**Program Progress Report**

**Institutional Quality Assurance Program (IQAP) Review**

**CHEMISTRY AND CHEMICAL BIOLOGY GRADUATE PROGRAMS**

**Date of Site Visit:** April 27-28, 2021

**Date of Submission of Program Response:** September 28, 2021

**Date of Submission of Dean's response**: October 18, 2021

**Date of Progress Report Submission:** October 2024

**Progress Report Prepared by:** Gillian Goward (Departmental Chair), Peter Kruse (Associate Chair, Graduate Studies) & Giuseppe Melacini (Director, Chemical Biology Graduate Program)

**Review team members:**

**External:** Anna Ritcey, Université Laval; Scott Prosser, University of Toronto; Neil Burford, University of Victoria

**Internal:** Ana Campos, School of Interdisciplinary Science

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| Recommendation:<br>**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. |
| Responsibility for Implementation:<br>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. |
| Anticipated Timeline for Completion: Fall 2021 |
| Additional Notes/Commentary:<br>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) and departmental web pages. We 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. |

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| Progress (check one)<br>X Completed<br>☐ In Progress<br>☐ Other (please explain) |
| Department's Comments:<br>This item has been completed. We have clarified the program expectations, including the differences between the chemistry and chemical biology graduate programs in terms of TA-loads and milestones (*e.g.,* transfer and comprehensive exams, committee meetings and course requirements). These clarifications were communicated through multiple media, from updated websites and handbooks to revised information graduate information sessions. We anticipate this information campaign will lead to more informed decisions when future applicants decide between the chemistry and chemical biology graduate programs. |
| Dean's Comments:<br>Thank you for the prompt completion of this action and the ongoing efforts to ensure that students are making informed choices. |
| QAC Comments (to be filled in by Quality Assurance Committee):<br><br>QAC reviewed this report and had no further comments or concerns |

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| **2. Introduction of modular short courses to provide hands-on interdisciplinary training options.** The Department of Chemistry and Chemical Biology (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. |
| Responsibility for Implementation: 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. |
| Anticipated Timeline for Completion: Ongoing |
| Additional Notes/Commentary:<br>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 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 and here. 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 educational and learning opportunities that are being coordinated centrally by the Faculty of Science and the MacPherson institute (see point 5).

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.

Progress (check one)

☐ Completed

X In Progress

☐ Other (please explain)

Department's Comments:

On the Chemical Biology side, we have reorganized the milestone Chemical Biology 700B graduate module to give more emphasis to common chemical biology techniques, including a critical assessment of their advantages and limitations. Having a better grasp of common techniques is crucial for our trainees to secure industry jobs. In addition, the chemical biology graduate program allows for a high degree of flexibility in the choice of graduate courses. Half of the required courses can be selected from offerings provided by seven affiliated departments (Chemistry & Chemical Biology, Physics & Astronomy, Biology, Biochemistry & Biomedical Sciences, Pathology & Molecular Medicine, Medicine, Chemical Engineering). We have launched a survey to collect more data and gauge interest in holding workshops on specific skill development, such as cell culture. However, the response rate was low, so we will attempt again. In the meantime, we also started conversations with the leadership of the Center for Advanced Light Microscopy (CALM) to ensure that our trainees have full access to their workshops, courses, internships, and summer schools.

On the Chemistry side, we are maintaining our 1.5 credit modules (which we continue to see as the minimum feasible course length), but have started to offer skills-focussed modules that are mapped onto 1-week Summer School offerings by our facilities, in particular Chem 799 "Fundamentals and Applications of Advanced Light Microscopy" offered by CALM starting Summer 2023 and Chem 799 "Radiopharmaceutical Chemistry" offered by the McMaster Radiochemistry and Radiopharmaceuticals group (https://www.mcmasterradiochemistry.com) starting Summer 2024. The course offerings can be taken for credit by our students and are coupled with an optional fee-based hands-on training experience offered by the respective facility. All facilities are already offering basic user training for our students, and the Canadian Centre for Electron Microscopy (CCEM) has recently launched a new set of training modules (https://ccem.mcmaster.ca/ccem-academy/microscope-training-program/) but those cannot be taken for Chemistry course credit. We hope to further expand the Summer School offerings coupled to Chemistry course credits in the future.

Dean's Comments:

I am satisfied that substantial efforts have been made to address the recommendations and that the appropriate adjustments have been made to these plans as the landscape for graduate training

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| evolves (ie introduction of training modules in CALM, Radiopharmaceuticals and CCEM). These graduate programs have been leaders in Science with respect to inclusion of EDII and communication skills in their required graduate courses. |
| QAC Comments (to be filled in by Quality Assurance Committee):<br><br>See above. |

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| Recommendation:<br>**3. Introduction of training programs associated with the research institutes.** The self-study from the Chemical Biology graduate program defines 3 key 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. |
| Responsibility for Implementation:<br>P. Kruse and G. Melacini will approach the directors of CPDC and BI to discuss options for themed symposia. Brainstorming about a FoS plenary has already started as part of the mentorship initiative. |
| Anticipated Timeline for Completion: Fall 2025 *was:* Summer 2022 |
| Additional Notes/Commentary:<br>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 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 (i.e., through its annual Graduate Symposium) will further enhance our trainee experience. All institutes provide instrumentation training to our trainees on a fee-basis. |
| Progress (check one)<br>☐ Completed<br>X In Progress<br>☐ Other (please explain) |
| Department's Comments:<br>We actively worked with the leadership of Nuclear Operation Facilities to promote broad CCB engagement with the Nuclear Reactor Facility and related *ad hoc* training. In this context, several training initiatives are now available to our graduate trainees. For example, the Mitacs/Fusion training program provided an opportunity for eight graduate students to spend a week in August shadowing team members at various departments (sales, regulatory, production, quality control) at Fusion |

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| Pharmaceuticals. This provided students with networking opportunities and a chance to observe the commercial side of radiopharmaceutical production. In addition, Dr. Sadeghi and Dr. Inkster are working with Nuclear Operation and Facilities to offer a summer graduate course on radiopharmaceuticals that brings in participation of students from King's College London UK. They also now have a partnership agreement with University of Alabama at Birmingham to exchange students and collaborate on various projects. Besides radiopharmaceuticals, several of our faculty members are also affiliated with several institutes (*e.g.,* IIDR, BIMR, MIRA, and BI) thus facilitating access of our trainees to institute specific training. Dr. Wylie is also working with Dr. Hoare to explore opportunities for new CREATE grants that will involve our research institutes. |
| Dean's Comments:<br>It is excellent to see the progress being made to leverage the resources and expertise in our research centres and core facilities to benefit graduate students. The Faculty of Science will continue to support these activities where possible. |
| QAC Comments (to be filled in by Quality Assurance Committee):<br>See above. |

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| Recommendation:<br>**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 Equity, Diversity, and Inclusion (EDI) training. |
| Responsibility for Implementation: The CCB EDI & Conversation Committee |
| Anticipated Timeline for Completion: Ongoing in collaboration with the Equity and Inclusion Office (EIO) staff and departmental committees. |
| Additional Notes/Commentary:<br>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. McMaster's Equity and Inclusion Office also offers several programs and resources that faculty, staff and students can access and complete. In addition, the DCCB in conjunction with the Faculty of Science (FoS) Dean's office is leading several initiatives aimed at stimulating discussions on EDI among faculty, staff, and students. |
| Progress (check one)<br>☐ Completed<br>X In Progress<br>☐ Other (please explain) |

Department's Comments:
Both graduate programs have benefited from the excellent work of the CCB EDI & Conversation Committee, which includes several graduate students. In addition, Dr. Wylie started a new accessibility fund dedicated to students in need with the goal of improving quality of life and equitable access to graduate school. For example, this fund can be requested to cover expenses related to special office equipment for medical issues. We also launched the second edition of the Inclusive Excellence Scholarship, whose Term of Reference was updated in coordination with the FoS's Equity, Diversity, Inclusion, and Indigeneity (EDII) office to honor student privacy, while improving access by clearly explaining the goals and eligibility requirements of the scholarship. In addition, as part of a mandatory 5-hour training for teaching assistants (TAs), students complete a module in Anti-Oppression (2 hours), and 2 hours of elective workshops which can include Accessibility/Disability Inclusion (1 hour), Anti-Racism (1 hour), Introduction to Indigenous Cultural Competency (1 hour) and Human Rights Fundamentals (1 hour).

Dean's Comments:
Progress continues in this area in the Department, at the Faculty level and across campus. CCB has been a leader in many of these areas and we look forward to continued progress in collaboration with the Office of the Associate Dean EDII in Science.

QAC Comments (to be filled in by Quality Assurance Committee):

See above.

Recommendation:
**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 career interests (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.

Responsibility for Implementation:
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 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.

Anticipated Timeline for Completion: Fall 2025 *was: Fall 2022.* 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 ongoing career, mentorship and micro-credential initiatives led centrally by the Faculty of Science (FoS). The FoS launched the Graduate Career and Graduate Mentorship programs in 2022. 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.

Additional Notes/Commentary:
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 many 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 supervisory committee meetings. We 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:

**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, including the annual SciGSA Alumni event.

**ii.** We will coordinate with and leverage 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.e.* Women in Science and Engineering: WISE) and will give our CCB trainees an opportunity to connect with alumni and leaders in other fields as well. In addition, we will coordinate with the Faculty's Associate Dean (Graduate) and the Science Career and Cooperative Education Office, who will be engaging in several career development projects to better support graduate students.

**iii.** We will also rely on the 'microcredential' initiative in the FoS to offer opportunities for industry/management-related professional training to our students.

We will add a link to the Life Science Ontario (LSO) site to our CB website.

Progress (check one)
☐ Completed
X In Progress
☐ Other (please explain)

Department's Comments:
We are complementing the significant career planning support provided by the FoS (https://science.mcmaster.ca/graduate/graduate-student-career-services/) through efforts within our graduate programs. The FoS has also started mentorship programs that tie into the career orientation efforts (https://science.mcmaster.ca/graduate/graduate-mentoring-program/). We have already successfully pilot tested a simple committee meeting form designed to stimulate discussions about professional development with the supervisory committee. The form simply asks the trainee to identify broad area of future employment (academic, government or industry) and the required skills, networking and mentoring to prepare for the desired job. Additional networking opportunities are

provided by the annual (since 2022) FoS Graduate Research Symposium (https://science.mcmaster.ca/graduate/graduate-research-symposium/) and the Chemical Biology symposia.

Dean's Comments:
Excellent progress is being made on this recommendation.

QAC Comments (to be filled in by Quality Assurance Committee):

See above.

Recommendation:
**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 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.

Responsibility for Implementation:
P. Kruse and G. Melacini

Anticipated Timeline for Completion: Fall 2025 *was:* We will continue to monitor our growth and consider a balanced growth vs sustainability model.

Additional Notes/Commentary:
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.e.,* prioritize quality *vs.* quantity). While the number of chemical biology applications over the last three years has on average increased more than 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 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 (approx. 20% of master's students) 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 (more than $325K in scholarships awarded this year alone to chemical biology graduate students).

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 program(s) and from across Canada.

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.

Progress (check one)

☐ Completed

X In Progress

☐ Other (please explain)

Department's Comments:

Domestic graduate student funding is capped in Ontario since 2019. Hence, we plan to prioritize quality *vs.* quantity in our graduate hiring. This may also become a necessity given the increased graduate stipends without corresponding increments in our tuition and government grant funding, which has been stagnant for several years. We are also planning to introduce a one-year MSc program to retain our best undergraduate students and complement research intensive 12–15-unit undergraduate theses.

Dean's Comments:

I support the CCB Department actions and considerations around graduate program size. The funding constraints are in direct contrast to the increased costs associated with TA wages, minimum stipends and affordability for graduate students. New faculty members have all been provided with start-up funds to support their graduate student supervisory aspirations in the first 2-3 years of appointment and we will continue to monitor graduate admission processes to ensure that junior faculty are not penalized due to funding constraints.

QAC Comments (to be filled in by Quality Assurance Committee):

See above.

Recommendation:

**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 with respect to equity and inclusion.

Responsibility for Implementation:
P. Kruse and G. Melacini

Anticipated Timeline for Completion: Fall 2025 *was:* Winter/Spring 2022

Additional Notes/Commentary:
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, this problem was exacerbated by the lack of a written component, but this has already been addressed as noted.

Progress (check one)
☐ Completed
X In Progress
☐ Other (please explain)

Department's Comments:
Expectations for comprehensive exams have been clarified in the handbooks. In addition, we plan to organize comprehensive exam coaching sessions in coordination with the graduate student society with the goal to demystify the comprehensive exams in both programs. We are in the process of organizing two comp coaching sessions for the Chemical Biology and Chemistry graduate students, as the two programs have different comp expectations. In Chemical Biology, students are expected to write a comprehensive review of their field, while in Chemistry they are asked to write a competitive research proposal outside their research project. Both comp session will attempt to identify and remove specific barriers to equity in access to comp resources and support.

We are also planning to create a database of comprehensive exam reports from previous students who successfully passed. Access to this database will be provided to all students preparing for comprehensive exams. Furthermore, we will give an opportunity to students to informally practice their comprehensive exam presentation at the monthly Chemical Biology journal club, which will provide early informal feedback.

Dean's Comments:
The Department is making considerable progress in addressing this recommendation.

QAC Comments (to be filled in by Quality Assurance Committee):

See above.

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| Recommendation:<br>**8. Expanded graduate student representation.** Include graduate student representatives on the advisory board for each program. |
| Responsibility for Implementation:<br>G. Goward, P. Kruse and G. Melacini |
| Anticipated Timeline for Completion: Fall 2025 *was:* Fall 2021 |
| Additional Notes/Commentary:<br>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. |
| Progress (check one)<br>X Completed<br>☐ In Progress<br>☐ Other (please explain) |
| Department's Comments:<br>Graduate student representatives now attend at least one CCB department meeting per term and we actively consult graduate students on the IQAP implementation. They have been active members of the IQAP advisory committees and graduate administrative staff hiring committees. We also reach out to students through regular graduate townhalls. In addition, we now have a graduate section in our CCB Newsletters in which we highlight individual graduate students. |
| Dean's Comments:<br>Each department in Science is being asked to develop unit level by-laws which will, among other things, help to codify the inclusion of student representatives on governance bodies. |
| QAC Comments (to be filled in by Quality Assurance Committee):<br><br>See above. |