

Science & Society

Rethinking Graduate
Education in
Parasitology:
A Case Study

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Using parasitology as the platform, we created a novel program, focused on professional skills development and community engagement, to enhance trainee competitiveness to enter the workplace and assume future leadership roles in any career. This enhanced trainee experience boosted research performance with the added value of promoting the parasitology discipline.

Has the pressure to secure grants and produce high-impact publications created an environment where principal investigators (PIs) focus on developing their trainees' technical expertise and research productivity at the expense of transferable skills the trainees require to excel in their future careers? Of 5700 doctoral students surveyed, ~75% were at least 'somewhat satisfied' with their decision to undertake a PhD, yet only 31% felt they were being trained well for 'satisfying careers' beyond research compared to 'research careers' [1]; this is a frustrating scenario given the estimate of 6.5 PhD graduates for every biomedical tenure-track academic position in the USA [1], and a Royal Society (UK) report suggesting that as few as 3.5% of PhD graduates secure academic positions [2]. Pertinently, ~30% of respondents disagreed with the statement that 'their supervisor had useful advice for non-academic careers', and only 15% said 'they found useful career resources at their institutions' [1]. Thus, a disconnect

exists between students' hope of becoming a professor and the reality of the job market. Further, pursuing a PhD is stressful, and rates of anxiety and depression amongst graduate students are six times higher than in the general public [3].

Acknowledging the challenges facing graduate students, the Natural Sciences and Engineering Research Council of Canada (NSERC) launched Collaborative Research and Training Experience (CREATE), a grant-based scheme with the onus on cutting-edge, discipline-specific training, and added value components to prepare trainees for the workplace. In 2012, we secured an NSERC-CREATE grant, Host-Parasite Interactions (HPI: 2012–2018), which set the following Program goals to:

- foster the discipline of parasitology from molecules to ecosystems;
- provide a sense of community for parasitology graduate students by being multidisciplinary; and
- use parasitology as the platform to provide professional skills training in order to increase students' competitiveness in the workplace and position them for leadership in their career of choice.

Seven years on, we believe that the HPI Program provides insights into how to improve the PhD experience and illustrates that promoting trainee professional development opportunities also benefits research programs.

What Is the HPI Program?

The Program is not a university administrative unit overseeing enrollment, academic performance, or coursework – it is a training program with a focus on professional development and networking. Parasitology is used as a bridging discipline to encourage and enable trainee engagement by providing a sense of community and a support network, and creating a critical mass of PIs under a unified research theme. The Program spans three universities, with 15 faculty

members and a Program Manager, and has graduated ~150 trainees¹. Research expertise amongst the PIs is comprehensive: helminthology, pathophysiology, drug resistance, protozoology, immunology, ecology, genetics, bioinformatics, genomics and cell biology.

The intent of the program is not to focus on advanced technical training, since this is achieved through individual supervised projects, but to use parasitology as a platform for professional development activities (Box 1). Having the parasitology theme has been critical to the Program's success and is a major reason each HPI trainee partakes in varied professional development and community outreach activities.

A unique feature of the HPI Program, and the main reason for its success, is that it is almost entirely trainee-led (Box 1). With the exception of formal educational activities, the trainees take responsibility for program content, with faculty serving as facilitators. This ownership by the trainees is achieved by the organizational structure of the Program (Figure 1A) and by building a sense of community where the trainees accept responsibility for their career development. Anonymous questionnaires reveal that trainees have a greater affinity with – and feel that training for their career aspirations is better met by – the HPI Program than with the graduate programs in their home universities (Figure 1B). Recognizing that it is their program, the trainees volunteer for the extracurricular activities and take pride in the reputation they generate for the Program. Indeed, the Program grew because trainees from other laboratories became aware of the Program via their peers and actively lobbied/self-selected their way into HPI Program activities. This benefited the Program by increasing recruitment of proactive trainees who recognized the added value the HPI Program brought to their graduate experience.

Box 1. The University of Calgary Host–Parasite Interactions (HPI) Training Program**Key for Success**

- Program is trainee-centric, not fulfillment of faculty member research agendas
- Trainees take ownership and drive activities
- Faculty commits to supporting trainee professional development
- The discipline is used as a platform to deliver training in transferable skills
- Experts deliver content
- Faculty facilitates program activities

Education and Professional Skills

Education

- Invited-speaker seminar series
- Bi-weekly seminar series
- Annual Research day
- Conferences and HPI-sponsored symposia
- Graduate course in parasitology
- One-week techniques workshop

Professional skills

- Academic (CV preparation, paper/grant writing and review, data analysis and presentation, bias in science)
- Nonacademic (e.g., presentation skills, vocal training, project management, project design, conflict resolution, negotiation, mental health and wellness, creativity, intercultural conflict, media communications, interview skills)
- Careers (finding a job, networking, roundtable discussion with MSc/PhD graduates not involved in academia, entrepreneurship)

Team-building

- Annual 2-day off-site bootcamp on transferable skills
- Social events
- Quarterly newsletter

Community engagement

- High-school and primary-school presentations
- Participation in university-based summer camps for schoolchildren
- Halloween monster mash-up at TELUS Spark Science Centre
- TELUS Spark Science Centre – themed adult-education evenings
- Let's talk science and university/faculty open houses
- Education with Canadian indigenous peoples
- Discovery Days, Science Fairs, Science Olympics

Placements

- Opportunities for trainees to gain experience in other laboratories, countries, and careers

Why is this? We believe it is because the HPI Program provides a win–win situation. The student-led approach, with an emphasis on transferable skills (e.g., communication, project management), has helped trainees to develop more self-reliance and become better researchers. In addition, building a sense of community around parasitology has boosted student enthusiasm and engagement in their research projects. We believe that the support network created by the HPI Program also benefits trainee mental health, assists new students settle into their programs, and helps sustain more established students. Trainee testimonials leave no doubt that the camaraderie within the group and diversity of activities (Box 1) elevates the graduate experience¹. This is of particular value for international students who must cope with the rigors of graduate school while settling into a new cultural environment.

One unanticipated benefit has been that increased interaction between trainees sparked curiosity in their peers' research and helped foster new research collaborations between the PIs, including trainee cosupervision. Finally, the HPI Program has significantly enhanced the profile of parasitology research at the University of Calgary, where it has been transformed from a niche discipline to one of a major presence campus-wide, and has been presented as a model for graduate programs juxtaposing professional training with discipline-specific training.

The Importance of the Trainee-Led Approach

The primary goal of the HPI Program is to prepare trainees to succeed in the workplace, and not necessarily in a parasitology-related career. For the Program to enable trainees to identify and pursue their career aspiration(s), the trainees themselves need to be instrumental in directing the Program; this is not about knowing what students need, rather it is listening to what they want and

A Balance between Research and the HPI Program

The sad perception that graduate students are cheap labor to conduct grant-funded research has gained prominence and was recently highlighted in the mainstream media [4]. Whatever the complexities of the debate, it behooves academicians to take such criticism seriously. It

is easy to imagine how a PI might be reluctant to encourage trainees to commit time and energy to other activities due to a concern of reduced research productivity. We find this not to be the case for the HPI Program. As the Program matured, faculty members were increasingly willing to promote the involvement of their trainees and to commit their own time to supporting the Program.

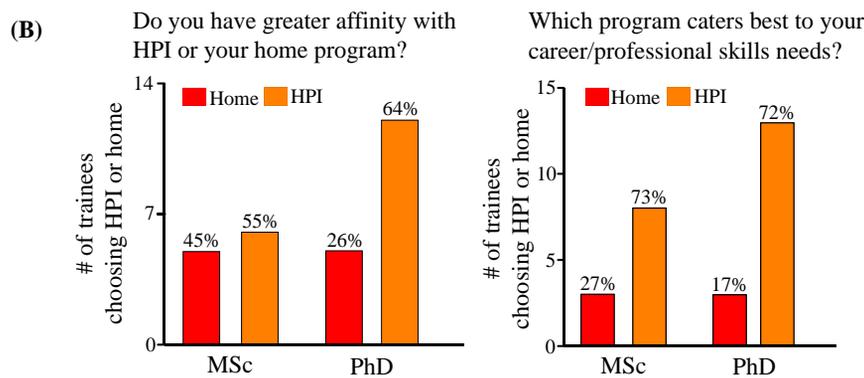
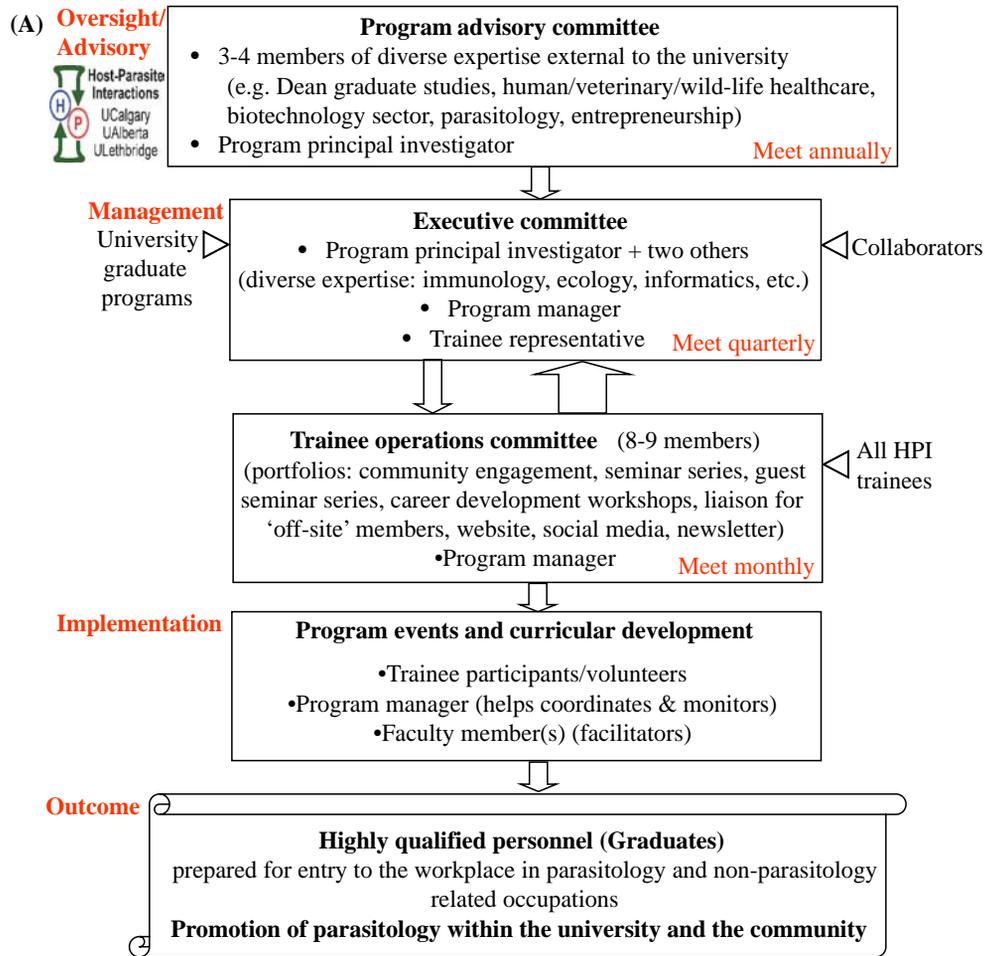


Figure 1. Host-Parasite Interaction (HPI) Program Organization and Trainee Satisfaction. (A) Overview of the organizational structure of the HPI Program, showing governance and operations and the central and key role occupied by the trainees. (B) Anonymous questionnaires of HPI Program trainees (2017) revealed their affinity for the Program over the graduate programs in their home universities (y axis is number of individuals responding to survey question, and % is the percentage of total number of respondents who favored that option).

assisting them in acquiring these skills. Professional development activities are predominantly provided by experts (not the HPI faculty) in small-group settings that are not embedded in scienceⁱⁱ. As examples: vocal training from a lecturer in the drama department; team-building exercise from a member of the arts faculty; martial arts as a means to discipline; and

roundtable discussion with recent MSc and PhD graduates successful in careers beyond academia. We find it useful to conduct some of this training at the annual off-site 2-day bootcamp, where trainee and faculty members participate in all activities.

How Does the HPI Program Operate?

Initially, student scholarships from the NSERC-CREATE grant provided some leverage to encourage faculty and trainee engagement. Whilst this was a valuable catalyst to kick-start the program, it was not a sustainable model for continued success. The HPI Program remains vibrant beyond the original grant-term due to the enthusiasm and engagement of trainees and faculty. The trainees recognize the opportunities provided by the Program and operate in volunteer mode to keep the group active on numerous fronts. The faculty recognizes the benefits to their students, their research programs, and the enhanced profile of parasitology at their institutions.

The driving force behind HPI Program activities is the trainee operations committee on which membership rotates annually to ensure leadership opportunities and committee work experience for the maximum number of trainees, with administrative support provided by the program manager (Figure 1A).

Community Engagement as a Professional Development Tool

Another emphasis of the HPI Program is community engagement and education; this has been a stellar success, reaching over 20 000 members of the community, of all ages, over the past 7 years. Effective communication is paramount in any career, and scientists often have a less than flattering reputation in their ability to relay science to a lay audience. Sessions with experts in science communication made it clear that it is an emotional connection with an individual/audience and not bombardment with facts that resonates with the public. The trainees developed a series of interactive modules

(games, specimens, displays) they use to convey the sophistication of parasite life cycles, anthelmintic resistance, and the impact of parasites on the individual and ecological health to schoolchildren and the public. One signature event organized and delivered by HPI trainees was at the TELUS Spark Science Centre in Calgary that was attended by ~1250 members of the public even though it was at 7–10 p.m. in mid-January! The response to these outreach events has been overwhelming. The trainees grew in confidence, and many became adept at stimulating a curiosity about how parasites affect the world around them. Event organizers and teachers are keen to have continued participation of the HPI Program trainees (faculty mentors attend events for moral support as the trainees deliver the material in an accessible way). Watching the public enthuse (or recoil) in wonder and amazement that swimmers itch is because of a juvenile schistosome, or that the masterful regulation of host immunity by helminths could be exploited to treat autoimmune disease, underscores to the trainees the value of their research.

Concluding Remarks

Globalization, environmental, societal, and climate change, and emerging – and in some cases widespread – drug resistance are making parasitic diseases in humans and animals increasingly relevant and problematic. Advanced research in these areas requires motivated, highly qualified personnel that can convert the benefit of their training into successful careers of their choice. The HPI Program was not designed to solve the problem of parasitic infections; rather, we sought to build community, enhance the graduate experience, and provide students with transferable skills training to follow any chosen career path. Parasitology can be invigorated by the recruitment of high-caliber trainees who will enhance the visibility of the discipline and keep parasitology at the leading edge of innovative research – for this to happen, the trainee's needs, beyond their parasitological expertise, must be held as the primary objective.

Acknowledgments

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Resources

- ⁱwww.ucalgary.ca/hpi/
- ⁱⁱwww.ucalgary.ca/hpi/news-events/career-development-workshops

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Spotlight

Bed Nets, Insecticides, and Antimalarials: Where to Next?

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Insecticide-impregnated bed nets have saved millions from fatal malaria, but their effectiveness is