**FINAL ASSESSMENT REPORT**

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

**CHEMISTRY AND CHEMICAL BIOLOGY UNDERGRADUATE PROGRAMS**

**Date of Review: March 22 - 23, 2022**

*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 undergraduate and graduate programs delivered by the Department of History. 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 Department of Chemistry and Chemical Biology submitted a self-study in January 2022 to the Vice-Provost Faculty to initiate the cyclical program review of its undergraduate programs. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis. Appendices to the self-study contained the CVs for each full-time member in the department.

Two arm's length external reviewers and one internal reviewer were endorsed by the Dean, Faculty of Science, and selected by the Vice-Provost Faculty. The review team reviewed the self-study documentation and then conducted a review on March 22 – 23, 2022. The review included interviews with the Provost and Vice-President (Academic), Vice-Provost Faculty, , Dean of Faculty of Science, Associate Dean, Academic, Chair of the Department, Undergraduate Chairs 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 Faculty of Science submitted responses to the Reviewers' Report (April 2023). Specific recommendations were discussed and clarifications and corrections were presented. Follow-up actions and timelines were included.

**The following program strengths were identified:**

- A good mix of disciplinary and interdisciplinary science that fosters collaboration among students, faculty, and staff.
- Numerous experiential learning opportunities.
- Student surveys indicate that the programs exceeded or significantly exceeded the majority of students' expectations.
- Innovation in both programs. ChemBio was the first program of its kind in Canada and has served as a model for other institutions. SusChem is the first such undergraduate program in Canada.
- Most innovative is the widespread use of inquiry-based teaching and peer mentoring.
- Excellent response to the COVID-19 pandemic.
- CCB is highly respected by all stakeholders, including students, the faculty, and the university academic administration.
- CCB has shown a strong desire and ability to "re-invent" itself to take advantage of the changing landscape of chemistry.
- CCB's strong track record of research support furnishes ample research opportunities for undergraduate students.
- The instructional support staff team functions very well.
- Enrollment in the Chemical Biology program has grown from ~120 to ~175 students since 2012, reflecting the popularity of this sub-discipline.
- Excellent rate of completion of work terms (100%) by co-op students, with numerous students receiving recognition as Science Co-op Student of the year.
- The success of the CCB Mentorship Circle Program in supporting undergraduate students was recognized

**The following areas of improvement were suggested:**

The reviewers made 26 recommendations for improvements in the areas of curriculum, teaching & assessment, resources, recruitment, and governance. There was no overarching theme among the recommendations, so the department has addressed each one individually in the section below.

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**Implementation Plan**

| | Recommendation | Proposed Follow-Up | Responsibility for Leading Follow-Up | Timeline for Addressing Recommendation |
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| 1. | In consultation with relevant Departments, CCB should consider the addition of STATS 2B03 (Statistical Methods for Science) as a recommended or required Level 2 course for all programs under review and, to accommodate the addition, postpone the offering of CHEM(BIO) 2A03 to winter term. At the very least, the Department should consider the addition of sufficient statistics content to CHEM(BIO) 2A03, possibly in the form of tutorials, to facilitate the data analysis performed in this course. | (1) The statistics section was modified significantly in 2022 by the new instructor to address concerns about a lack of clarity. It now occupies the first three weeks of lectures, and includes videos on how to use Excel and conduct statistical tests. Chem/ChemBio 2A03 is now self-contained with regards to statistics content (measures of central tendency, error estimation and propagation, confidence interval, t-, Grubb's, and F-tests). We will continue to monitor student feedback and make changes as necessary. In addition, in 2023 the first lab will be moved back to better align the statistics content with the lab.<br><br>(2) We will investigate the viability and potential impact of adding a statistics course (e.g., Stats 2B03) to the recommended (not required) course list in Level 3 (or by graduation). We agree that this would be a useful addition since | Associate chair (undergrad), Chem/ChemBio 2A03 instructor | (1) Starting from Fall 2022<br><br>(2) 2 - 3 years |

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| | | many students will require statistics in their post-graduate education. | | |
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| 2. | To better prepare students for the linear algebra and coding content covered in CHEM 3PC3, the Department, in consultation with the Math Department, should either (i) introduce a new prerequisite, (ii) add relevant content to one or more existing prerequisites or, (iii) modify CHEM 3PC3 to introduce the required background content. | Chem 3PC3 is intended to introduce basic skills in linear algebra, amongst other content, in preparation for quantum chemistry (Chem 3PA3). As some students take linear algebra in Level 1 but others do not, there will inevitably a mixture of backgrounds (and therefore performance and perception of difficulty) in this part of the course.<br><br>According to the instructor, concerns around Chem 3PC3 in 2021 stemmed largely from the programming section of the course, which is taught in conjunction with linear algebra. Nonetheless, the course average was 83%, so it was not overly difficult. The Python section was modified in 2022 to address those concerns. It will be further modified and monitored in future years. Hence, option (iii) is preferable.<br><br>We will:<br><br>(1) Continue to monitor and re-assess, if necessary, the linear algebra and | Associate chair (undergrad), curriculum committee, Chem 3PC3 course instructor | (1) Starting from Fall 2022 – 2023<br><br>(2) 2 – 3 years |

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| | | programming component of Chem 3PC3, and<br><br>(2) Coordinate with the initiative by Physics and Astronomy on Programming in Science to increase students' access to experience in programming, and make those resources available to our students as they are developed. | | |
| 3. | CCB should meet with Chemistry Co-op students to discuss the issues they are encountering and work with the Co-op office and perhaps professional networks to secure more relevant job placements for these students. | There was a comment about "a lack of co-op jobs listed as chemistry". This suggests that this student believed they could only apply for jobs reserved for a specific program. Science Careers and Cooperative Education (SCCE) has confirmed that students are told multiple times that co-op students are eligible to apply to any position for which they meet the required skills regardless of whether the word "Chemistry" appears in the job description. This has been confirmed by people present during the information sessions.<br><br>We will poll program students about this issue, but it does not appear to be a widespread concern. | Associate chair (undergrad), SCCE | Ongoing |
| 4. | The CCB curriculum committee should consider the "other student recommendations" (i) and (ii) listed in **Section 3(i)** as soon as possible | The specific recommendations were to: | n/a | n/a |

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| | and discuss a more formal and frequent process for soliciting future feedback on curriculum issues from all members of the Department, including students. For example, the Department should engage in discussions with the Department of Biochemistry as to how to best serve the knowledge requirements of the ChemBio students or consider offering their own biological chemistry course to meet these needs. | (1) *Add a Level 3 analytical chemistry course*.<br><br>There is already one Level 3 analytical chemistry course, CHEM 3AA3 (Instrumental Analysis). There is no compelling pedagogical reason to add another, and we do not have the resources to mount it. Nonetheless, we will survey program students to see if there is widespread support for a new analytical chemistry course.<br><br>(2) *Replace required Biochemistry and Biology courses with courses taught within CCB*.<br><br>We are actively pursuing options with regard to the Biochemistry courses (Biochem 3G03, Biochemistry of Macromolecules, and Biochem 2EE3, Metabolism and Physiological Chemistry).<br><br>With respect to the Biology courses, Chemistry and Chemical Biology are by their nature interdisciplinary subjects, and it is important for students to be exposed to other perspectives, including biologists' (Biol 1A03, 1M03, 2B03). These three courses cover the basics of their respective subjects, and if they | | |

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| | | were taught by CCB, the content would be much the same, with a slightly different emphasis and less expertise. This would not be an efficient use of teaching resources, nor in the students' best interest. | | |
| 5. | CCB should consider ways to make lab curriculum renewal possible. One option would be to have teaching faculty supervise CHEM 3RP3 or CHEM 4RP6 students in Chemistry Education Research (CER) projects focused on lab curriculum renewal. Alternatively, the Department could consider hiring TAs during the summer to assist with the development or revising of lab curricula where required. | Lab curriculum has been usually done on an ongoing basis, often using TA support in the summer, as well as undergraduate or graduate students through the MacPherson's student partner program. The pandemic forced an adaptation for remote delivery, but as we return to normal course delivery, we plan to review, revise, and refresh our lab offerings. We have hired an instructional assistant (IA), Ernest Prack, dedicated to the upper-year labs. He is tasked with curriculum renewal in collaboration with two faculty members.<br><br>In addition to the student support cited above, we will investigate adding experiential education students through Chem/ChemBio 3EP3 to work on lab development in collaboration with Dr. Prack and course instructors. (Chem 3RP3 and 4RP6 are research | Undergraduate curriculum committee; IA for upper-year labs | Ongoing |

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| | | focused and not suitable for lab development projects.) We will also explore the increased involvement of undergrad summer students in lab development. | | |
| 6. | CCB should consider ways to utilize teaching faculty as catalysts for continued evaluation, enhancement, adaptation, and invigoration of Departmental teaching and assessment methods and formally recognize them, e.g., with course remissions and, if appropriate, teaching award nominations. All faculty members should be encouraged to utilize the expertise available through the MacPherson Institute. | There are three parts to this recommendation:<br>(1) using teaching faculty as a resource for other instructors,<br>(2) recognizing teaching faculty with award nominations and<br>(3) using the expertise of the MacPherson Institute.<br><br>(1) CCB already has in place a process of annual teaching peer evaluations of assistant and associate professors by experienced instructors. As the teaching faculty progress in their careers, they will take on an increasing role in this process of assisting their peers. At present, two teaching faculty are too early in their careers (less than 3 years) to take this major responsibility. Nevertheless, we agree that the expertise of teaching faculty should be widely shared within our department to the benefit of all instructors. The teaching | Associate chair (undergrad) | Ongoing |

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| | | faculty already run an informal monthly lunch-and-learn meeting to discuss teaching strategies. We will extend this invitation to all CCB faculty and create a written repository of teaching strategies.<br><br>(2) Teaching faculty in CCB are in the process of building the portfolios and track records that will soon make them competitive for teaching awards. They have received internal awards and grants such as the Partnered in Teaching and Learning grants and the Teaching and Learning Fellowships. We will nominate them for other external teaching awards as soon as their files are competitive.<br><br>(3) Faculty are already encouraged to use the MacPherson Institute's expertise. For example, they often organize in course and program refinement exercises and course (re)design workshops. McMaster's new strategy (Partnered in Teaching and Learning) will also add expertise | | |

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| | | here, as one of the impact areas involves Inclusive Excellence and Scholarly Teaching, with a theme area on evaluation of teaching. In addition, we will consult with the Faculty's Education Developer Liaison staff member (Kris Knorr) to further enhance the learning experience of our students. | | |
| 7. | Lab instructors and faculty should review lecture and lab content together to increase alignment between the theory presented and the experiments conducted in all courses with integral lab components. | The lab component was designed with the lecture course content in mind. However, it is possible that over time, and especially because of the pandemic, the lecture-lab links have been blurred.<br><br>There is a limit to how well the labs lectures can align in time because lecture content changes faster than labs, and some experiments must be done in rotation (i.e., students do different labs each week in rotation) as certain equipment cannot be made available to more than 8-10 students at a time.<br><br>We will survey the current course/lab offerings and explicitly highlight to students the connections between lecture topics and lab experiments and how they both relate to the primary course objectives. This | Undergraduate curriculum committee; IA for upper-year labs | 2 – 5 years |

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| | | will be a task for the new instructional assistant in courses that include a lab component (e.g., Chem/ChemBio 2OG3, 2A03). | | |
| 8. | The Department should review the scheduling of those Level 3 courses that serve as a specific pre-requisite for a corresponding Level 4 course offered in alternative years and actively advise students to facilitate planning their program. In subdisciplines with typically low course enrolments, e.g., theoretical/computational chemistry, the Department should make attempts to justify course offerings despite the failure to meet the 20-student minimum. | We agree that offering several Level-4 courses in alternating years can create issues for some co-op students, who are not on campus in the Winter of Level 3 and Fall of Level 5. There is no simple solution to create a schedule that works for everybody, especially since it is not typically possible to finalize the Level 4 offerings until June of the preceding academic year. Nonetheless, we will try to make the schedule clearer to the students. We will also specifically reach out to our co-op students by teaming up with the SCCE office and will add an academic advising component to the Mentorship Circles to make students aware of the issue early on.<br><br>We are already working to meet the 20-student minimum requested by FoS by offering some courses in alternate years. These courses are needed to maintain the diversity of courses | Chair, associate chair (undergrad) | Starting 2023 |

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| | | required by the Canadian Society for Chemistry (CSC) for accreditation of the Chemistry programs. Offering them in alternate years allows us to simultaneously maintain course diversity and increase enrolment in these courses. | | |
| 9. | CCB should identify courses across the curriculum that may rely too heavily on a small number of high stakes assessments and either (i) supplement these with formative, low stakes assessments, (ii) replace them with larger numbers of smaller formal assessments, or (iii) adopt more flexible grading schemes. | (1) This recommendation appears to relate to one specific course in which the evaluation was based on two group presentations. The evaluation mechanism for this course has already been modified and its effectiveness will be assessed.<br><br>(2) As a more general approach, given the large number of inquiry-style projects in upper year courses, the department will discuss the use and best practices for group work, including the use of within-group peer evaluations. Within-group peer evaluations allow for individual marks to be assigned in group projects and allow high contributing students to be rewarded for their efforts. We have successfully implemented such evaluation schemes in second year inquiry courses (Chem/ChemBio 2Q03). | Associate chair (undergrad), curriculum committee | (1) ongoing<br><br>(2) 1 – 2 years |

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| | | (3) CCB will encourage adding more low stakes assessments, including quizzes, mid-terms and/or assignments, and introducing more "milestone" assessments that provide interim feedback on larger projects. | | |
| 10. | CCB should work with other Departments within the Faculty of Science (and beyond if necessary) to coordinate midterm exam schedules across all years of the programs under review. A simple solution that works well at one reviewer's institution to avoid conflicts and space midterm tests as much as possible is to use a central document (e.g., Google spreadsheet sorted by Levels) to which instructors can post midterm test days and times well in advance. | This is already being done for Level 1 and 2 courses by the Undergraduate Program Advisor and by the Level 1 Coordinator. | Undergraduate Program Advisor for upper-level courses, Level 1 Coordinator for Chem 1A03/1AA3 | Ongoing |
| 11. | The Department should prioritize the request for recruitment of two research-active faculty members: one in inorganic chemistry and one in sustainable chemistry. | The department will take this recommendation into account in future hiring discussions. While departmental hiring priorities are not within the scope of this committee, we will certainly bring this point to the attention of our colleagues. | Chair | N/A |
| 12. | Working with the Faculty of Science, the Department should advocate for hiring an additional | An instructional assistant, Dr. Ernest Prack, was hired in Fall 2022, and has begun work on upper year lab courses. | Chair, IA search committee | Fall 2022 |

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| | instructional assistant to support the upper-year laboratory courses. | | | |
| 13. | The Faculty of Science should consider supporting the Department's hiring of an additional administrative assistant to facilitate interactions with and advising of undergraduate students, as well as maintenance of social media sites. | CCB has recently hired a new Admin Assistant / Undergrad Program Advisor (Masarrat Saiyed), and will be hiring an Assistant Administrator, who may be able to take on some of these roles. We will also consider hiring a work-study student to assist with website maintenance and social media maintenance.<br><br>In addition, the CCB website will be migrating to WordPress in the next 1 – 2 years, which will make social media integration easier. | Chair | 1 – 2 years |
| 14. | The Department should review processes for making TA assignments to ensure the best match possible between course content and TA academic background and experience, utilizing senior undergraduate students in cases where a good match cannot be found. | An SOP, written by the associate chair (grad), Peter Kruse, already exists for TA assignments. The SOP includes asking for both instructors' and grad students' preferences for TA assignments in terms of both tasks (lab, tutorial, marking) and expertise, and undergrad TA hiring. Furthermore, we are taking advantage of the interdisciplinarity of the Chemical Biology graduate program to best match course content to student expertise. For example, we implement TA swaps between students supervised by | Associate chair (grad), Level 1 coordinator | Complete |

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| | | Biochemistry and CCB PIs. The SOPs are reviewed periodically. | | |
| 15. | All faculty members should work with the IAs assigned to their courses to develop a plan for better use of more modern, specialized equipment in the teaching labs. | Experimental education in our courses is in transition. Introductory experiments in analytical and organic chemistry were revised when the laboratory was reintroduced into CHEM 2OG3 and 2AA3 in 2019. The contents of CHEM 2LB3 and 3LA3 will be reviewed in 2022-2023. Current experiments in those courses can be adapted to take advantage of the bench-top NMR. New opportunities for enhancing the courses were created with the recent acquisition of infrared spectrometers with attenuated total reflection (ATR) accessories that make it very easy for students to use for liquid and solid samples. There are also new UV-vis spectrometers, GC and HPLC chromatographers, and new digital melting point instruments. ChemBio 3OA3 will reinstate the lab component that was cancelled during the last two years due to the COVID-19 pandemic.<br><br>Instructional assistants are already involved in designing and updating labs in Level 1 (Linda | IA, individual course instructors. | Ongoing, to be completed by 2024. |

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| | | Davis/Rebecca Turner), Level 2 (Kylie Luska) and upper levels (Ernest Prack). Undergrad lab technicians have been polled for equipment needs. We will conduct on a regular basis a formal review of the lab experiences to identify opportunities for modernization. This type of review will assist with identifying major equipment to be requested for lab renewal in each budget cycle. | | |
| 16. | The Department should work with the Faculty of Science to ensure that plans are in place to accommodate future requirements for office space and research and teaching laboratory space given recent hires, increasing enrollments and the staff needed in support of both. | We will continue to work with the Dean's office to ensure that suitable space is available to support our undergraduate programs as enrollment increases. | Chair | Ongoing |
| 17. | The Department should focus on developing a social media site that is up-to-date and highlights the exciting research and experiential opportunities taking place in the Department and celebrates the achievements of its undergraduate and graduate students. | See response to recommendation #13. The department as whole, the Level 1 general chemistry, and the Level 2 organic chemistry teams are active on Instagram and Facebook. The department coordinates with the undergraduate society (MUSCS) on social media posts. We also started a CCB e-newsletter to | Chair, associate chair (undergrad) | Ongoing |

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| | | highlight and celebrate our achievements. | | |
| 18. | The Department should modify administrative staff responsibilities to include recruitment efforts. For example, administrative staff (currently, Linda) could reach out to CHEM 1A03 students with a welcome message, information on research, Co-op and career opportunities, and an invitation to respond with an expression of interest in the Chemistry, Chemical Biology or Sustainable Chemistry program and/or follow-up questions. | See recommendation #13. In addition, we will connect with SCCE to come up with messaging content and strategies to make co-op opportunities more visible especially to Level 1 students. We will also connect with the Associate Dean's office and staff support available in that office focused on recruitment & advising to upper-level programs, *e.g.,* the Manager of Undergraduate Recruitment & Education. | Recruitment, in-reach, outreach (RIO) committee | 1 – 3 years |
| 19. | Based on information gathered through implementation of Recommendation 18 and conversations and observations from CHEM 1A03 lectures and labs, the Department should consider establishing one or more special lab sections in CHEM 1AA3 to build a sense of community among Level 1 students identified to have an interest in the Chemistry, Chemical Biology and/or Sustainable Chemistry programs. | Special research sections of the Chem 1AA3 labs were run by the Level 1 course coordinator in the 2010s. They were effective in engaging a cadre of 16 highly motivated Level 1 students. However, they were extremely resource intensive, and by his estimate they resulted in 1 – 2 Chem students and 3 – 4 ChemBio students per year entering Level 2. Moreover, the Faculty voiced concerns about unequitable treatment of students. Overall, the special lab sections gave a poor return on | Level 1 coordinator | 2 – 4 years |

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| | | investment in terms of Level 2 recruitment.<br><br>Once the current Level 1 course coordinator returns from parental leave in 2024, we will investigate other initiatives that students have enjoyed previously (e.g., crystal growing competitions, Chemistry Olympiads) that require fewer resources and are accessible to more students. This would likely involve pre-defined rather than research experiments using more advanced techniques / equipment than the general Chem 1AA3 labs.<br><br>Once the Office of Undergraduate Research has been established, we will consult with them about increased Level 1 opportunities. | | |
| 20. | The Department should make it a priority to place excellent senior Chemistry & Chemical Biology (and Sustainable Chemistry) undergraduate TAs in the Level 1 Chemistry labs and base part of their training on recruitment efforts. | This is already being done. TAs in Level 1 chemistry labs are often upper-year undergraduate students who make themselves visible by wearing black lab coats. They are typically active in our undergraduate society (McMaster Undergraduate Society for the Chemical Sciences, MUSCS). In addition to their TA duties, they also act as ambassadors for the program by volunteering to take part in | Level 1 course coordinator, RIO committee | Complete |

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| | | recruitment events that the RIO committee runs, such as the Sci 1A03 introducing lecture, Fall Preview, and the Level 2 program fair. See also recommendation #23. | | |
| 21. | Instructional support staff, in collaboration with faculty members, should incorporate additional real-world examples, particularly those highlighting research at McMaster and across Canada, into the Level 1 laboratories. | We are currently developing a Level 1 lab focusing on microwave synthesis to highlight the sustainable chemistry program at McMaster. We also regularly incorporate both real-world examples and research in our department during the Level 1 lectures.<br><br>Once the Office of Undergraduate Research has been established, we will consult with them. | Level 1 course coordinator, Level 1 instructional team | Ongoing |
| 22. | The Faculty of Science should work with the Faculty of Health Sciences and the Provost's Office to try to mitigate attrition of students from the Chemical Biology program that could arise from moving the Biochemistry program from the Faculty of Science to the Faculty of Health Sciences. | There has been little attrition from ChemBio to Biochemistry in the upper levels over the last five years. One student transferred to Biochemistry in 2017, and fewer than two per year transferred to the Biomedical Discovery and Commercialization, a third year entry program.<br><br>We agree that it will be important to continue to closely monitor potential attrition due to the move of the undergraduate Biochemistry program from FoS | Dean, Chair, Associate Chair, and curriculum committee | Ongoing |

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| | | to FHS. We have initiated discussions with the Dean's office about how to preserve and possibly increase recruitment in the ChemBio program by taking advantage of the complementary relationship between the two distinct curricula, with ChemBio and Biochemistry being currently focused on molecular and cellular aspects of biological system, respectively. We will also continue to actively advertise our Chemical Biology program to students in Level 1 gateway programs to minimize potential attrition within that cohort. | | |
| 23. | The Department should increase the number and frequency of formal and informal opportunities for Level 1 students to interact with senior undergraduate Chemistry, Chemical Biology and Sustainable Chemistry students and faculty members. These interactions should be used to demonstrate and communicate the tight-knit community and increased opportunities for interaction with professors, including options for research, compared to competitor programs. | The first-year labs for CHEM 1A03/1AA3 already make extensive use of undergraduate TAs, who act as ambassadors for the program in addition to their TA duties. We will consult with the Office of Undergraduate Research on how to further expand on these ongoing initiatives. For example, we plan to invite Level 1 students to our graduate colloquium day, our graduate information session and 4$^{th}$ year thesis night to connect with more senior students. | Level 1 coordinator | Ongoing |

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| | See also response to recommendation #20. | | | |
| 24. | The Department should develop terms of reference for standing committees. In doing so, the Department should consider "best practices" for diversity, inclusiveness, and equity. | Terms of reference have already been written for the core facilities and EDI (equity, diversity, inclusion) committees. The rest of the CCB departmental committees have been requested to elaborate their own. | Chair | 1 – 3 years |
| 25. | The Department should continue to support and encourage the Mentorship Circles Program. | Thank you for the endorsement. | Mentorship circles committee | Ongoing |
| 26. | The Department should consider using the Mentorship Circles Program as an important vehicle to promote awareness among students about career options (e.g., presentations from chemists working in biotech companies, pharma, government, patent law, academia, etc.). | We agree that this is an excellent idea. In fact, the mentorship circle held its first alumni event in February 2022, during which recent alumni discussed their career paths with undergraduates. We expect this to continue annually. Furthermore, the departmental seminar series is open to everyone in the department, including undergraduates, and has already included some career talks, in addition to research talks. The seminars committee is planning to make such events regular and advertise them to undergraduate students. We will further expand on these career-networking events by connect with the SCCE office and the alumni advancement team within | Mentorship circle and seminar committee | Ongoing |

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| | | the Dean's office. We have circulated a list of CCB alumni (primarily grad school graduates) who have identified themselves as willing to meet current students. The department will provide funds for local travel to meet these alumni. | | |

**Dean's Response**

**Faculty of Science**

Curriculum/Teaching & Assessment (Recommendations 1 – 10)

The IQAP reviewers have provided numerous thoughtful suggestions for the modification of course content, recommended courses, and refreshed laboratory experiences to the CCB curriculum. The CCB unit is clearly embracing these recommendations and is taking action with content changes already underway in several courses and with particular attention to lab experiences led by a new Instructional Assistant with support from instructional faculty. There are also clear steps being taken to enhance instruction and diversify assessment methods using thorough reviews of student experience survey (course evaluation) feedback, peer observation and feedback from research and teaching stream faculty, and expert support through the MacPherson Institute; including workshop attendance and consultations with Scholarly Teaching/Educational Development Liaisons.

Resources (Recommendations 11 – 16)

As noted in the Department's response, prioritization of new faculty appointments is guided by processes that extend beyond the IQAP committee as a comprehensive needs assessment that may include the reviewers' suggestions. The Faculty of Science has been actively engaged with the Chemistry and Chemical Biology Department leadership in support of the reviewers' recommendations and the unit's other priorities for resource needs. We were pleased to have the hiring of Dr. Ernest Platt to develop and refine laboratory experiences and Masarrat Saiyed to enhance service provision in the academic program advising spaces. In addition to the activities and improvements planned for website and social media targeting enhanced communication with students, the Faculty of Science has also encouraged all academic units to create Department-specific content space in the Learning Management System

(Avenue to Learn) where students are alerted to important and time-sensitive information in a similar manner to how they receive announcements and updates in each of their courses.

The Faculty acknowledges the consistency between the reviewers' recommendations and Department's standard operating procedures for assigning Tas and encourages continued refinements to optimize the alignment of TA expertise and the needs of the course as well as TA's preferences and opportunities to gain valuable teaching experience for their own professional development. The Faculty continues to work concertedly with the CCB Department to ensure their teaching, research and administrative space and resource needs are maintained and has supported strategic investments in new equipment (e.g., infrared and UV-vis spectrometers) in addition to their innovative efforts to expand, modernize and diversify laboratory experiences for students at all levels.

Recruitment (Recommendations 17 – 23)

The Faculty of Science recognizes the Reviewers' recommendations to undertake and amplify efforts and to promote interest and accessibility to the Chemistry and Chemical Biology programs among 1$^{st}$ year students and in the broader university. As noted in the Department's response, several existing and developing initiatives are being implemented to increase enrolment in the Program specializations that begin in Level 2. The Faculty supports these efforts through the Office of the Associate Dean-Academic where the Manager of Undergraduate Recruitment and the Science Career and Cooperative Education (SCCE) office are coordinating events and activities along with the Department's Recruitment, In-reach, Outreach (RIO) committee (e.g., "what to do in Level 2") to showcase innovative laboratory experiences linked to research and relevant real-world applications of Chemistry, Chemical Biology, and Sustainable Chemistry through the diverse curriculum, cooperative education opportunities, and career pathways available through the Specialization Programs.

The Faculty of Science also launched the Office of Undergraduate Research in January, 2023 and has implemented communications through online and social media channels that are connecting undergraduates in all disciplines with research opportunities including: graduate and undergraduate research student "shadowing" activities, LabCrawls, research workshops, undergraduate research colloquia, and a host of 'new' summer research experiences funded in partnership with the Provost's Office as well as external funders such as Canadian Nuclear Laboratories that are particularly relevant to students in Chemistry, Chemical Biology, and Sustainable Chemistry.

Governance (Recommendations 24 – 26)

Recommendations to codify terms of reference and procedures in the Chemical and Chemical Biology Department are consistent with the Faculty of Science's initiatives to have all Academic units to develop by-laws, terms of reference, and/or any other relevant

governance structures and procedures that standardize and make transparent all aspects of their strategic operations. McMaster University and the Faculty of Science are actively advancing shared equity, diversity, inclusion, and indigeneity (EDII) strategic plans and objectives. I support and encourage the Chemistry and Chemical Biology program in an enhancement of training and activities related to EDII.

With respect to the recommendation for increased professional development and career planning through the implementation of Mentorship Circles and other activities, the programs are actively working with supervisors, alumni, and other stakeholders to implement these recommendations.

**Quality Assurance Committee Recommendation:**

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation at the April 25, 2023, meeting. The committee recommends that the **Chemistry and Chemical Biology undergraduate programs** 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 eight years after the start of the last review.