

Study Abroad in the Sciences: Increasing Disciplinary Diversity in Programming Abroad

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1. Science is a global enterprise.

One needs to visit any science lab in the US, be it university or industry, to find a predominantly international work force. In direct contrast, American students' interest in a science major at the undergraduate and graduate level have been declining while that of their counterparts outside the U.S. has been steadily increasing. The need for scientifically and technically trained labor is thus being met from international sources.

Problems confronting this scientific enterprise are more global than ever. Greenhouse gases, mad cow disease, pandemic avian virus, global warming, computer viruses – are just a few examples of how international teams of scientists come together to solve problems that affect many countries.

R&D funding in EU and Asian countries has grown rapidly, at a more rapid pace than in the US and as the competition for US grant funding heats up, scientists have to be able to reach for these new sources of funding. Successful grant applications for these new pools of money involve partnerships, previously formed networks and alliances and cooperation across national borders.

The scientist of tomorrow will face fierce competition not only from within the US, but also from their international peers. While the supremacy of American science was unquestioned in the past, the US has lost ground in several key areas such as green technologies. Key indicators like the citation index document the importance of non-US contributions to the growing body of scientific knowledge. The landscape of science has changed dramatically and science education has to adapt.

2. Impact on Science Education

Science Educators have the sobering task of preparing their students for a new tomorrow. Not only do they have to find ways to capture the declining interest of students in the sciences, they have to retain them and train them with the skills they will need for competing in this environment. The good news is that if done right, study

abroad for science students can address all these science education goals, and will benefit students and faculty at the same time.

Science study abroad programs can engage students and lead to increased motivation to study and stay in the major because students are engaged not only in the science, but also with the broader context. Analytical chemistry is learned while students analyze wines and oils, or they learn about coral reefs – when actually looking at the impact of human habitation on the reefs. Contextual learning, leads to deeper and richer understanding, but also to greater interest. Student groups in these programs work cooperatively, and are mentored closely by faculty; and benefit from more interaction with faculty than in typical large science classroom. When the study abroad experience includes international universities, faculty and students, it encourages future professional collaborations and research partnerships.

When students undertake study abroad singly, such as during the semester, or for independent research, the resultant increase in maturity and development is noticed by their faculty and research advisors. Research advisors who send their students to work with their collaborators in international labs find their research programs are also benefited by study abroad. For all these reasons, Study Abroad for the sciences emerges as a clear win-win for students and faculty.

3. Real and Imaginary Obstacles

With such a clear value, it is surprising that science study abroad is not as prevalent as we would like to see it. This is because there are both real and perceived obstacles. Science students feel that study abroad is difficult and many unthinkingly rule it out without ever talking to a Study Abroad Advisor. Programs of study in the sciences are often more structured with sequential courses and required courses than non-science majors and students are locked into their schedules with little flexibility to take a semester off. There is the real worry about on-time graduation. Unfortunately, many do not realize the value of study abroad for their chosen field. In some cases, language is barrier; science students typically do not the time to invest more than minimally in language study and some study abroad programs with language requirements are therefore inaccessible. Similarly, study abroad programs that require non-science courses, disqualify others.

Another real obstacle is the fact that many science faculty are either unaware regarding study abroad or may even hold a negative opinion. Science students may not receive the same level of encouragement and advice from their science advisors as non-science students. Science faculty may not be knowledgeable about the high quality of science courses available abroad. When faculty are reassured of the quality of these courses, the specific skills and learning that students will obtain – that may not be available in the institution and the increased interest in the science domain that they see in returning students, some of these obstacles can be overcome.

3. PreMedical students

Most science majors and many non-science majors harbor medical school ambitions. Premeds are by far the most difficult group to send for study abroad during the semester. They have two specific constraints.

Most premed advisors advise students to take all their premed science courses in the US. These include General and organic Chemistry, introductory physics and biology. For a typical student, completing these courses will take three years. We encourage careful planning, summer courses and encourage our students to consider taking some of these courses in established, reputable international institutions. In our experience such students have successfully matriculated to medical school. So I see this more as a perceived obstacle. While medical school admissions will not corroborate this definitively one way or the other, it is a factor that the Study Abroad Advisor needs to keep in mind.

The second constraint is the timing for the MCATs and the requirement to stay in the US in the Spring Semester when medical school interviews are conducted. Students could be asked to interview at very short notice and their inability to participate in an interview could seriously impact their chances of being accepted at that medical school. This is therefore a valid constraint and students should not be advised to study abroad during this semester.

However, study abroad can be a valuable component of competitive premedical applications. Medical School Admissions look for maturity and development, experience with health care systems, communication skills and above all, seek the unique student who stands apart from the crowd. In our experience, a well-constructed study abroad trip can provide students with these benefits, especially if the student can integrate health care experiences into their study abroad.

4. Science Friendly Models

Successful partnerships between Study Abroad office and science faculty anchor successful Study Abroad programs. When science faculty are actively engaged in program development, selection and approval of courses, when they have first hand experience of the program, when they participate in site visits or direct the program, we have found that their engagement translates into greater student enrollment in study abroad programs. We have found it invaluable to start with one or two faculty champions-who can accomplish a great deal, by persuading their colleagues with convincing arguments and personal experience. For example our organic chemistry faculty was so impressed by one of his site visits that he has offered his personal endorsement of the programs, talks to his colleagues and encourages his students to go to this site.

To encourage students to study abroad during the semester, we have found it critical to have a database of faculty approved courses that students and their faculty advisors can consult. We note where approved courses fulfill major's core requirements or electives. Some students look for introductory courses, but most juniors seek upper level elective courses within their major that offer greater flexibility and range of content. We help science students in particular to plan their four-year college schedule with course planning sheets and have developed individual guides for each major. Finally, in recognition of the importance of research experiences for science students, we have successfully integrated research experiences in both summer and semester programs.

At Emory we have adopted a two pronged approach to accommodate the needs of science students. Faculty-run summer science study abroad programs, Chemistry in Italy, Environmental studies in Australia, Neuroscience in France for example, are led by science faculty, offer critical science courses required in the major, and often work with the international institutions' science department faculty and students. This timing during summer works best for premedical students who find it difficult to schedule study abroad otherwise. We also offer summer independent research programs and support students' research in international labs.

The second strategy is to identify a small number of international institutions that are highly ranked and are approved by the science faculty and provide science majors with lists of preapproved courses and course planning for these specific institutions. If the Study Abroad office can support the cost of limited and strategic faculty site visits, the resultant increase in engagement of faculty endorsement provides an excellent return on investment. Moreover, semester programs can be expanded to offer research opportunities with international research mentors and in this way, engage science faculty further in study abroad.

5. Surveys

We surveyed our students for two consecutive years trying to understand the causes for lower participation of science majors. We learned that more science students than non-science students reported that their faculty were not very encouraging or knowledgeable about study abroad. We learned that courses were more important when they looked for study abroad than location. From the ones who did participate, we noted that they reported significant gains in skills and knowledge pertaining to their field. Most importantly, they reported increased interest in their major as a result of the study abroad experiences. We also identified faculty on campus who stood out as being encouraging and knowledgeable about study abroad. Based on this we were able to target faculty involvement and training and through meetings, workshops, seminars

and discussions, managed to improve this in the next year's survey.

6. Student Comments

Post program comments by students bore out the benefits of study abroad both for their studies and for their general education experience. Students indicated that they formed close bonds with faculty program leaders and that their enthusiasm for their academic work was enhanced by the study abroad experience. They felt that they had the opportunity to work with faculty and facilities not available to them on the home campus, and to get a new and valuable perspective on their studies. They also felt that it was beneficial to gain a new cultural perspective along side broadening their science education.

Conclusion

Broadening participation and increasing disciplinary diversity can be particularly challenging when dealing with Science Departments. Traditionally, these departments have not participated the development of study abroad programs and have never seen the need to do so. However, with the changing landscape of science, and the increasing internationalization of science, it is critical that our developing scientists integrate a study abroad experience into their science education. Study abroad can increase student interest in their major leading to an increase in retention in the sciences, and improves student's skills and training in the major. Both goals are aligned with that of science departments and therefore should lead to successful partnerships for science study abroad programs. We provide a brief summary of our experiences and insights and would welcome further discussion.

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