

FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

Chemistry and Chemical Biology Graduate Programs

Date of Review: April 27 and 28 2021

In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response and assessments of the graduate programs delivered by Chemistry and Chemical Biology. This report identifies the significant strengths of the program, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.

The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Review

In accordance with the Institutional Quality Assurance Process (IQAP), the Chemistry and Chemical Biology programs submitted two self-studies in March 2021 to the Vice-Provost and Dean of Graduate Studies to initiate the cyclical program review of its graduate programs. The approved self-studies presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis. Appendices to the self-study contained all course outlines associated with the program and the CVs for each full-time member in the department.

Three arm's length external reviewers and one internal reviewer were endorsed by the Dean, Faculty of Science, and selected by the Vice-Provost and Dean of Graduate Studies. The review team reviewed the self-study documentation and then conducted a virtual review on April 27 and 28, 2021. The review included interviews with the Provost and Vice-President (Academic); Vice-Provost and Dean of Graduate Studies, Associate Deans, Grad Studies and Research, Chair of the department and meetings with groups of current students, full-time faculty and support staff.

The Chair of the department and the Dean of the Faculties of Science and Health Science submitted responses to the Reviewers' Report (September and October 2021 respectively). Specific recommendations were discussed and clarifications and corrections were presented. Follow-up actions and timelines were included.

Strengths

- 1) Internationally recognized faculty members and research programs.
- 2) Outstanding leadership within the Department and the Faculty.
- 3) World class facilities and instrumentation.
- 4) Affiliation with Centre for Probe Development and Commercialization (CPDC), Biointerfaces Institute, Institute for Infectious Diseases Research, Brockhouse Institute for Materials Research (BIMR), & the McMaster Nuclear Reactor

Areas for Improvement

1. Clear definition of the expectations of the programs
2. Introduction of modular short courses to provide hands-on interdisciplinary training options
3. Introduction of training programs associated with the research institutes
4. Increased EDI training for faculty, staff and students
5. Increased professional development and career planning
6. Strategic plan for sustainability versus growth
7. Review comprehensive exam expectations
8. Expanded graduate student representation

Please outline the recommendations made by reviewers and indicate how you plan to address the recommendations in the chart below.

Recommendation	Proposed Follow-Up	Responsibility for Leading Follow-Up	Timeline for Addressing Recommendation
<p>1. Clear definition of the expectations of the programs. Each program should define and communicate their mission for the recruitment of new students and ensure that all admitted and incoming students are aware of the requirements and expectations of the degree program they have selected.</p>	<p>As suggested, we have updated our website to reflect the proposed definition of chemical biology as “the application of chemical principles to Biochemistry & the Medical Sciences. Examples might include therapeutics, drug delivery systems, medicinal chemistry, or structural biology, where in all cases the use of chemistry is central.” In the meantime, we will also continue to emphasize the Chemistry vs. Chemical Biology differentials in terms of TA, course load and exam milestone expectations during our joint graduate program presentations to prospective students, such as the annual Graduate Information Session (GIS). We</p>	<p>P. Kruse and G. Melacini will continue to work collaboratively on broad information campaign aimed at reaching all members of our graduate communities. We will accurately inform students during the annual GIS and P. Kruse and G. Melacini will discuss this topic with colleagues at departmental meetings, graduate newsletters and workshops.</p>	<p>Underway. A new website for Chemical Biology has been completed, and the administrative assistants of the two programs will undergo training to keep both websites updated as living documents both for recruitment and as a resource for the current students. The information campaign is an ongoing effort starting from the Fall 2021.</p>

	<p>will also encourage our colleagues in both programs to ensure that graduate applicants are aware of such differences before finalizing their choices. We agree that it is in everybody's best interest to ensure that students make an informed decision and enroll in the program that best fits their needs and aspirations. However, we also recognize that chemical biology graduate students cost more to supervisors due to the lower TA load and this may also be a factor in the selection of one graduate program vs. another.</p>		
<p>2. Introduction of modular short courses to provide hands-on interdisciplinary training options. DCCB should review the role of formal graduate courses in graduate student training with the goal of improving efficiency and consistency. Training requirements for each program should be identified (i.e. foundation science, experimental techniques, communication, EDI, etc.) and the mode of delivery selected as appropriate.</p>	<p>We fully understand that shorter but more frequent courses will serve some of our students better, especially the M.Sc. cohort whose graduate tenure is typically limited to only two years and is denser in formal class requirements. Currently, most graduate modules (worth 1.5 units each) are offered only every other year. To address this limitation, we will initiate discussions at departmental meetings and graduate workshops about allowing more flexibility in the scheduling of our graduate modules to better meet the demands of our student population. We will also capitalize on graduate courses offered by other departments and neighboring universities. A process is already in place for visiting graduate students within Ontario without the need of formal admission in other graduate programs or of additional fee payment. Further</p>	<p>P. Kruse and G. Melacini will initiate discussions with colleagues about enhancing the scheduling flexibility of our graduate offerings and planning hands-on workshops. Such discussion will not be limited to McMaster, but we will also contact our counterparts at neighbouring institutions to identify synergies at the level of graduate offerings.</p>	<p>Our graduate teaching schedule is already set until Fall 2022. In addition, this is a substantial change that requires ample buy-in from colleagues and pre-planning with stepwise implementation. So, we do not expect to be able to implement such changes before Fall 2023.</p>

	<p>details about the Ontario Visiting Graduate Student (OVGS) application are available here. To facilitate this process, we will add examples of such courses that have been taken by our students on Grad FAQ page. In addition, we plan to complement our existing graduate module portfolio in CCB with hands-on instrumentation/technique-based workshops for which students will earn micro-credits. In line with these efforts, we will also capitalize on micro-credentials that are being coordinated centrally by the Faculty of Science and the MacPherson institute (see point 5).</p> <p>As to the CB700 milestone, most of the feedback provided by students pertains to a previous edition of this course, as the students who attended the IQAP meeting are all senior and did not have an opportunity to attend the recently revamped version of CB700. The new CB700 now includes two modules: 700A, joint with Chemistry, and focusing on communication and EDI, and 700B, focusing on foundation science and experimental techniques. Both 700A and 700B are offered every year.</p>		
<p>3. Introduction of training programs associated with the research institutes. The self-study from the Chemical Biology graduate program defines 3 key</p>	<p>We concur about the importance of capitalizing on synergies with McMaster institutes. Several PIs in the Chemical Biology graduate program are affiliated with institutes, such as the Institute of Infectious Diseases (IIDR) and</p>	<p>P. Kruse and G. Melacini will approach the directors of CPDC and BI to discuss options for themed symposia. Brainstorming</p>	<p>Summer 2022</p>

<p>institutes that align with the research interests of faculty: i) The Michael DeGroote Institute for Infectious Disease Research (IIDR), ii) Centre for Probe Development and Commercialization (CPDC), and iii) Biointerfaces Institute (BI). These institutes provide an enormous opportunity to PIs and students from the perspective of advanced research facilities and technical expertise. We propose that these key research institutes could be leveraged to enhance research output and opportunities for both the Chemistry and the Chemical Biology Programs by establishing an affiliated Training Program. To borrow from a new evolving policy at the University of Toronto, Research Institutes which fulfill the strategic priorities of the University are provided with additional seed funding on a competitive basis. This seed funding is</p>	<p>the McMaster Institute for Research on Aging (MIRA), that already organize themed symposia and scholarships. The Faculty of Health Sciences (FHS) also organizes an annual FHS plenary that chemical biology graduate students typically attend. We agree that extending similar initiatives to the CPDC, BI and FoS will further enhance our trainee experience. All institutes provide instrumentation training to our trainees on a fee-basis.</p>	<p>about a FoS plenary has already started as part of the mentorship initiative.</p>	
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<p>used to provide themed symposia, poster sessions, student presentations, and workshops, which would be available to students across a wide range of programs who make use of the research institutes.</p>			
<p>4. Increased EDI training for faculty, staff and students. The goal would be to create modules that might encompass ~10-hour exercises and case studies, to be offered annually. These modules could then evolve into more formalized exercises as the upper administration implements EDI training.</p>	<p>As discussed in the recommendation 2 proposed follow up on the introduction of short modular courses, EDI is now a central component of the joint CCB introductory 700 graduate course required for all new graduate trainees. In this graduate module, EDI is approached both conceptually and through case studies with the support of McMaster Equity & Inclusion Office (EIO) staff. In addition, the CCBD in conjunction with the FoS Dean's office is leading several initiatives aimed at stimulating discussions on EDI among faculty, staff and students.</p>	<p>The CCB EDI & Conversation Committee</p>	<p>Ongoing in collaboration with the EIO staff and departmental committees.</p>
<p>5. Increased professional development and career planning. That the program leadership consider incorporating a discussion of career planning during the annual doctoral committee meetings. The student could be asked to identify</p>	<p>We fully agree about the importance to build a personalize career plan over the course of the graduate career to facilitate the transition to employment post-graduation, especially considering that the majority of our trainees may not secure permanent positions in academia. We will ensure that discussions about future career directions start early and become an integral part of</p>	<p>In departmental meetings and graduate newsletters, P. Kruse and G. Melacini will bring to the attention of our colleagues the need to initiate career planning discussions during committee meetings. They will</p>	<p>We plan to have the changes pertaining to the supervisory committee meetings and seminar speakers implemented by the Fall 2022, so we can present and discuss them with our colleagues. In addition, we will coordinate with the</p>

<p>career interest (academic, industry or otherwise) and the committee could discuss strategies for preparing the path. This is not meant to “lock in” any choices, just to open the discussion.</p>	<p>supervisory committee meetings. We will request that the ‘additional direction’ section of our current supervisory committee report includes a summary of such discussions with the goal of identifying mentors from industry or government. This type of mentorship is critical to guide students beyond the specific confines of their academic projects. To further enhance opportunities for meaningful non-academic mentorships, as suggested, we will also:</p> <ol style="list-style-type: none"> <li data-bbox="565 764 881 1255">i. Invite our alumni and other industry/government leaders as seminar speakers and ample opportunities will be given to trainees to interact directly with them during their visits at McMaster. We will also connect our trainees to the Faculty of Science (FoS) alumni initiatives. <li data-bbox="565 1262 881 1896">ii. We will coordinate with and leverage on the FoS mentorship program to further expand networking opportunities for our graduate students. This is a new initiative led by the FoS that expands on already successful similar programs (<i>i.e.</i> Women in Science and Engineering: WISE) and will give our CCB trainees an opportunity to connect with alumni and 	<p>also check that a summary of such discussions is included in the committee reports prior to signing them. P. Kruse and G. Melacini will also proactively suggest or solicit suggestions of CCB seminar speakers from industry and government. We will start from our substantial network of alumni. P. Kruse and G. Melacini will also pro-actively serve as liaisons between our trainees and the mentorship, micro-credential and alumni initiatives currently being led by the FoS. We will introduce our students to these opportunities in the initial training sessions as well as in our regular Q/A sessions with CCB graduate trainees, which typically occur twice a year. G. Melacini will add the LSO to the CB website.</p>	<p>ongoing mentorship and micro-credential initiatives led centrally by the Faculty of Science (FoS). The FoS is in the process of launching Graduate Career and Graduate Mentorship program pilots this Fall and full implementation over the next three years. The Science Career and Cooperative Education Office (SCCE) will be overseeing the career initiative. Students in both Chemistry and Chemical Biology graduate programs will have the opportunity to participate in these initiatives and be able to network with alumni, get career guidance, acquire new sets of skills through workshops and micro-credentials, and have experiential learning opportunities.</p>
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	<p>leaders in other fields as well. In addition, we will coordinate with the Science Career and Cooperative Education Office, who will be engaging in several career development projects to better support graduate students.</p> <p>iii. We will also rely on the 'microcredential' initiative in the FoS to offer opportunities for industry/management-related professional training to our students.</p> <p>iv. We will add a link to the Life Science Ontario (LSO) site to our CB website.</p>		
<p>6. Strategic plan for sustainability versus growth. The committee brought up the realities of graduate studies in Ontario and the evolution of doctoral and MSc caps. Faculty are under the impression that as other graduate units come and go; this will not be a problem. At the same time, there was no real strategy or consensus on how to react at a departmental level or the level of individual faculty to the transition from a</p>	<p>In alignment with the institutional graduate enrollment quota, our strategic priority is currently on the recruitment of top graduate students as opposed to further expansion (<i>i.e.</i> prioritize quality vs. quantity). While the number of chemical biology applications over the last three years has on average increased in excess of 40% relative to the previous three years, our most recent acceptance rates are now below 25%. This reflects our stringent acceptance criteria, especially considering that the applications we receive are often already pre-vetted by our faculty members through personal correspondence and interactions. Furthermore, the recent (2018-2020) 40% increase in the number of</p>	<p>P. Kruse and G. Melacini</p>	<p>We will continue to monitor our growth and consider a balanced growth vs sustainability model</p>

<p>growth model to a sustainability model. Specific Recommendations (where applicable): We recommend that Department analyze the consequence of the imposed cap to graduate student recruitment to estimate the risk for young faculty and the risk to a healthy distribution of students among various research groups.</p>	<p>applications speaks to the reputation of our faculty and demand for our program. Within the same timeframe, we have also witnessed a shift in the number of accepted students coming from undergraduate programs outside of McMaster. In 2018-2020, this non-MAC cohort has become much of our incoming class, which means that our program is highly visible, and its reputation is attracting students nationwide as well as internationally. Nevertheless, VISA students remain a minority because of increased tuition costs at the M.Sc. level and of the hesitation of most faculty members to accept foreign students directly into the Ph.D. program. The quality of our graduate students is also clearly reflected by their success in graduate scholarship applications (in excess of \$325K in scholarships awarded this year alone to chemical biology graduate students).</p> <p>The chemistry graduate program has seen steady enrolment numbers over recent years, with some fluctuations due to faculty renewal (retirements and new hires), so in a way we have been in a sustainability model for some time now. We accept less than 20% of applicants, with uptake limited by research grant funding. Our fraction of international students has remained steady at around 1/3, with domestic students being a healthy mix of graduates from our own undergraduate</p>		
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	<p>program(s) and from across Canada.</p> <p>As suggested, we have also analyzed the consequence of the imposed cap to graduate student recruitment and currently the distribution of students among research groups does not seem to overly favor senior PIs. Presently, the average number of chemical biology graduate students per PI is 2.7 for assistant, 3.0 for associate and 2.1 for full. Based on these data, it does not seem that the enrollment cap is penalizing our junior colleagues. However, we agree that support should be provided to ensure that such distribution of graduate students to PI in different ranks remains healthy over time.</p>		
<p>7. Review comprehensive exam. The evaluation criteria and parameters related to the comprehensive exam for both programs should be reviewed and the objectives of the review should include clarity, objective evaluation criteria and uniformity within each program. In addition, the review should acknowledge that this type of exam may be susceptible to unconscious biases and presents a risk</p>	<p>The overarching goal of the comprehensive exam remains the enhancement of breadth in the training of our doctoral students to complement the depth of their specific research projects. We are aware that such breadth challenge, defined by the 'distance from the research area of the student' and the time allowed to 'travel' it, may vary from group to group. Hence, careful central supervisions will be exerted to minimize student-to-student variance in breadth, while acknowledging that even with best intentions variations may remain due intrinsic differences among sub-disciplines and logistical scheduling constraints. In the case of the Chemical Biology comprehensive exam,</p>	<p>P. Kruse and G. Melacini</p>	<p>Winter/Spring 2022</p>

with respect to equity and inclusion.	this problem was exacerbated by the lack of a written component, but this has already been addressed as noted.		
8. Expanded graduate student representation. Include graduate student representatives on the advisory board for each program.	While we routinely consult with our graduate student base through surveys, follow up workshops, and regular Q/A sessions, we agree that student representation in the advisory boards offers a more direct means to include feedback from trainees. We have added one student representative to each graduate program advisory board, and we have also invited graduate student representatives (one Chem & one ChemBio) to our CCB departmental meetings.	G. Goward, P. Kruse and G. Melacini	Fall 2021

Faculty Response

We sincerely thank all three reviewers for their thorough and constructive review of the Chemistry graduate program and the Chemical Biology graduate program. The programs put together very thorough IQAP self-study documents that describe a wide range of activities to support interdisciplinary training of graduate students. The reviewer report highlights many strengths of this research-focused program, including its students and supervisors. This Dean's response is submitted jointly between Science and Health Sciences in recognition that the Chemical Biology Graduate Program is a joint program between those Faculties.

We have reviewed the program's response to the review and fully agree with proposed plans and timelines for improvement and enhancement. It should be noted that many of the recommendations are already being implemented or planned to be addressed in the near future. We agree with the proposed time frames and action plans on the remaining items. Both Faculties see the Chemical Biology graduate program playing a crucial role in producing high-quality trainees with expertise at the interface of Chemistry, Biochemistry and Medical Sciences, and are, therefore, committed to supporting it.

The occasion of the review was an opportunity to reflect on the collaborative relationship between the Faculties of Science and Health Science in offering the Chemical Biology Program, although it is noteworthy that the reviewers offered no comments in this regard. The administrative and

intellectual home of Chemical Biology is clearly in the Faculty of Science. However, the program is important to Health Sciences faculty who recruit students with strong undergraduate backgrounds in chemistry to work on research problems in biochemistry. Consultations within the Faculty of Health Sciences suggest that this relationship is currently working well, and we will continue to foster and monitor the collaboration to ensure that students have access to the excellent supervision and research opportunities in both Faculties.

We would like to highlight the recommendation for increased EDI training for faculty, staff and students. McMaster University and the Faculties of Science and Health Sciences are advancing our shared EDI strategic plan goals centred around inclusive excellence. We will support and encourage the programs in an enhancement in training and activities related to EDI.

With respect to the recommendation for increased professional development and career planning. The programs are actively working with supervisors and other stakeholders to implement the recommendation. Additionally, they will be supported by central initiatives coordinated by the Associate Dean of Graduate Studies (Science) office. Specifically, Faculty of Science is in the process of launching Graduate Career and Graduate Mentorship program pilots in the fall term 2021 and full implementation over the next three years. Students in Chemistry and Chemical Biology graduate programs will have the opportunity to participate in these initiatives and be able to network with alumni, receive career guidance, acquire new sets of skills through workshops and microcredentials, and have experiential learning opportunities.

Quality Assurance Committee Recommendation

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation and the committee recommends that the program should follow the regular course of action with an 18-month progress report and a subsequent full external cyclical review to be conducted no later than 8 years after the start of the last review.