PHILIP C. BEVILACQUA

MAKING BIOCHEMISTRY REQUIRED READING

Its pervasiveness in current research makes biochem must-have background for chemists

CHEMISTRY HAS LONG BEEN RECognized as "the central science." Chemists are engaged in research that touches on almost all areas of science and engineering. My research group is interested in biological chemistry, with an emphasis on RNA catalysis and folding. Like most researchers in this area, we draw on knowledge and expertise in many other disciplines, especially biology and physics. Interdisciplinary research is certainly commonplace, and in numerous graduate programs, students have access to research groups in different departments—sometimes with dual advisers. Granting agencies have programs that foster the cooperation of biologists, chemists, and physicists. These programs prepare graduate students for careers in industry where interactions among different scientists are necessary to solve practical problems, often of a medicinal nature.

Biological chemistry presents many important issues. Recent advances in the study of nucleic acids that stand out are the sequencing of many different genomes (especially the human genome) and solving the structure of the ribosome. These advances present many opportunities to academic and industrial chemists alike, including making sense of genetic information through proteomics and understanding translation, the function of antibiotics, and drug resistance. Approaches of organic, analytical, physical, and computational chemists are necessary to make advances in these fields.

Important challenges for the academic chemical community are integrating biochemistry into the curriculum of the chemistry major and getting the best students interested in research careers in biological chemistry. In teaching freshman introductory chemistry and advising undergraduate students, I was surprised to find that many students still perceive a dichotomy between these two fields. Increasing students' awareness of interdisciplinary undergraduate and graduate programs and of career opportunities that cross disciplines might help attract top students into chemistry departments. It might be accomplished by having an open dialogue with high school teachers about research opportunities in academia and industry. Presentations of interdisciplinary research to high school students by college faculty could help open these channels.

VISUALIZING MOLECULES **Bevilacqua confers with graduate student Susan Senchak.**

Informing high school teachers about new advances in the field and software available for teaching biochemistry might help pique their students' interest in a career in biological chemistry.

Another way to increase undergraduate student interest in interdisciplinary opportunities in chemistry and biology is through freshman seminar programs in which students meet research professors and learn about their research programs. Such a program has been instituted campuswide at Pennsylvania State University. The program introduces students to research collaborations that exist among chemists, biologists, and physicists. Undergraduate research continues to be an avenue for preparing students for professions in biological chemistry. An introduction to research is an important part of the undergraduate experience that moves students past textbook learning and introduces them to the process of creating new knowledge.

The American Chemical Society has initiated a new requirement of a course in biological chemistry for the ACS-certified degree in chemistry. These courses have a broad goal of helping students understand biological phenomena in chemical terms. ACS has presented several options for integrating this component into the curriculum, including distributing biochemistry into currently required chemistry core courses or offering a stand-alone biochemistry course. The flexibility of the biochemistry requirement seems to be a good idea because it will promote creative and diverse approaches.

Biomolecule visualization software for the PC is commonplace and can be readily instituted. Homework problems on biological systems could be assigned throughout the chemistry curriculum. The preparation of effective texts and problem sets is an important challenge. It is interesting to watch the creative learning materials and tools that are being written, including textbooks, Web pages, and interactive learning tools on CD-ROM.

The biological problems being studied by chemists are pervasive, and not understanding the basics of biochemistry will be a severe handicap to future chemists in academia and industry. It is curious to note that physics has long held a prominent position in the chemistry major's curriculum, with multiple courses required in physics and physical chemistry. However, only now are courses in biochemistry gaining widespread acceptance as formal requirements in chemistry departments.

Biological chemistry courses should help make students aware of exciting research problems they might otherwise miss—I know, because I almost did. When I was a second-semester senior, I took an introductory course in biochemistry, largely because one of my professors thought that it would widen my experiences and opportunities. It turned out to be a life-changing experience, and the new requirement may have a similar effect on the next generation of chemistry majors.

Philip C. Bevilacqua *is an assistant professor of chemistry at Pennsylvania State University. He received a B.S. in chemistry from John Carroll University in 1987 and a Ph.D. in physical chemistry from the University of Rochester in 1993. From 1993 to 1997, he was a postdoctoral fellow at the University of Colorado.*