UNIVERSITY OF TORONTO

University of Toronto Quality Assurance Process (UTQAP)
Cyclical Review: Final Assessment Report and Implementation Plan

Programs Reviewed:	B.Sc. Hons., Biological Chemistry (Specialist) B.Sc. Hons., Chemical Physics (Specialist) B.Sc. Hons., Chemistry (Specialist, Major, Minor) B.Sc. Hons., Environmental Chemistry (Specialist, Minor) B.Sc. Hons., Materials Science (Specialist) Minor in Nanoscience, Joint program with the National University of Singapore B.Sc. Hons., Synthetics & Catalytic Chemistry (Specialist) M.Sc., Chemistry Ph.D., Chemistry
Unit Reviewed:	Department of Chemistry
Commissioning Officer:	Dean, Faculty of Arts & Science
Reviewers (Name, Affiliation):	1. Prof. John Hepburn, Vice-President, Research & International, and Professor, Department of Chemistry, University of British Columbia 2. Prof. Robert Lemieux, Dean of Science, and Professor, Department of Chemistry, University of Waterloo 3. Prof. Rik Tykwinski, Chair, Department of Chemistry, University of Alberta 4. Prof. Richard M. Crooks, Department of Chemistry, University of Texas, Austin
Date of review visit:	March 19 – 20, 2018
Date reported to AP&P:	November 1, 2018

Unless otherwise noted, all bulleted comments apply to all programs reviewed.

1 Outcome

The Committee on Academic Policy and Programs (AP&P) concluded that there were no issues to be drawn to the attention of the Agenda Committee but requested a follow up report in one year to provide an update on the development of a standardized research requirement within undergraduate programs. The follow-up report will be considered by AP&P at the Cycle 2 meeting in 2019-20.

2 Significant Program Strengths

- Department is an international leader in Chemistry
- High entering undergraduate averages
- Impressive time-to-completion of graduate students
- Department research areas well-aligned with real-world needs
- Strong departmental inventions record, faculty publications, and success rate in external funding competitions

3 Opportunities for Program Enhancement

The reviewers recommended that the following be considered:

- Enhancing the undergraduate programs through increased clarity of program learning objectives and course content; improving research and experiential learning opportunities; increasing student engagement in labs and tutorials; adding content on social and ethical responsibility and data analysis; and increasing guidance for teaching and syllabus development
- Exploring ways to boost enrolment in the Chemistry Specialist and Major
- Strengthening ties with graduates to improve the departmental resource base
- Addressing issues impacting graduate student morale and experience including international graduate student enrolment and professional development and training opportunities
- Addressing the lack of faculty renewal, which could have a negative impact on the department's research profile and limit the department's ability to address its gender imbalance
- Addressing challenges around travel/transportation, technology, and engagement of faculty and students at UTM and UTSC
- Increasing internal consultation with faculty, staff and students, including around facilities, business models, and strategic planning
- Tapping into relationships faculty members have with external organizations to extend the Department's reach
- Exploring options for revenue generating opportunities in professional development and/or extended credentials

UNIVERSITY OF TORONTO
FACULTY OF ARTS & SCIENCE

October 12, 2018

Professor Susan McCahan
Vice-Provost Academic Programs
University of Toronto

Re: UTQAP cyclical review of the Department of Chemistry

Dear Professor McCahan,

Along with the faculty, staff, and students of the Department of Chemistry, I am pleased with the external reviewers' assessment of the Department of Chemistry and its programs: Biological Chemistry, B.Sc. Hons. (Specialist); Chemical Physics, B.Sc. Hons. (Specialist); Chemistry, B.Sc. Hons. (Specialist, Major, Minor); Environmental Chemistry, B.Sc. Hons. (Specialist, Minor); Materials Science, B.Sc. Hons. (Specialist); Minor in Nanoscience, Joint program with the National University of Singapore; Synthetics & Catalytic Chemistry, B.Sc. Hons. (Specialist); and Chemistry, M.Sc., Ph.D. The reviewers complimented the Department on being *"one of the leading, if not the leading, Chemistry department in Canada, and easily ranks amongst the best in the world."*

The quality of this program notwithstanding, as per your letter dated August 28, 2018, the review report raises a number of issues and challenges. I am writing to address the areas of the review report that you identify as key. The response to these items and implementation plan are separated into immediate (6 months), medium (one to two years), and longer (three to five years) terms, where appropriate, along with who (Program Coordinator, Department, Dean) will take the lead in each area. The Department of Chemistry has discussed the reviewers' comments through consultation with various groups and has begun to implement changes where appropriate and that are consistent with the Department of Chemistry's mission.

Undergraduate

The reviewers recommended providing more clarity on program learning objectives and course content. They recommended improving research and experiential learning opportunities, adding content on social and ethical responsibility and data analysis, and increasing guidance for teaching and syllabus development.

Several steps are being taken to address these concerns over the next two academic cycles (AY 2018-19 and 2019-20).

Immediate-term response: The Department of Chemistry has struck two committees to renew the curricula of the large 1st and 2nd year course offerings: CHM135, CHM136, and CHM247, including adding content on social and ethical responsibility and the importance of critical analysis of data. This curriculum renewal will be supported by the work of the new A&S First

Year Foundations Council, which is developing a coordinated approach to enhancing first-year academic offerings across the Faculty. The Department has also reached out to the Curriculum Development Specialist in the office of the Vice-Provost, Academic Programs for additional support.

Medium-term response: The Department has scheduled a Departmental retreat for February 2019, during which the learning objectives of its programs will be revisited by faculty subgroups. The various sub-discipline groups at STG will also be asked to review their advanced level courses (3rd and 4th Year) with a view to reviewing course syllabi, identifying possible improvements and clarifying course offerings to avoid unnecessary overlap of content and to provide a more streamlined path toward developing skills and knowledge in the discipline. A&S will support this retreat process, equipping Chemistry with resources and advice in terms of undergraduate data and curricular change that allows the Department to consider its renewal in light of wider trends and initiatives in the Faculty.

The Department will also apply for ATLAS funding with the goal of enabling a few instructors to spend substantial amounts of time in AY 2019-20 to work on renewal of the courses, particularly for first and second year introductory courses.

Finally, efforts are underway to add an increased focus on data analysis to several of the Department's courses. The Department is writing a LEAF grant to obtain funding to network more of its laboratory instruments and make digital data from more of its undergraduate laboratory instruments readily available to students (e.g., via Quercus). This will enable better data analyses to be incorporated into the laboratory portions of several courses. In addition, a new faculty hire plans to introduce a 300- or 400-level Science Studio course which will have a strong focus on data analysis (either in AY 2019-20 or 2020-21).

The reviewers recommended seeking ways to improve student engagement in labs and tutorials.

Immediate-term response: One way the Department is currently working to improve laboratory engagement is through two ATLAS grants that were funded last year. One faculty member will be introducing a glucose monitoring lab into the physical chemistry portion of CHM151 labs. Another faculty member will be introducing Arduino microcontrollers into CHM417 laboratories. The Department will also improve laboratory and tutorial engagement through the Department's Chemistry Teaching Fellows Program, which pays stipends to graduate students and post-doctoral fellows who, with a faculty supervisor, design new materials for course use. For 2018-19, the Department funded twelve such proposals, half of which proposed to make improvements to laboratories.

Medium-term response: The Department notes that it would benefit from access to better rooms. Rooms that are appropriate sizes, and can facilitate group work (for example, by allowing desks to be grouped) would change the way the Department is able to run tutorials. Related to this, the Department would appreciate appropriate room assignments earlier in the year. This year, the Department was working to get tutorial rooms assigned for their large chemistry courses after the start of classes. Naturally, this is a high priority for the Department: course instructors and TAs must know what kind of rooms they will be in to plan the most engaging tutorials possible. There have been many challenges across the Faculty this past year in relation to the centralized ACE room booking system, and the Faculty is working to implement better coordination between

ACE and A&S-level participation in room bookings, which should help to resolve some of these issues.

Research experiences are provided to students either through research courses or paid summer positions (e.g., NSERC USRA). The Department acknowledges that not all specialist students participate in such research experiences. This is primarily due to a lack of associated research funds (research costs are estimated to be approximately $1.5-2K per CHM499Y student) and space to accommodate these students.

Longer-term response: Currently, some Chemistry tutorials are large; for example, the average tutorial group in CHM135 is 50 students. The Faculty will work with the Department to examine options for enhanced TA funding aimed at reducing tutorial sizes.

The reviewers commented on the declining enrolment, variation in enrolment across the specialist programs, and the high attrition rate of the Chemistry Specialist and Major. The reviewers recommended exploring developing new programs to boost enrolment.

Immediate-term response: Enrollment is a challenge, especially given the planned decrease in the number of undergraduate students at the STG campus. The Department hopes that curriculum renewal of its large 1st and 2nd year courses will result in attracting more students to Chemistry programs.

Medium-term response: Other means (e.g., considering new programs) to increase enrolment in Chemistry programs will be a subject for discussion during the Department's upcoming Faculty Retreat. It would likely not be until AY 2019-20 or 2020-21 that any new proposals could be implemented. In the short term, one Departmental initiative that we hope will help is that beginning in 2018-2019, students who have chosen Chemistry programs will be given the option to have faculty mentors, who will meet with them at least twice a year.

A reimagined Pharmaceutical Chemistry Program (currently led by the Faculty of Pharmacy) will involve Chemistry taking the administrative lead on this program. The Department anticipates that greater flexibility to include chemistry courses in order to meet the program requirements will be possible.

The reviewers recommended strengthening ties with graduates to improve the Departmental resource base.

Immediate-to-medium-term response: The Department will work with the Faculty Advancement office to explore possible ways to address this recommendation. The Department also anticipates that the faculty mentor program will help strengthen ties with students in the longer term. Implementation of any new plans would occur in AY 2019-20 or 2020-21.

Graduate

The reviewers recommended addressing several issues identified by graduate students that impact student morale. These include: a desire for qualifying exams to be more uniform across campuses; increasing the frequency and meaningfulness of meetings with departmental leadership; improved coordination of coursework to avoid content overlap;

and, resolving the issue of a student holding a TA-ship at one campus while being primarily located on another campus.

As noted above the Department will hold a Faculty Retreat in February 2019, focusing on the student experience, broadly defined. Coordination of graduate course content and developing a more uniform approach to the graduate program requirements across sub-disciplines and between campuses will be one of the questions that will be addressed during the retreat.

Immediate-term response: It is not possible to commit to students that their TA work will always align with their home campus. While every effort is made to accommodate TA preferences for their assigned course, section, and campus, the distribution of available work may not always align with those preferences. In such instances, it is normal for TA's to work on different campuses from their home unit. In units where 100% of graduate students are affiliated with St. George (which is the majority of units), TA's may work at UTM or UTSC.

Immediate-to-medium-term response: In recognition of challenges with standardizing the graduate experience across all three campuses, the Chair recently appointed a UTM faculty member as Associate Chair of Graduate Studies. This faculty member is a full professor of Chemistry with a cross appointment to the Biochemistry department and with significant administrative experience, having served as the Director of the Master of Biotechnology Program, serving 84 graduate students, for 8 years.

As noted, the new Associate Graduate Chair will be tasked with reaching out to the UTM and UTSC campuses with the intention of creating a more cohesive tri-campus community. This has begun with (well-attended) annual retreats for all faculty and joint events planned across campuses. The Chair will also make annual visits to UTM and UTSC to consult with students and faculty there. In addition, the recently expanded Graduate Student Advisory Committee (GSAC) group includes tri-campus representation of graduate students (see below).

The reviewers observed that most graduate students are recruited from the Greater Toronto Area, and recommended working to remove any barriers to international enrolment to the graduate degrees, if possible.

The University of Toronto has recently reduced tuition fees for international PhD students to the same level as those paid by domestic PhD students, which will have a positive impact on the Department's efforts to recruit and retain top international students.

Immediate-term response: A new recruiting initiative with Mexico which the Department hopes will attract additional environmental, analytical and physical chemistry students, is being led by two Chemistry faculty members who will travel there this fall.

The reviewers indicated that the Department should more clearly identify professional development and training opportunities available for graduate students.

Immediate-to-medium-term response: The Department's former Associate Graduate Chair has been tasked with revamping professional training in the Department's Masters and Doctoral programs. The Department has initiated new professional development workshops to be held throughout the year. At the same time, the Department is examining practices of cognate departments such as the (professional) Master of Biotechnology Program, which routinely

interfaces with a number of chemistry and pharmaceutical industries in the GTA, to identify professional events that might serve the program.

An International Doctoral Cluster was established this year that will allow organic, inorganic, and materials synthesis students to conduct research in Germany. Also, several students in the Department have participated in industrial placements including those arising from NSERC CREATE programs.

Faculty, students and/or staff can also apply for A&S Milestones and Pathways funding to run professional development events in their unit. In addition, students can access Faculty-led M&P programming. This year, A&S is hosting events aimed at students interested in careers outside of academia; these are advertised to each graduate unit.

Faculty

The reviewers were concerned that the lack of faculty renewal would have a negative impact on the department's research profile and limit the department's ability to address its gender imbalance.

While the Department agrees that there are substantial challenges related to lack of faculty renewal, there is little that can be done to address this outside of new hiring, particularly with regards to gender imbalance. At STG, the solution is somewhat dependent on future retirements or the opening of new salary lines by the Faculty of Arts & Science, as well as access to new research space. Chemistry will continue to emphasize the need for future new hires and will apply for new faculty positions through applications to the Faculty Appointments Committee (FAC). Units submit requests in March of each year for consideration by the Faculty Appointments Committee, which includes faculty representatives from across the three FAS sectors (the Humanities, Social Sciences, and Sciences) as well as the Colleges. After considering the full range of requests, the FAC makes recommendations to the Dean. Any requests for additional faculty has an impact across the division, and as such, faculty appointments are considered not in isolation, but with respect to needs that exist across the Faculty.

Hires at the suburban campuses are determined by strategic priorities at UTM or UTSC, and growth can be anticipated in line with projected growth in student numbers according to institutional plans. UTM and UTSC each have their own critical mass in life science chemistry and environmental chemistry, respectively. Research, training, and facilities at each campus are also in a rapid growth phase. UTM will soon begin building a new Life Science and Medicinal Chemistry Research building with the intention of hiring three new senior researchers related to Medicinal Chemistry, new animal facilities, 90 dedicated fume hoods, and extensive facilities for related biological sciences. This building represents one of the University of Toronto's largest building initiatives. UTSC has also seen significant growth and focus through their recent construction of the Environmental Science and Chemistry Building and two new hires. In both cases, these initiatives stand to greatly strengthen the Department of Chemistry and its graduate offerings, and help to address imbalances between the campuses.

Recently, the UTM campus initiated a specialist program in Medicinal Chemistry adding to their Chemistry major program and a Biological Chemistry specialist program. At the same time,

UTM runs a successful professional program in Biotechnology which, in fact, recruits many UofT chemistry undergraduates. A new Professional Master's program in Digital Health will begin in May 2019 at UTM. These new programs create opportunities for the Chemistry graduate program in terms of possible joint hires or research foci, which overlap with Medicinal Chemistry for example.

Together these initiatives will strengthen the research profile across the tri-campus Chemistry Graduate Department.

Immediate-term response: Supporting diversity is a key priority for A&S moving forward. Indeed, the Faculty is putting in place training for academic administrators in partnership with TIDE (Toronto Initiative for Diversity and Excellence – see: http://www.faculty.utoronto.ca/resources/enhancing-diversity/). In November 2018, the Faculty will be hosting a Lunch and Learn on Equity, Diversity and Inclusion in Faculty Recruitment.

Longer-term response: The Department will continue to advertise positions in a way that encourages gender diversity, and diversity more generally.

Administration

The reviewers made several recommendations to address challenges around travel/transportation, technology, and engagement of faculty and students at UTM and UTSC.

The Provostial Tri-Campus Review, currently underway, will examine issues concerning graduate studies; this will be especially salient for units such as Chemistry that have graduate activities on all three campuses.

Immediate-term response: The Department is currently reviewing its video-conferencing capabilities to increase tri-campus engagement. The goal is to establish a solution where all three units are using the same video-conferencing platform or program to decrease technical issues and ensure all users are familiar with the technology. In particular, the Department requires that graduate students from all three campuses must attend seminars in their respective disciplines.

The Department is now actively seeking new turn-key technology and a universal multi-platform software solution for cross-campus seminars, meetings, and classes. At this moment, the Department is testing Zoom (https://www.zoom.us/) as this is currently being adopted on the UTM campus. At the same time, the Department is addressing a lack of technical support available for seminars and classes needing video-links. While UTM and UTSC have dedicated technicians to facilitate video-conferencing, the Department of Chemistry (STG) is addressing the need to facilitate timely execution of video-conference events.

Medium-term response: At STG there are a large number of research labs as well as shared research facilities. In order to more efficiently use these resources and space, the Chair has established an ad hoc space planning committee with assigned faculty members. Further consultation will be conducted with staff and students once this initial group has provided feedback on facilities and space.

The reviewers recommended forming a task force composed of faculty, staff and students to "review the departmental facilities and make recommendations to the Chair on appropriate business models and strategic planning to insure their long-term sustainability, including management structure, technical support, instrument maintenance and renewal and funding model" (p.18).

Immediate-term response: The Department CAO is retiring in December 2018. Once a new replacement is in place (renamed as Director, Operations and Technical Services), the Department will proceed with a review of issues related to facility renewal.

The reviewers recommended increasing internal consultation with faculty, staff and students.

Immediate-term response: There are currently a variety of events and committees that the Department has developed to solicit feedback from faculty, staff, and students:

- Faculty meetings are conducted four times a year.
- The Chair will introduce weekly "Chair Office Hours" to give department members an opportunity to meet with him directly. (AY 2018-19)
- With regards to graduate students, the Chair has introduced a new recruitment process for the Graduate Student Advisory Committee (GSAC). In the past, members were identified by faculty. To solicit more diverse feedback, a direct call for 2018-19 members was sent to students. All self-identified members were accepted.
- The Chair will conduct Town Halls with faculty, staff, and students for special initiatives and projects to ensure department members have an opportunity to express their views.

The reviewers recommend tapping into relationships faculty members have with external organizations to extend the Department's reach.

Immediate-to-medium-term response: The Department currently involves alumni through a variety of formal programs (e.g., mentoring, seminars, awards, etc.). The Chair will work with faculty and the Graduate Office to identify a larger group of participants who can engage directly with students and these programs as well as champion the Department in other professional circles.

Medium-to-longer-term response: The Department will consider the concept of establishing an advisory board consisting of alumni and key decision makers in industry and academia, which could allow for a more effective network for purposes of professional development, employment, and strengthening the reputation of our existing research programs through outreach.

The reviewers suggested exploring options for revenue generating opportunities in professional development and/or extended credentials.

The Department currently does not have the capacity to support this type of activity. Consequently, there is no obvious desire at the current time to initiate a purely Chemistry-led professional development program. Such an initiative would require careful planning and identification of an individual(s) to lead the program. Nonetheless, Chemistry remains open to such an opportunity, including partnering with other units or Departments in mutually beneficial programs.

To conclude, we appreciate that the external reviewers recognized the Department of Chemistry's strengths and noted a few areas for development. The Department of Chemistry has already begun to move forward with plans to address the recommendations as presented by the reviewers.

Sincerely,

David Cameron

David Cameron,
Dean and Professor of Political Science

cc.
Rob Batey, Chair, Department of Chemistry
Poppy Lockwood, Vice-Dean, Academic Planning and Strategic Initiatives, Faculty of Arts & Science
Daniella Mallinick, Director, Academic Programs, Planning and Quality Assurance, Office of the Vice-Provost, Academic Programs
Andrea Benoit, Academic Review Officer, Office of the Dean, Faculty of Arts & Science

5 Executive Summary

The reviewers identified the programs' strengths as the Department's position as an international leader in Chemistry; high entering undergraduate averages; impressive time-to-completion of graduate students; department research areas well-aligned with real-world needs; and a strong departmental inventions record, faculty publications, and success rate in external funding competitions. The reviewers recommended that the following issues be addressed: enhancing the undergraduate programs; exploring ways to boost enrolment in the Chemistry Specialist and Major; strengthening ties with graduates to improve the departmental resource base; addressing issues impacting graduate student morale and experience including international graduate student enrolment and professional development and training opportunities; addressing the lack of faculty renewal; addressing challenges around travel/transportation, technology, and engagement of faculty and students at UTM and UTSC; increasing internal consultation with faculty, staff and students, including around facilities, business models, and strategic planning; tapping into relationships faculty members have with external organizations to extend the Department's reach; and exploring options for revenue generating opportunities. The Dean's Administrative Response describes the Faculty, unit and programs' responses to the reviewers' recommendations, including an implementation plan for any changes necessary as a result. The Committee on Academic Policy and Programs (AP&P) concluded that there were no issues to be drawn to the attention of the Agenda Committee but requested a follow up report in one year to provide an update on the development of a standardized research requirement within undergraduate programs. The follow-up report will be considered by AP&P at the Cycle 2 meeting in 2019-20.