LAYING THE FOUNDATION
Undergraduate research should be the cornerstone of every chemistry degree

Almost all ACS members share the common background of a bachelor’s degree in chemistry, and many of us received our degrees at predominantly undergraduate institutions (PUIs). Whereas the mission statements of PUIs typically downplay the importance of research, I would like to focus on the richly rewarding experience of conducting research with undergraduate students. Many faculty and others with deep interest in undergraduate research have written eloquently about this topic. Many of the thoughts I present here were clarified by reading “Academic Excellence: The Role of Research in the Physical Sciences at Undergraduate Institutions,” a book edited by Michael Doyle and published by the Research Corporation.

Success in research draws on personal qualities that are quite different from those needed for success in the classroom: enduring interest and enthusiasm, resourcefulness, and tenacity. Many undergraduate students, rising to the challenge of advancing science, are able to make remarkable progress on significant research problems. Watching students gain confidence by contributing to science through undergraduate research and by communicating their scientific results to others is one of the greatest rewards for faculty mentors.

The importance of a significant research experience for undergraduate science majors is recognized to varying levels across the entire spectrum of higher education. Indeed, the ACS Committee on Professional Training, in its 1999 publication Undergraduate Professional Education in Chemistry: Guidelines and Evaluation Procedures, “strongly endorses undergraduate research as one of the potentially most rewarding aspects of the undergraduate experience.”

What should be the goals of a successful undergraduate research program? Without a doubt, education of the student is paramount. Less obvious is that what is best for the student goes hand in hand with what makes a research project in science capable of attracting external grant support and of being published in peer-reviewed journals. The key point is that research-productive science faculty at PUIs, working with undergraduates, enrich the education of students. It is not a zero-sum game between teaching and research as some suggest; some of the best teaching of undergraduates takes place in the research laboratory.

Academic research is a collaborative effort in which both the student and the faculty member are learning together, attempting to solve an unanswered problem. It affords the desirable opportunity to blur the distinction between student and faculty member, even at the undergraduate level, as the research team works toward a common goal. Indeed, research provides the opportunity for students to view faculty in a role with which the students are quite familiar. Just as faculty evaluate student performance, the peer-review system places a faculty member’s work under scrutiny. The self-doubt of one’s research ideas and conclusions in the face of external review are healthy reminders to faculty members of what students experience throughout the academic year.

So what is the status of undergraduate research at PUIs? Professional societies such as ACS are encouraging greater involvement of undergraduates in the research aspects of their organizations. Undergraduate student attendance at ACS national meetings has increased steadily in recent years, and many students give poster presentations describing their research work. The next step is to get these students (through their faculty mentors) more integrally involved, that is, by presenting their work at disciplinary poster sessions—where the action is—instead of only at Undergraduate Research poster sessions.

On the faculty side, there are puzzling, if not troubling, signs that do not bode well for sustaining and increasing the number of meaningful undergraduate research opportunities for chemistry majors at PUIs. Proposal volume to private foundations—Research Corporation, ACS’s Petroleum Research Fund (PRF), Camille & Henry Dreyfus Foundation—and federal agencies (National Science Foundation and the National Institutes of Health) with programs that target faculty at PUIs has been flat over the past 15 years. Only PRF’s starter grant program for PUI faculty (Type GB) has experienced significant growth during this time, but many of the faculty who receive these initial awards apparently do not continue to seek external research grants as their careers continue.

From these external grants programs come the funding that enables PUI faculty to maintain productive research programs, enriching the education of undergraduate chemistry students by providing opportunities for one-on-one mentoring in the research laboratory during both the academic year and summer. In addition, students lose the opportunity to contribute to research projects that have passed the scrutiny of external peer review, and the faculty mentors miss out on the positive feedback that this process provides to get their research headed in a productive direction. Undergraduate research can be the cornerstone of a chemistry degree. The time has come for students and faculty, working together, to put it firmly in place.

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