An optional travel abroad experience allowed students to visit historic sites and have personal interactions with people from different cultures.

Jennifer Spillman's course presented chemistry in the local context of the Caribbean *(7)*. This multidisciplinary course was based on natural phenomena encountered by students in the University of the Virgin Islands. Students saw how wide range of sciences including chemistry, biology, chemistry, geology, meteorology, and physics are involved in understanding events like hurricanes, earthquakes, volcanoes, and tsunamis. The release of energy is a common theme for these disparate events.

Strategies for the integration of computational chemistry into the general chemistry curriculum for undergraduates and high school students were discussed by Robert Gotwals *(8)*. The author argued that computational methods should take their place beside traditional "wet chemistry" methods in the curriculum.

Lon Porter described a course based on nanotechnology open to all students at Wabash College *(9)*. He used a variety of sources from the realm of science fiction along with technical readings to help his students explore the social, political, and moral implications of this technology. "Lectures are coupled with guided discussions on prevalent course readings and students participate in a significant number of writing assignments, molecular modeling simulations using standard software packages, and a select number of guided laboratory exercises."

Rachel Wang and Adriana Bishop teamed up with faculty from the English Department to teach a nonmajors chemistry course along with English Composition as part of learning community *(10)*. The learning community helped students clarify their thoughts by expressing them in writing. Additionally, pedagogical approaches such as small group activities, seminars, and field trips were used to enhance student learning. The authors compared their experiences with learning communities to classes taught using the traditional approach.

A counter embedded in the papers indicated that they were accessed about 8200 times during the conference. The papers

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continue to be accessed with 12,369 page views through June of this year. This level of activity is a measure of the continued value of the papers presented in ConfChems. The conference Web site contains the papers from the conference *(11)*. Papers and discussions of past ConfChem sessions are archived on the conference Web site *(12)*. However, the discussions for this conference were lost during a move of conference proceedings to a different server. Anyone interested in organizing a future ConfChem may contact Bob Belford (rebelford@ualr.edu) or John Penn (John.Penn@mail.wvu.edu).

Chemistry in the Natural Sciences

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Described in this paper is the role that chemistry plays in the two-term integrated science course "Science of Everyday Life" that is being taught at the University of Pittsburgh *(5)*. The principal goals of this course are to engage students in thinking about the natural world that surrounds them and to encourage them to develop an understanding of the fundamental scientific principles that govern its behavior, as well as to appreciate the "beauty of all things". The principal topics discussed in the first term include the laws of motion, work, and energy; the molecular world, including the kinetic theory of gases and degrees of freedom; sources of energy, renewable and nonrenewable, and energy transfer; electricity and magnetism; atomic theory; the chemical bond; intermolecular forces; materials (including an introduction to organic chemistry); radioactivity; and the subatomic world. The course continues in the second term with discussions of astronomy, geology, and planetary science; energy and the environment; and biology. All topics are taught from a conceptual point of view, though quantitative ideas (orders of magnitude, statistics, etc.) are introduced when necessary. Knowledge of the simple physical and chemical ideas discussed early in the course gives the students a basis for understanding the more complex topics discussed later in the course. Most instructors in the course attend all lectures, making it possible to reinforce connections between "old" topics and "new" ones as they are introduced.

Teaching Science in Cultural Context with an Optional Travel-Abroad Component

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The recently developed course called Science in Cultural Context introduces students to the spirit of science (and chemistry in particular) as a process as opposed to a specific body of knowledge by employing the multidisciplinary tools of philosophy, history, and geography of science *(6)*. The first unit covers the birth of modern science in Europe from a historical perspective. The second unit teaches students the main ideas and accomplishments of chemistry from Lavoisier to Schrodinger and Watson and Crick. The philosophical aspects of science are considered in the third unit, which looks at science's uncertainty, recentness, completeness, objectivity, and unity. Special attention is devoted to the unnatural character of the scientific way of thinking. Unit four tries to answer Yali's question about the reasons for Europe's scientific and technological superiority by exploring the physical geography of science. The fifth unit of the course compares ancient cultures and discusses the cultural geography of science including the religious, economic, political, and other human factors that gave birth to the scientific way of thinking in only one place—the agora of ancient Greece. The last unit of the course is an optional trip to Europe, to places such as Italy, Russia, southeastern Europe (Bulgaria, Greece, and Turkey), or central Europe (Austria, Germany, the Czech Republic, and Paris). The course may also be conducted entirely on the campus of the American University in Bulgaria. The travel component allows students to (i) study the cultural and geographic aspects of science by visiting museums, laboratories, schools, hospitals, and sights of historic and artistic significance and (ii) explore the European culture, study the communication patterns, look for the elements of the scientific discourse by conversing with the locals (including local university students), and observe how people relate to each other. The travel-abroad component presents our students with the opportunity to understand the role of science in the society from a cross-cultural perspective while helping them to appreciate and evaluate their own U.S. culture more critically. The course uses the following texts: *The Ascent of Science* by Brian L. Silver, *Uncommon Sense: The Heretical Nature of Science* by Alan Cromer, *Guns, Germs and Steel* by Jared Diamond, and *Germany—Unraveling an Enigma* by Greg Nees or *Exploring the Greek Mosaic* by Benjamin Broome.

Integrating Computational Chemistry (Molecular Modeling) into the General Chemistry Curriculum

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Computational science is considered by many scientists to be the fourth leg of modern science, joining observational, experimental, and theoretical science. Computational chemistry (also known as molecular modeling) is one of the most important application areas in the computational sciences. In North Carolina, we have built a statewide resource to provide precollege students and teachers with access to research-grade computational chemistry resources *(8)*. We have also developed several complete courses (Intro to Computational Chemistry and Research in Computational Chemistry) and have written a textbook specifically for high school teachers and students. Recently, we have partnered with the Global Grid Exchange to provide computing resources to a national audience.

In this paper, we describe these efforts and how they can be utilized by other educators.

Offering Introductory Chemistry in a Learning Community versus a Stand-Alone Course: Gains, Losses, and Extras

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At Spokane Falls Community College (SFCC), up to 350 students enroll in Chem 100 (Survey of Chemistry) each year for various reasons. As a college-level, fully transferrable laboratory science course, Chem 100 satisfies a degree requirement of the Associates of Arts and several vocational-technical programs. It also prepares students for more advanced chemistry courses. In the past five years, students at SFCC were offered an option to take Chem 100 in conjunction with English Composition 101 (or 201, for those with more advanced writing skills) in a learning community (LC). This LC enrolls up to 45 students per section; they attend classes together, led by one instructor from each discipline, working collaboratively. The LC integrates traditional course content in both chemistry and English composition, with an added emphasis on personal and civil responsibilities to the environment. This report compares the chemistry portion of five LC sections versus traditional stand-alone Chem 100 sections offered during the same period *(10)*. Aspects compared include course format, student profiles and completion rate, assessment strategies, curriculum issues, administrative—instructor issues, and some unexpected extras.

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Supporting Information Available

Each peer-reviewed and updated paper of the Fall 2007 ConfChem articles. This material is available via the Internet at http://pubs.acs.org.

