

IN HAWAII, A PILOT COURSE IN PROFESSIONAL DEVELOPMENT FULFILLS AN UNMET NEED IN GRADUATE EDUCATION

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Multiple studies highlight gaps between typical graduate training and the reality of the post-Ph.D. job market. In a recent issue of this journal, Hansen et al. (2014) reported that fewer than 20% of ecology graduates obtain jobs in academia within five years of obtaining their Ph.D.s. The data raise the question: are academic institutions equipped to train Ph.D. students successfully for the remaining >80% of positions in industry, consulting, government, non-profits, and anything “alternative” to the tenure-track academic route? The authors recommended three approaches:

- Programs and advisors should be forthcoming about the capacity to prepare students for a diversified, competitive job market.
- Programs and advisors should offer graduate training in skills critical to academic and non-academic jobs.
- Ph.D. students must proactively obtain cross-training in marketable skills.

In response, we propose one solution: professional development courses offered widely across graduate institutions.

In Spring 2013, the Center for Microbial Oceanography: Research and Education (C-MORE) at the University of Hawaii at Manoa piloted Oceanography 750: Professional Development Skills Training. This graduate-level seminar emphasized two themes: broader impacts of science and job application skills. Aiming for an average graduate-level seminar size of six students, we were thrilled when 19 students enrolled from oceanography, marine biology, geology, astronomy, and other disciplines. Clearly, this indicated a broad, interdepartmental need and enthusiasm for this type of training.

PROFESSIONAL DEVELOPMENT DEFINED THROUGH CAREER EXPLORATION CYCLE

First – what IS professional development? In the first class meeting, we defined professional development by asking students to review current job ads in the natural sciences. This exercise aimed to define “careers in science” and motivate the

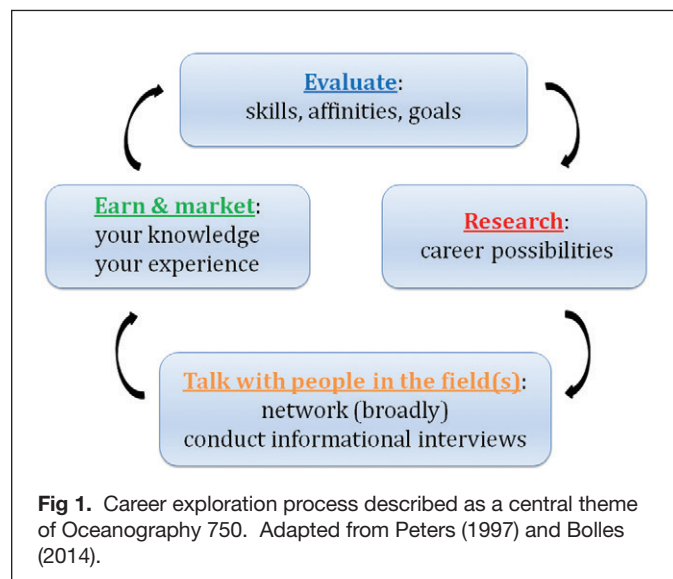


Fig 1. Career exploration process described as a central theme of Oceanography 750. Adapted from Peters (1997) and Bolles (2014).

skills taught in the curriculum. Jobs included those in scientific research, outreach, science communication, within tenure-track academia, consulting, government, and non-profit organizations. Students analyzed the minimum and desired job qualifications, such as:

- Expertise in evaluation of student learning, for diverse populations.
- Experience working with volunteer organizations.
- Ability to handle multiple tasks simultaneously while focusing on team performance.

Such job qualifications illustrate the demand for experience in teaching, managing people, conducting outreach, and overseeing multiple projects. To satisfy these qualifications, the typical student will need to develop experience outside of core research responsibilities. Furthermore, students must effectively market and promote these skills.

Throughout the semester, we promote an investigative cycle of career exploration (Figure 1). Ideally, students begin the process by evaluating their skills and goals. Next, they identify potential “best fit” careers (or, better yet, “dream jobs”) by talking with professionals. Armed with further insights into day-to-day responsibilities, students fill gaps in skills needed to compete successfully, and then they practice promoting those skills. The cycle is repeated over a lifetime, as professional goals, the job market, and personal circumstances change.

TEACHING PHILOSOPHY AND SYLLABUS

We taught broader impacts and job application skills, integrated with self-reflection exercises. Our curriculum incorporated key modules of C-MORE’s Professional Development Training Program (Bruno et al., 2013) to train students in science communication, mentoring, and other skills common to academics and non-academics alike. We used the popular job-search book, “What Color is Your Parachute?” (Bolles, 2014), as a toolkit for affinity and goal evaluation. In practice, this approach incorporated:

- Team teaching: Instructors (Guannel and Bruno) represented different perspectives and career stages.

- Active learning: Discussion and hands-on activities allowed students to explore and immediately apply new knowledge.
- Camaraderie: During each class period, time was allotted for students to share and network. “Safe space” guidelines (e.g., confidentiality within the classroom) promoted open discussion of sensitive issues.
- Guided reflections: Students reflected on career paths by assessing how future positions might fit their talents and life goals.
- Active feedback: We encouraged feedback at any time, in addition to mid-course and final course evaluations.

The course met once a week, for two-hour sessions (Table 1). Most classes included introductory lecture, discussion, and skill-honing exercises. Readings were assigned for two “broader impacts” sessions: Mentoring (Committee on Science, Engineering, and Public Policy, 1997) and Diversity (Bertrand and Mullainathan, 2004; Moss-Racusin et al., 2012).

In-class activities included:

- Networking exercises, such as role-playing how to enter and exit conversations gracefully and real-life networking with representatives from on-campus resources (Week 2, Networking).
- Outreach presentations to peers, whereby students developed and presented ~10-minute demonstrations about their research or other science activities intended to engage youth or the general public (Week 3, Outreach & Communication).
- Preparation of a self-reflection exercise from Bolles (2014) entitled the “flower diagram,” in which students evaluated critical components to career satisfaction: types of people they enjoy as co-workers (artistic or conventional?), responsibility level (team member or leader?), geographic location (city or country?), and others (Week 8, Work-Life Balance).

Four components were assigned roughly equal weight: homework assignments (written reflections on course content, preparation for in-class activities), a job application package (C.V., business card, cover letter, and personal website), participation (attendance), and – perhaps most critically – a class project (elements described below).

CLASS PROJECT HIGHLIGHTS

Students designed, executed, and evaluated semester-long projects that built experience outside of their research roles. They practiced project management skills through key planning milestones: meetings with instructors (Week 2), project proposals (Week 4), progress reports (Week 8) and final presentations and written reflections (Weeks 15–16). Furthermore, to

build quantitative evidence of their enhanced expertise, students evaluated their projects through surveys or other assessments. We encouraged students to integrate evaluation results into their C.V.s or personal websites, as a means of self-promotion. Below, we highlight two exemplary projects and the students’ reflections on how these projects contributed to their skill-building and career exploration.

Week	Topic	Content and Activities
Theme 1: Developing Professional Skills for a Range of Science Careers		
1	Class Introductions	Social bingo. Job ad review.
2	Networking	Role-play with class members. Networking with invited guests.
3	Outreach & Communication	Elevator speech. Outreach demonstrations.
4	Mentoring	Mentoring “best practices.” Guest speakers.
5	Diversity	NSF statistics on diversity. Team-teaching of readings.
Theme 2: Expanding Your Career Planning Toolkit		
6	C.V. Writing	C.V. content tips. C.V. examples from classmates.
7	C.V. Peer Review Mid-Course Evaluation	Discuss C.V.s in small groups. Formative evaluation.
8	Work-Life Balance	Preparation of “flower diagram” (Bolles, 2014).
9	Career Panel	Guest speakers (academia, outreach, business).
10	Applying for Jobs	Cover letter basics. Draft cover letter for a job ad.
11	Creating Your Online Presence	Personal website options. Google Sites examples.
12	Interviewing	Dos and Don’ts of interviewing. Short role-play exercises.
13	Thesis & Manuscript Writing	Grammar/writing tips. Project planning.
14	Teaching Philosophy	Critique of teaching statement samples.
Theme 3: Communicating New Skills and Perspectives		
15	Student Presentations	Students present projects (10–15 min) and discuss.
16	Student Presentations Final Course Evaluation	Students present projects (10–15 min) and discuss. Summative evaluation.

Table 1. Example syllabus from Oceanography 750: Professional Development Skills Training, a graduate-level seminar offered at the University of Hawaii at Manoa with weekly meetings of two-hour sessions.

CAREERS FOR ASTRONOMY PH.D.S: NICHOLAS LEE, DOCTORAL CANDIDATE IN ASTRONOMY

Non-academic careers can be difficult to envision from within an academic institution. To address the challenge for Ph.D.-level astronomers, Lee collected and synthesized details from 15 informational interviews with professionals. He created a five-week series of two-hour seminars to present his findings to his peers, supplemented by Oceanography 750 materials on networking tips, C.V. basics, teaching statements, and interviewing (Figure 2). Lee demystified the responsibilities, salaries, and pros/cons of positions such as lecturer, data scientist, technical consultant, aerospace scientist, science policy fellow, and patent agent – as well as traditional postdoctoral researcher and tenure-track faculty member.

To evaluate his project's success, Lee designed an evaluation for the ~25 students and post-doc attendees. All 19 survey respondents reported that information about non-traditional careers is “important” or “very important” for astronomy Ph.D.s and that the seminar series should be offered regularly. Most (58%) stated that the seminar should be repeated every year. One respondent commented: “This was probably the most useful ‘class’ I’ve had at the [Institute for Astronomy].”

Which motivations were driving this high interest? Qualitative feedback suggested that students may be afraid of not finding suitable employment following graduation due to ever-increasing competition for faculty positions and lack of education about non-academic careers:

“It seems all we ever hear is that professorships don’t exist ...

This seminar was a breath of fresh air, and it made me feel a lot better about ... finishing the Ph.D. program.”

“I didn’t know much about careers in astronomy beforehand ... This class was really valuable for me to look to the future.”

FOSTERING COLLABORATION BETWEEN OCEANOGRAPHERS AND ANALYTICAL CHEMISTS: MAXIME M. GRAND, DOCTORAL CANDIDATE IN OCEANOGRAPHY

The Collaborative on Oceanographic Chemical Analysis (COCA) was a four-day open science meeting of 53 participants from 14 countries at the University of Hawaii at Manoa in March 2013 (Figure 3). The overarching goals were to foster collaboration between analytical chemists and oceanographers and identify analytical chemistry developments to inform the design of novel oceanographic sensors. Grand asked the questions, “How would these conversations be structured?” and “How would researchers become motivated to engage with one another?”

Grand’s project therefore aimed to maximize the potential conversations at COCA. He initiated pre-meeting communication between these two groups of researchers so, upon arrival in Hawaii, they could hit the ground running. Participant names and research interests were shared in advance, and working group ideas were disseminated on the first day.

The success of COCA was assessed through a post-workshop survey, designed by Grand and completed by 61% of attendees. Two-thirds (66%) of respondents agreed that the workshop led to significant progress in delineating future research areas, and



Fig 2. In a non-traditional classroom setting, Oceanography 750 student Nicholas Lee presents a seminar on careers in industry to graduate students, post-docs, and faculty at the University of Hawaii’s Institute for Astronomy. Photo credit: Megan Ansdell.

87% agreed that they will engage in novel collaborations as a result: “Overall [this was] an excellent meeting. I think most oceanographers came with the attitude that they did not really have anything much to get from the other side. Many analytical chemists were not sure they had many relevant things to contribute. I do not think either set left with those feelings.”

PROJECT REFLECTIONS

Students submitted written reflections on their projects, in which they answered two key questions about new skills and future career goals. Reflection excerpts from the highlighted projects follow.

(1) In your project, how did you apply skills learned in class?

Lee: “Only ~20% of the people I interviewed were people I knew personally, and a lot of the time I found these people through networking. This included asking other students for contacts, emailing a few people out of the blue, and asking some interviewees for other people I could talk to (which is something I learned to do in class). I have also used the class on designing websites to create a site (<https://sites.google.com/site/nylee23/careers-talk>) to host the lectures, and I have submitted a blog piece (<http://www.astrobetter.com/careers-for-astronomy-Ph.D.s/>).”

Grand: “The class inspired me to create surveys to help prepare the meeting, assess its success, and identify areas where it could have been improved. Lessons from the evaluation survey will be extremely useful in the development of future COCA meetings. The networking tips of the course were also very useful, particularly when we were asked to prepare a one-minute elevator speech that I found myself using repeatedly with participants I had never met before.”

(2) How might you approach your current and future roles differently as a result of what you have learned through your project?



Fig 3. Participants of the four-day Collaborative on Oceanographic Chemical Analysis (COCA) Workshop, held in Honolulu, Hawaii, in March 2013. Oceanography 750 student Maxime Grand organized working groups. Photo credit: Tina Lin.

Lee: “First and foremost is the enormous amount of information I have now learned about possible career opportunities. I got a lot of great networking experience, which will make me much more comfortable to conduct future informational interviews and talk to people in general. I was especially nervous about talking to people on the phone, but I have found that it’s actually quite easy and enjoyable. I also feel more confident as a lecturer and presenter.”

Grand: “Keeping emails short when communicating with a group of busy individuals is critical. When asking for a service with no tangible benefits to the respondent, it is worth finding a ploy to catch people’s attention. For example, I was initially disappointed by the lack of responses to the survey I had spent so much time putting together. Then, I sent a reminder email and noted that completing the survey would ensure wireless internet access during the meeting. My mailbox was swamped overnight!”

COURSE EVALUATION

This course differed drastically from traditional science courses – and frankly we wondered how scientists would respond to an introspective approach. The final course evaluation (developed in consultation with Day-Miller) was completed by 16 students and reflected a high level of agreement with a range of statements on a scale of 1 (“Strongly Disagree”) to 5 (“Strongly Agree”). Ultimately, students would recommend this course to a peer (mean \pm standard deviation = 4.6 ± 1.0).

The course was unique in its focus on both job application and broader impacts skills. Students reported an increase in perceived improvement related to both components (job application = 4.6 ± 1.0 ; broader impacts = 4.3 ± 1.0). Similar levels of enthusiasm were exhibited for the application of both elements in the future (job application = 4.6 ± 1.0 ; broader impacts = 4.3 ± 1.0).

Furthermore, although students initially expressed reservations about the course’s emphasis on broader impacts, in the end, 94% reported profound appreciation for roles beyond that of the traditional researcher:

“Prior to taking this class, I viewed outreach as a rather futile activity that we are required to do as part of [National Science

Foundation] projects. I now view these activities with more excitement and with the realization that they are the best way to communicate science to a wide audience.”

“Broader impacts issues are already seldom discussed, and it might be a good thing to ‘force’ students to have exposure to these. I know that I, for one, probably would have only signed up for [an] ‘applying for jobs’ course, even though I think broader impacts are important.”

PROFESSIONAL DEVELOPMENT FOR THE FUTURE

We firmly believe that students will be best prepared for a multitude of career paths if they are provided with structured time and support to pursue professional development.

Many Ph.D. students appear to be yearning for such career guidance, as echoed in the feedback of one of our students: “this course should be required.” We propose that professional development courses be developed and required by graduate programs nationwide to complement the traditional roles filled by advisors and other academic mentors.

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