FEATURE

Chemical and biological research with deaf and hard-of-hearing students and professionals: Ensuring a safe and successful laboratory environment

Abstract. Conducting research with deaf and hard-of-hearing (D/HH) students and professionals can be productive and rewarding to the researcher, their research group peers, supervisors, and faculty mentors. However, these efforts can also prove to be intimidating for faculty members/laboratory supervisors, especially to those who are new to working with this population. As is the case with any traditional research initiative, safety is of paramount importance and additional safety and communication considerations for working with D/HH individuals are discussed. Years of experience have indicated that barriers to working with D/HH researchers in the science laboratory are rarely primarily safety-related (as there are strategies to address and remedy these issues), but can rather be 'attitudinal' or due to general apprehension when host laboratories lack information/experience in working with this group of individuals. The goals of this article are to discuss laboratory safety strategies for working with D/HH individuals on research projects in the chemical and biological sciences and encourage faculty and supervisors in other organizations to involve and hire these competent scientists who bring valuable/diverse perspectives and experiences to the workplace. Though written from the perspective of academic settings, the best practices outlined here are predominantly transferable to governmental and industrial laboratories.

By Susan B. Smith, Annemarie D. Ross, Todd Pagano

INTRODUCTION

The integration of research as a teaching tool might be traced back to 1810, when Wilhelm von Humboldt encouraged the inclusion of research for students to learn through inquiry.[1] He believed that "in this form of education, research activity is the glue that holds together teaching and learning. Through research the professor teaches, and simultaneously, the student studies and learns. Research integrates teaching and learning."[1] This concept spread throughout the German higher education system[2] and later to American universities. However, as enrollment in universities increased, the student-to-faculty ratio also naturally increased, making small group or individual research experiences more logistically prohibitive.[2] While seemingly somewhat stagnant for a period, the momentum of incorporating undergraduate research as an inquiry-based experience began to build again in late 1960s, and notably when Massachusetts Institute of Technology initiated their Undergraduate Research Opportunities Program.[2] To encourage more universities to incorporate similar programs, the National Science Foundation (NSF) established the Research Experiences for Undergraduates (REU) program in 1987.[2,3]

Today, the growing emphasis on undergraduate research by students in

Susan B. Smith *is affiliated with Thomas H. Gosnell School of Life Sciences, Rochester Institute of Technology, United States.*

Annemarie D. Ross *is affiliated with Department of Science & Mathematics, Laboratory Science Technology Program, National Technical Institute for the Deaf at Rochester Institute of Technology, United States.*

Todd Pagano *is affiliated with Department of Science & Mathematics, Laboratory Science Technology Program, National Technical Institute for the Deaf at Rochester Institute of Technology, United States (52 Lomb Memorial Drive, Rochester, NY 14623, United States. Tel.: +585 475 4539; email: tepnts@rit.edu).*

1871-5532
http://dx.doi.org/10.1016/j.jchas.2015.03.002

postsecondary programs is exciting and can be very valuable to students' educational paths. Nationwide, faculty are now being encouraged to take undergraduates into their research groups, mentor them, and produce original and scholarly results as an outcome of their efforts. Through undergraduate research, students have unique opportunities to learn discipline-specific information, share technical information with peers and professionals in their field, and work on projects that are often prohibitive in the traditional classroom setting. These student-centered efforts to conduct original scholarship help to promote student learning while contributing to the advancement of their discipline[4,5] Despite the obvious benefits, research opportunities at any level are often limited for students with disabilities, and in particular, deaf and hard-of-hearing (D/HH) students. Opportunities for the involvement of early undergraduates (i.e., Associate degree level students and/or those in the first and second years of their college careers) who are also D/HH are even scarcer.

We are of the belief that *all* students, regardless of disability or post-secondary degree year/level, can find success with research, especially in the chemical and biological sciences. Of course, dedicated faculty members and supervisors are crucial for developing and overseeing programs for students with disabilities, which can be a daunting task, especially if they are new to working with individuals with disabilities. Teaching Chemistry to Students with Disabilities is a great resource for general discussions about chemical education for students with disabilities, including D/HH students.[6] Booksh et al.[7] also provide general information about sustaining interventions and programs for students with disabilities. And Ross and Pagano discuss the importance of laboratory safety training for D/HH students in the chemical and biological sciences.[8]

We discuss some of the safety considerations and best practices when working with D/HH students in the laboratory that can also be extended to working professionals. The Americans with Disabilities Act (ADA), authored by Senator Tom Harkin (who incidentally, had a deaf brother and once delivered an entire speech to the Senate in sign language[9]), was signed into law in 1990 and established civil rights laws prohibiting the discrimination of individuals with disabilities and called for schools and employers to make reasonable accommodations for persons with disabilities.[10] While a few communication, infrastructural, and procedural safety issues need to be addressed, through a history of working with these students (both in our own laboratories and overseeing their involvement in internships/co-operative work experiences throughout the nation), we are of the strong opinion that the safety logistics can be readily addressed and are additionally beneficial to hearing members of the laboratory. We do not suggest that research mentors or employers often intentionally discriminate against D/HH scientists, but rather due to the lack of the experience and/or information, they can inadvertently cite safety concerns as the major barrier to working with this group. Some apprehension to working with new groups of individuals is natural, but when stereotypes or pre-conceived notions are set aside, great things can happen for an institute or organization. Employees with disabilities tend to be extraordinarily safe workers, and are naturally more aware of hazardous situations *because of* their disability and are not more hazardous *due to* their disability. Through this discussion, we hope that faculty mentors and laboratory supervisors will be encouraged to take-on/hire qualified D/HH individuals who also bring unique perspectives and experiences to diversify the exchange of ideas in the workplace. And though we present from the perspective of academic laboratories, through a sustained history of collaboration with partner laboratories, we believe that many of the best practices outlined have utility also in government and industrial facilities.

SAFETY CONSIDERATIONS FOR D/HH RESEARCHERS IN THE LABORATORY

Our research program is rather unique in that it emphasizes the participation of D/HH students, both at the early college and/or Associate degree level and at the Bachelor degree level.[4] The National Technical Institute for the Deaf (NTID), the world's largest technical college for D/HH students, is one of the nine colleges of Rochester Institute of Technology (RIT) in Rochester, NY. NTID's unique science research program started over twelve years ago. Many of the student researchers are typically enrolled in Associate degree programs in NTID's Laboratory Science Technology major,[11] but many continue research as they advance to Bachelor degree programs within other colleges of RIT, including the College of Science. An underlying goal of our research program is to be a model for others who might consider recruiting D/HH and early undergraduate students into their research groups.

RIT provides a vibrant atmosphere for undergraduate research by having weekly seminars for sharing student research, a summer research program, and a large annual undergraduate research symposium.[4] Faculty at NTID can communicate in sign language and can have research groups made-up entirely of D/HH students. Being on the campus of RIT, about 1,400 D/HH students study alongside about 17,000 hearing students.[12] D/HH students also conduct research in the laboratories of RIT faculty members outside of NTID. Often these faculty members know some or no sign language and can have research groups with both hearing and D/HH students. RIT/NTID provides unique services in a portion of faculty who are fluent in sign language, note takers, Communication Access Real-time Translation (CART) and C-Print specialists, content area tutors, academic advisors, and the world's largest group of college/university sign language interpreters.

Of course, safety is of paramount importance in the laboratory environment and there are a few considerations specifically related to working with D/HH students and professionals. Many potential faculty mentors/internship supervisors/job employers often first inquire about safety issues before agreeing to work with these researchers. Their concern in working with a new,