

**MEMORANDUM**

ATTENTION Senate **DATE** Oct 31, 2024 
FROM Dilson Rassier, Provost and Vice-President Academic, and Chair, SCUP **PAGES** 1/40
RE: External Review Report and Action Plan for the Department of Chemistry (SCUP 24-50)

At its meeting on October 23, 2024, SCUP reviewed the External Review Report for the Department of Chemistry that resulted from its External Review.

The Educational Goals Assessment Plan was reviewed and is attached for the information of Senate.

Motion: That Senate approve the Action Plan for the Department of Chemistry that resulted from its external review.

C: Angela Brooks-Wilson, Dean, Faculty of Science
Charles Walsby, Chair, Department of Chemistry

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MEMORANDUM

ATTENTION Dilson Rassier, Chair, SCUP **DATE** October 9, 2024
FROM Peter Hall, Vice-Provost and Associate Vice-
President, Academic **PAGES**
[Signature]
RE: External Review of the Department of Chemistry

Attached are the External Review Report and the Action Plan for the Department of Chemistry. The Educational Goals Assessment Plan and constructive feedback from SCUTL are included for information only. The site visit took place at the Burnaby campus from April 10 – 12, 2024. The external review committee met with students, faculty, staff, and senior administrators.

Excerpt from the External Review Report:

"The quality of research, and research faculty, in the Department of Chemistry is very high. The Department wisely recognizes that the traditional disciplines of chemical research do not adequately reflect ongoing foci at SFU and have identified three interdisciplinary strategic areas (pillars) of research: Biological & Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science. The Review Committee found these to be appropriate and reflective of current research activities in the Department, and its long-term development and hiring plan."

Following the site visit, the report of the External Review Committee* for the Department of Chemistry was submitted in April 2024. The reviewers made a number of recommendations based on the Terms of Reference that were provided to them. Subsequently, a meeting was held with the dean of the Faculty of Science, the chair of the Department of Chemistry, and the director of Academic Planning and Quality Assurance to consider the recommendations. An action plan was prepared taking into consideration the discussion at the meeting and the contents of the external review report. The action plan has been endorsed by the department and the faculty dean.

Motion:

That SCUP approve and recommend to Senate the Action Plan for the Department of Chemistry that resulted from its external review.

*External Review Committee:

Jennifer van Wijngaarden, York University (Chair of External Review Committee)
Robert Lemieux, University of Waterloo
Alison Thompson, Dalhousie University
Michael Silverman (internal), Simon Fraser University

Attachments:

1. External Review Report (April 2024)
2. Department of Chemistry Action Plan
3. Department of Chemistry Educational Goals Assessment Plan
4. Feedback on Educational Goals Assessment Plan

cc Angela Brooks-Wilson, Dean, Faculty of Science
 Charles Walsby, Chair, Department of Chemistry

External Review Report for the Department of Chemistry at Simon Fraser University April 2024

Review Committee

External Reviewer and Chair: Professor Jennifer van Wijngaarden (York University)

External Reviewer: Professor Robert Lemieux (University of Waterloo)

External Reviewer: Professor Alison Thompson (Dalhousie University)

Internal Reviewer: Professor Michael Silverman (Simon Fraser University)

Site visit

April 10th-12th, 2024

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As part of the cyclical quality assurance process of the Department of Chemistry and its programs, the members of the External Review Committee visited SFU's Burnaby campus from April 10th through April 12th, 2024. To prepare for the visit, committee members carefully reviewed the Department's Self-Study Report and appendices along with relevant academic and strategic planning documents from SFU and the Faculty of Science, for broader context. Committee members were very impressed with the quality of the Department's Self-Study and felt that it provided an excellent brief to prepare for our visit.

The site visit afforded several opportunities for the Review Committee to meet with academic leaders of the University including: Peter Hall, Vice-Provost and Associate VP Academic; Valorie Crooks, Associate VP Research pro term; Mary O'Brien, Vice-Provost and Dean of Graduate Studies; Angela Brooks-Wilson, Dean of the Faculty of Science and Charles Walsby, Chair of Chemistry. These meetings provided helpful perspectives regarding institutional challenges and practices.

The 2.5-day schedule included formal and informal meetings with smaller groups of faculty, staff and students within the Department of Chemistry. This involved focussed discussion groups for each of the Department's three research pillars and with key committees charged with overseeing space, research and funding, undergraduate (DUGS) and graduate (DSGS) studies. The External Review Committee also met individually with stakeholder groups representing undergraduate students, graduate students, administrative staff, technical staff, teaching faculty, early career faculty and women faculty. Undergraduate representatives from the Chemistry Student Society gave a brief presentation summarizing recent survey results collected from ~40 undergraduate students, while the Graduate Student Caucus shared copies of a confidential report prepared from three semi-annual surveys regarding the workplace experience of graduate students. Overall, the External Review Committee witnessed very strong engagement from Department members and is grateful that so many brought forward their candid thoughts on the Department and its programs.

Committee members enjoyed a 1-hour tour of departmental facilities hosted by Diana Yu, Manager of Laboratory Operations. During this time, we visited several laboratories used for teaching and research and shared resources including 4D Labs and the NMR facility. This tour highlighted the state of these physical spaces and the equipment they house, and enabled discussion regarding operational and funding challenges. Informal breaks provided additional opportunities to visit other shared Chemistry spaces such as the impressive periodic table cabinet and the visually attractive posters featuring famous scientists incorporated into the last renovation.

Overall, the External Review Committee was struck by the commitment to collegiality and teamwork that came through in all interactions. We appreciate the time each stakeholder set aside for these meetings, the organizational oversight of Bal Basi and Glynn Nicholls from Academic Planning and Quality Assurance and the insights provided by the Internal Reviewer, Michael Silverman.

The External Review Committee members were provided with a Terms of Reference (ToR) sheet for the review process, outlining assessment expectations regarding the Department's strengths and weaknesses and where opportunities might lie. This report follows the general structure

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outlined in the ToR, and takes the instructional wording and statements for each section from that document (provided in bold in this report).

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Summary of Recommendations for the University

University Recommendation # 1. To align excellence with timely graduate programs, leaders at SFU should determine the reasons behind extended times to completion for MSc and PhD programs at the University, and consider enabling discipline-specific requirements so that graduation timelines can be flexible to diverse training goals.	9
University Recommendation # 2. SFU leadership should identify ways to strengthen and safeguard nuclear chemistry expertise (people and infrastructure) in order to maximize opportunities across research output, student enrolment and partnerships with industry, government and communities.	10
University Recommendation # 3. SFU leaders are encouraged to engage with the Department of Chemistry to maximize knowledge of departmental successes in order to bolster informed community engagement relevant to enrolment and to advancement/support of University, Faculty and Department endeavours. First steps may involve strengthening communications and valuing teamplay between the Faculty of Science and the Department.	11
University Recommendation # 4. SFU leaders are encouraged to ensure that a single access point to support services is evident, well-placed, and broadly communicated in a consistent manner. Furthermore, anyone seeking support in their place of learning or place of work should be provided with clear information as regards next steps, including those for which details involving other people must remain confidential.	12
University Recommendation # 5. With the goal of diversifying voices, the Review Committee encourages SFU leaders to find ways to diversify voices across all career stages in the Department of Chemistry: this may include targeted hiring and retention strategies, or other strategic approaches to fixing this deleterious deficit. There are some very strong Chemistry voices already, and much good will. There remains significant opportunity to diversify excellence with experiences and viewpoints that would challenge status quo and encourage thinking 'outside the box' such that Departmental policy be more inclusive and more agile. Diverse voices would significantly improve the collective ability to identify challenges and work towards nimble, meaningful and feasible solutions that span hiring, infrastructure, undergraduate laboratory provisions, space needs, efficiency and workplace satisfaction. Creation of an environment with diverse voices at the table will cement the perception of SFU as a desirable chemistry workplace.	13
University Recommendation # 6. The Review Committee recommends that SFU leaders work with the Department to ensure succession planning, including a strong understanding of endowed/special Research Chairs and possibilities for revenue streams such as to improve Departmental proactiveness in identifying opportunities that align with institutional goals. Strengthening expertise in nuclear chemistry is critical to maintaining this unique edge. Enabling recruitment of early-career faculty members means that next-generation colleagues, and SFU, benefit from very high-quality mentorship from the Department's international leaders in each of its three pillars (Biological and Medicinal Chemistry; Materials, Energy and Sustainability; Nuclear Science). Retention of excellence is equally urgent and important, and includes building relationships across multiple levels of the University to explore opportunities that enable retention of faculty member excellence across research, teaching and service.	13
University Recommendation # 7. The University and Faculty of Science should consider developing a risk management policy and building a risk management funding pool to guard against the ongoing risk of catastrophic failures of major research instrumentation.	14
University Recommendation # 8. The Review Committee recommends that SFU leaders work with the Department of Chemistry and the Health/Safety Office to ensure that learning environments meet expectations regarding room temperatures and air-handling: in addition to an audit being essential to ensuring suitable work and learning spaces, record-keeping and prior planning are key to being nimble when opportunities for renovation arise....	15

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Summary of Recommendations for the Department of Chemistry

Chemistry Recommendation # 1. The Department and its EDI Committee are encouraged to partner with Indigenous experts whose workload and expertise is sharply focused on integrating, into the SFU environment, Traditional Knowledge and Teachings of Indigenous Peoples in Canada: First Nations, Inuit and Métis. The Review Committee feels there are opportunities for Chemistry to be a leading Department in the Faculty in this regard.....	8
Chemistry Recommendation # 2. In partnership with Indigenous experts on campus, the Department is encouraged to brainstorm ways for faculty and staff members to enhance their education and awareness around indigenization, decolonization and diverse inclusiveness, and to develop and implement actions and curriculum innovations that align with workspaces and program offerings. Indigenizing curriculum is one aspect of addressing the Truth and Reconciliation Commission's 94 Calls to Action; others include, and are not limited to, examination of spaces/art/culture/infographics; mode of meetings/learning environments/speaking circles; using a broad (local, Canadian and global) diversity lens when identifying experts (and their work) to profile, invite or showcase in classrooms and seminars; and committing to reading and incorporating already-published work showcasing Traditional Knowledge that has relevance to the chemistry/science of program curriculum. ..	8
Chemistry Recommendation # 3. The Department is encouraged to continue assessing the suitability of programming, including implementing nimble approaches to managing enrolment for service and program-specific classes in the context of financial and resource limitations. ..	8
Chemistry Recommendation # 4. The Department is encouraged to explore certificate/specialization programming to enable undergraduate Chemistry students to personalize their degree and marketability for career planning. Opportunities exist in the development of certificate programs that lie wholly within a Chemistry Major degree (e.g. Biological and Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science), thus enabling students to focus their interests – and gain a certificate – without the necessity of committing credits to a Minor program. ..	8
Chemistry Recommendation # 5. The Department is encouraged to align the certificate/specialization programming for Chemistry students such that classes also attract non-chemistry students in the form of a Minor specialization or a certificate that aligns with research strengths: Biological and Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science. ..	9
Chemistry Recommendation # 6. The Department should identify and address the origins of extended times to completion for MSc and PhD programs. Notwithstanding individual circumstances, the Review Committee believes these timelines are too long given that these programs must align with trainees' goals and also that they face (inter)national competition from programs with much shorter times to completion.....	9
Chemistry Recommendation # 7. The Department should develop, and share with incoming and in-program graduate students, process and documentation regarding expectations in graduate programs. The process should enable updates and flexibility as per each trainee's needs and goals. Elements should include written confirmation of course requirements, and individualized expectations regarding research achievements and timeframes. In developing this process, the Department of Chemistry is encouraged to seek input from SFU colleagues whose insights include viewpoints of other graduate programs.	9
Chemistry Recommendation # 8. The Department is encouraged to review the undergraduate course offerings with respect to professional development and education goals, including identification of strengths, and adoption of measures to address weaknesses and opportunities, e.g. ethical decision-making, literature searching/assessment, plagiarism/copyright, hazards assessment.....	9
Chemistry Recommendation # 9. To enhance enrolment in this important pillar, the Department is encouraged to take a high-level look at accessibility to nuclear chemistry offerings. Suggested areas for consideration include the development of courses that are more accessible by virtue of a reduced math requirement,	

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alternating on/off course offerings, and a chemical ethics class that includes a 360-degree look at nuclear science in communities.....	10
Chemistry Recommendation # 10. The Department is encouraged to brainstorm and work together across all roles to overcome concerns regarding the limited/maximum enrolment in nuclear chemistry classes as a result of undergraduate laboratory access. Suggestions include incorporating nuclear chemistry instrumentation into analytical/inorganic chemistry laboratories and offerings, thereby reducing the time-consuming need to re-position equipment on a frequent basis.....	10
Chemistry Recommendation # 11. The Department should identify and implement ways by which to celebrate and share news of diverse excellence, including students, staff and faculty, across all levels of the university..	11
Chemistry Recommendation # 12. The Department is encouraged to identify ways for faculty and staff members to expand and strengthen understanding and awareness of how the institution operates on a broader level so as to be best prepared to take advantage of timely opportunities ..	12
Chemistry Recommendation # 13. The Department is encouraged to develop, document and implement best practice for all types of working relationships, i.e. peer-to-peer and peer-to-other across all levels of the department (undergraduate students, graduate students, staff, faculty). This may include strengthening collegial governance within the Department, appointing a faculty adviser for undergraduate and graduate societies, etc ..	12
Chemistry Recommendation # 14. The Department is encouraged to work as a team to develop an ambitious strategic plan for a vibrant place of work and learning, meaningful undergraduate offerings, and strong research and training profiles. This should include strengthening engagement with communities, alumni and industrial partners. Exploring mechanisms to partner with experts across campus (e.g. Dean of Science, Advancement) and to augment relationship-building that ultimately serves to support student recruitment (undergraduate; graduate), curriculum and fundraising is critical. First steps may include identifying Department's strengths; developing a profile; identifying ways to ensure others across campus are aware of strengths/profile; working with recruitment and advancement personnel.....	13
Chemistry Recommendation # 15. The Department is encouraged to expand awareness regarding various trusts and programs managed/implemented in the VPR office, thereby readying for a nimble response to any arising opportunities. In this vein, recent modifications to funding core facilities via the Canada Foundation for Innovation should be explored for research facilities such as nuclear magnetic resonance spectroscopy (NMR), mass spectrometry and X-ray facilities. Similarly, incorporation of facilities aligning with nuclear science could be considered as a means by which to be ready for institutional calls for proposals for major research instrumentation. Readiness strategies should include projects of multiple genres, sizes and areas of impact so as to be ready for multiple types of opportunities ..	14
Chemistry Recommendation # 16. Building on successes regarding securing analytical instrumentation, the Department is encouraged to expand this partnership model by sharing with colleagues and brainstorming ways to effect department-wide acquisitions. This may include building and cultivating relationships with colleagues, and partnering with members of industry, communities and alumni. The Department should develop a close working relationship with the Faculty of Science Advancement team to build relationships with donor prospects, create a compelling case for support and assist Science development officers in fundraising for the modernization of undergraduate laboratories ..	15
Chemistry Recommendation # 17. Building on successes partnering with colleagues across campus expert in building and cultivating relationships with alumni, the Department is encouraged to identify attractive possibilities for instrument/lab support: possibilities should be of multiple genres, sizes and areas of impact so as to be ready for multiple types of opportunities and partners' interests.....	15

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Chemistry Recommendation # 18. The Department is encouraged to conduct a space audit with the goal of ensuring all spaces are used appropriately and within safety guidelines. This includes undertaking a process of decommissioning older and unused equipment etc., and exploring the possibility of incentivised disposal via the Faculty of Science or Health/Safety Office.	15
Chemistry Recommendation # 19. The Department is encouraged to work with the Faculty of Science to implement a transparent space allocation and usage protocol, e.g., via a newly formed Faculty of Science space management committee.	15
Chemistry Recommendation # 20. Along with enhancing awareness of financial and resource-based limitations across the institution, the Department is encouraged to brainstorm for ways to move program offerings and/or instrumentation from one teaching space to another, with the longer-term goal of positioning where usage can be maximized and weekly needs to relocate are minimized. Examples include moving equipment from the undergraduate analytical lab into the inorganic/nuclear lab so that room temperatures are better controlled and so that equipment usage serves more than one sub-discipline.	15
Chemistry Recommendation # 21. The Department is encouraged to work urgently with Faculty of Science and Employee Relations talent management team members to find ways to accelerate job regrading such that recruitment and retention in pivotal student-facing positions is ensured. This includes technical and office staff positions.....	16

1. The quality of the unit's programs (graduate and undergraduate) is high and there are measures in place to ensure the evaluation and revision of the teaching programs. Some issues to consider include:

- **degree requirements, structure, breadth, orientation and integration of the programs including the cooperative education program and the course offering schedule of the graduate programs;**

The Department's core BSc Honours and Major degree programs are accredited through the Canadian Society for Chemistry, which designates that the curriculum and laboratory infrastructure meet national standards for training future chemists in terms of breadth and rigour. Beyond these core programs, the opportunity to enroll in a joint program with a related discipline offers additional flexibility and options for students to personalize their degree. The Department has separated the laboratories from lectures in many courses, including at the first-year level, which was deemed an excellent approach to extend limited resources and support diverse student pools at SFU. Particularly noteworthy for the Review Committee was the success of the co-op program, which is popular with students and well-supported by the existing scheduling matrix that sees core courses offered year-round. Overall, undergraduate student programs and their development are well-served by the strong, active members of the DUGS committee and the highly engaged Associate Chair of Chemistry, Byron Gates.

Coursework for graduate students includes core courses (CHEM 801, 802, 808) that bolster professional skills by providing experience in developing scientific proposals and delivering effective presentations. This framework offers opportunity for further innovation through continued development of these courses to promote other professional competencies and could include, for example, exercises related to preparing funding pitches, learning about public policy, research ethics, and so on. A suitable library of other graduate courses has historically been offered in rotation to provide the opportunity for students to gain advanced training in specific disciplines. The DSGS committee provides oversight of the graduate programs, with members taking the lead on different aspects of the committee's portfolio, which is an effective approach to building faculty engagement.

Many members of the Department and University expressed the need for greater Indigeneity across the workplace environment and across programming. The Review Committee met with members of the Equity, Diversity and Inclusion (EDI) Committee in Chemistry, and values their work towards achieving a more inclusive environment for all students and employees. However, we all share responsibilities for indigenization and inclusive learning environments and workplaces, and the Review Committee feels that this work cannot lie with one committee or individual. The Review Committee also noted that the EDI Committee member leading the goals towards

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indigenization is not Indigenous, which may present challenges such as those recently expressed in the following article:

<https://universityaffairs.ca/the-many-faces/what-does-indigenization-mean/>

Published work to draw on may be found in journals such as the *Journal of Indigenous Research*, *Chemistry Teacher International*, the *Journal of Chemical Education* and other works such as the following starting points:

<https://ecampusontario.pressbooks.pub/enhancedchemistry/front-matter/commitment-to-edi-and-indigenization-in-chemistry/>

<https://uwaterloo.ca/chem13-news-magazine/categories/chemistry-and-inuit-life-and-culture>

<https://sites.google.com/view/diversityinchemistry/home>

Chemistry Recommendation # 1. The Department and its EDI Committee are encouraged to partner with Indigenous experts whose workload and expertise is sharply focused on integrating, into the SFU environment, Traditional Knowledge and Teachings of Indigenous Peoples in Canada: First Nations, Inuit and Métis. The Review Committee feels there are opportunities for Chemistry to be a leading Department in the Faculty in this regard.

Chemistry Recommendation # 2. In partnership with Indigenous experts on campus, the Department is encouraged to brainstorm ways for faculty and staff members to enhance their education and awareness around indigenization, decolonization and diverse inclusiveness, and to develop and implement actions and curriculum innovations that align with workspaces and program offerings. Indigenizing curriculum is one aspect of addressing the Truth and Reconciliation Commission's 94 Calls to Action; others include, and are not limited to, examination of spaces/art/culture/infographics; mode of meetings/learning environments/speaking circles; using a broad (local, Canadian and global) diversity lens when identifying experts (and their work) to profile, invite or showcase in classrooms and seminars; and committing to reading and incorporating already-published work showcasing Traditional Knowledge that has relevance to the chemistry/science of program curriculum.

▪ enrolment management issues, student progress and completion, and support for graduate students;

Some challenges were identified regarding the delivery of large classes in a manner that is feasible, given current personnel resources, and is appealing and useful to undergraduate students within Chemistry-focussed streams and within non-Chemistry streams: the organic teaching team appeared to be ready to propose and implement alternative course offerings to fit these needs. The Review Committee identified substantial opportunities for the development and improvement of specialized programs that have the potential to attract increased undergraduate enrolment while maximizing returns from resource investment.

Chemistry Recommendation # 3. The Department is encouraged to continue assessing the suitability of programming, including implementing nimble approaches to managing enrolment for service and program-specific classes in the context of financial and resource limitations.

Chemistry Recommendation # 4. The Department is encouraged to explore certificate/specialization programming to enable undergraduate Chemistry students to personalize their degree and marketability for career planning. Opportunities exist in the development of certificate programs that

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lie wholly within a Chemistry Major degree (e.g. Biological and Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science), thus enabling students to focus their interests – and gain a certificate – without the necessity of committing credits to a Minor program.

Chemistry Recommendation # 5. The Department is encouraged to align the certificate/specialization programming for Chemistry students such that classes also attract non-chemistry students in the form of a Minor specialization or a certificate that aligns with research strengths: Biological and Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science.

The Review Committee was surprised at the average lengths of graduate degree programs at SFU, both in the Department of Chemistry and the University in general (additional data provided by Dr. Mary O'Brien, Vice-Provost and Dean of Graduate Studies). Notwithstanding individual circumstances, the Review Committee suggests that such program lengths do not generally align with trainees' goals to use graduate school as a learning experience that enables skill acquisition en route to career-stage employment. Furthermore, the Review Committee noted that the timeframe to completion appears to be somewhat difficult for graduate students to predict and that guidance on expectations is not always evident; this must be addressed. The Review Committee also noted that an optional university-level form to document program expectations is not used by the Department of Chemistry.

University Recommendation # 1. To align excellence with timely graduate programs, leaders at SFU should determine the reasons behind extended times to completion for MSc and PhD programs at the University, and consider enabling discipline-specific requirements so that graduation timelines can be flexible to diverse training goals.

Chemistry Recommendation # 6. The Department should identify and address the origins of extended times to completion for MSc and PhD programs. Notwithstanding individual circumstances, the Review Committee believes these timelines are too long given that these programs must align with trainees' goals and also that they face (inter)national competition from programs with much shorter times to completion.

Chemistry Recommendation # 7. The Department should develop, and share with incoming and in-program graduate students, process and documentation regarding expectations in graduate programs. The process should enable updates and flexibility as per each trainee's needs and goals. Elements should include written confirmation of course requirements, and individualized expectations regarding research achievements and timeframes. In developing this process, the Department of Chemistry is encouraged to seek input from SFU colleagues whose insights include viewpoints of other graduate programs.

▪ educational goals that are clearly aligned with the curriculum and are assessable.

The Review Committee commends members of the Department of Chemistry for working together to provide a collegial environment in which to work and study. To augment development in this regard, the Review Committee considered the accessibility of broad learning opportunities.

Chemistry Recommendation # 8. The Department is encouraged to review the undergraduate course offerings with respect to professional development and education goals, including identification of strengths, and adoption of measures to address weaknesses and opportunities, e.g. ethical decision-making, literature searching/assessment, plagiarism/copyright, hazards assessment.

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The Review Committee is convinced that the Department's expertise in nuclear chemistry provides a competitive edge that is attractive to students looking for meaningful careers across medical, materials and policy professions. Furthermore, nuclear chemistry is highly relevant to Canada's energy and health needs, and thereby offers valuable opportunities for large-scale partnerships. Whilst unique to SFU, this expertise is lean and therefore vulnerable. The Review Committee noted the need for a succession plan and earmarking of resources for sustaining critical infrastructure (e.g., tritium source replacement) to ensure the sustainability of this pillar.

University Recommendation # 2. SFU leadership should identify ways to strengthen and safeguard nuclear chemistry expertise (people and infrastructure) in order to maximize opportunities across research output, student enrolment and partnerships with industry, government and communities.

The Review Committee felt unconvinced that current nuclear chemistry offerings were widely available to undergraduate students.

Chemistry Recommendation # 9. To enhance enrolment in this important pillar, the Department is encouraged to take a high-level look at accessibility to nuclear chemistry offerings. Suggested areas for consideration include the development of courses that are more accessible by virtue of a reduced math requirement, alternating on/off course offerings, and a chemical ethics class that includes a 360-degree look at nuclear science in communities.

Chemistry Recommendation # 10. The Department is encouraged to brainstorm and work together across all roles to overcome concerns regarding the limited/maximum enrolment in nuclear chemistry classes as a result of undergraduate laboratory access. Suggestions include incorporating nuclear chemistry instrumentation into analytical/inorganic chemistry laboratories and offerings, thereby reducing the time-consuming need to re-position equipment on a frequent basis.

2. The quality of faculty research is high, and faculty collaboration and interaction provide a stimulating academic environment.

The quality of research, and research faculty, in the Department of Chemistry is very high. The Department wisely recognizes that the traditional disciplines of chemical research do not adequately reflect ongoing foci at SFU and have identified three interdisciplinary strategic areas (pillars) of research: Biological & Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science. The Review Committee found these to be appropriate and reflective of current research activities in the Department, and its long-term development and hiring plan.

There is significant cross-fertilization and collaboration between the various research groups within each research pillar, which creates a very stimulating environment for research, discovery, innovation and commercialization. This fertile research ecosystem is sustained by state-of-the-art core facilities that also act as proverbial 'scientific water coolers' where researchers can discover new collaborative opportunities: 4D LABS, the Centre for High-Throughput Chemical Biology (cHTCB) and TRIUMF. SFU's participation in the latter has allowed for the development of a unique research strength in nuclear science, although its critical mass needs bolstering, both on the teaching (vide supra) and research fronts. The business plans and management structures of 4D

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LABS and cHTCB are viewed by the Review Committee as excellent models for university-level core research facilities, and these facilities should be strongly supported by SFU on a go-forward basis.

Chemistry researchers continue to publish highly impactful work in high-quality journals at a level that is competitive across Canada. Researchers are well-funded by Tri-Council and other sources; the fact that 25 out of 27 Chemistry faculty hold NSERC Discovery Grants is a strong indicator of the research intensity of the Department. The average award for Established Researchers is slightly above that for successful returning applicants in NSERC Evaluation Group 1504; notably, four of the five top NSERC Discovery Grants at SFU are held by members of the Chemistry department. The significant number of Chemistry faculty holding research chairs and having received prestigious awards is further indication of the Department's standing as one of the research engines of the institution. The Review Committee also noted many comments regarding the teaching excellence of many of its top researchers.

The Department provides a premier undergraduate student research experience, which was enhanced by the recent addition of a full-year undergraduate research course (CHEM 484) to complement the existing one-semester courses CHEM 481 and 483. To further encourage students to undertake undergraduate research, the department also created 'feeder' courses at the second- and third-year levels: "Introduction to Experiential Undergraduate Research" (CHEM 296) and "Experiential Undergraduate Research" (CHEM 396).

Notwithstanding the foregoing, the Review Committee noted that the Department could benefit from a more aggressive and vibrant PR voice celebrating its various scholarly successes. In tandem, a higher level of engagement with the Faculty of Science Advancement team would allow the Department to leverage these successes to support fundraising from various sources (vide infra).

Chemistry Recommendation # 11. The Department should identify and implement ways by which to celebrate and share news of diverse excellence, including students, staff and faculty, across all levels of the university.

University Recommendation # 3. SFU leaders are encouraged to engage with the Department of Chemistry to maximize knowledge of departmental successes in order to bolster informed community engagement relevant to enrolment and to advancement/support of University, Faculty and Department endeavours. First steps may involve strengthening communications and valuing teamplay between the Faculty of Science and the Department.

3. Unit members participate in the administration of the unit. Some issues to consider include unit size, adequacy and effectiveness of the administrative complement and facilities.

The Review Committee noted that the Departmental committee structure is strong, and people work well together to improve the learning environment and workplace. However, the Review Committee identified multiple opportunities for department members to engage more meaningfully with university-level operations to improve awareness of opportunities (and systemic constraints). The Review Committee felt that improved awareness of such matters would enable

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the Department to develop timely and useful strategies towards projects that improve research and teaching endeavours and that align with university goals.

Chemistry Recommendation # 12. The Department is encouraged to identify ways for faculty and staff members to expand and strengthen understanding and awareness of how the institution operates on a broader level so as to be best prepared to take advantage of timely opportunities.

4. The unit's workplace environment is conducive to the attainment of their objectives, including working relationships within the unit, with other university units, the community and the unit's alumni.

In general, the workplace environment in the Department of Chemistry is healthy and vibrant. The Review Committee members certainly noted this when they attended the weekly departmental coffee event and in the many conversations they had during the visit and social events.

Notwithstanding the foregoing, the Review Committee noted that, when inevitable personal crises or interpersonal conflicts would arise, there seemed to be a lack of understanding and awareness of institutional processes and/or resources to seek the support (professional, personal) and/or conflict management necessary to move forward. Although it was indicated to the Review Committee that there were indeed many resources available for counselling and conflict management, these appeared poorly integrated and lacked a common access point that would enable people with concerns and/or complaints to be supported quickly and ably.

Of significant concern were the multiple discussions, at all levels of the SFU community, that reflected an environment where the goals and expectations of leaders misalign with the workplace and learning environment: any such disconnect inhibits personal and institutional success across all levels.

Chemistry Recommendation # 13. The Department is encouraged to develop, document and implement best practice for all types of working relationships, i.e. peer-to-peer and peer-to-other across all levels of the department (undergraduate students, graduate students, staff, faculty). This may include strengthening collegial governance within the Department, appointing a faculty adviser for undergraduate and graduate societies, etc.

University Recommendation # 4. SFU leaders are encouraged to ensure that a single access point to support services is evident, well-placed, and broadly communicated in a consistent manner. Furthermore, anyone seeking support in their place of learning or place of work should be provided with clear information as regards next steps, including those for which details involving other people must remain confidential.

5. Future plans of the unit are appropriate and manageable.

The Department self-study details short-term and long-term plans that are ambitious, thoughtful and appropriate for a research-intensive unit like the Department of Chemistry. Many of the short-term goals address urgent needs that are likely not unique to Chemistry, and the Department would, therefore, benefit from framing these goals in a formal Strategic Plan covering the next 5-10 years. The Review Committee heard of the many industrial connections and successful Chemistry alumni, which could be leveraged in a fundraising campaign built on the foundation of the Strategic Plan. Such a campaign would require a much stronger engagement of the

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Department with the Science Advancement group in building a strong case for support, prospect identification and qualifying, and relationship building with alumni and other Chemistry stakeholders.

Chemistry Recommendation # 14. The Department is encouraged to work as a team to develop an ambitious strategic plan for a vibrant place of work and learning, meaningful undergraduate offerings, and strong research and training profiles. This should include strengthening engagement with communities, alumni and industrial partners. Exploring mechanisms to partner with experts across campus (e.g. Dean of Science, Advancement) and to augment relationship-building that ultimately serves to support student recruitment (undergraduate; graduate), curriculum and fundraising is critical. First steps may include identifying Department's strengths; developing a profile; identifying ways to ensure others across campus are aware of strengths/profile; working with recruitment and advancement personnel.

6. Issues of specific interest to the university and/or the unit that the review committee should consider during the review are:

▪ 6.1. Faculty hiring: How can the Department redress the low numbers of early career researchers, as well as female faculty and members of other underrepresented groups?

A significant concern voiced by all faculty groups is that there have been 6 departures of research faculty and only 3 new hires since the last external review, which resulted in a net decrease in the research faculty complement from 30 to 27. Such limited faculty renewal has resulted in a faculty age profile heavily weighted towards senior faculty at the full professor rank. Furthermore, over the course of the three-day site visit, it became clear to the Review Committee that the lack of diverse voices and experiences in a multitude of discussions and across a multitude of topics is hampering the identification and implementation of timely, modern, quality strategies to address teaching, research and workplace shortcomings. The Department self-study identified that women faculty members are in the minority, and saw recruitment of women faculty as a priority. The Review Committee agrees, and would like to see broadened representation across all forms of diversity.

University Recommendation # 5. With the goal of diversifying voices, the Review Committee encourages SFU leaders to find ways to diversify voices across all career stages in the Department of Chemistry: this may include targeted hiring and retention strategies, or other strategic approaches to fixing this deleterious deficit. There are some very strong Chemistry voices already, and much good will. There remains significant opportunity to diversify excellence with experiences and viewpoints that would challenge status quo and encourage thinking 'outside the box' such that Departmental policy be more inclusive and more agile. Diverse voices would significantly improve the collective ability to identify challenges and work towards nimble, meaningful and feasible solutions that span hiring, infrastructure, undergraduate laboratory provisions, space needs, efficiency and workplace satisfaction. Creation of an environment with diverse voices at the table will cement the perception of SFU as a desirable chemistry workplace.

University Recommendation # 6. The Review Committee recommends that SFU leaders work with the Department to ensure succession planning, including a strong understanding of endowed/special Research Chairs and possibilities for revenue streams such as to improve Departmental proactiveness in identifying opportunities that align with institutional goals. Strengthening expertise in nuclear chemistry is critical to maintaining this unique edge. Enabling recruitment of early-career faculty

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members means that next-generation colleagues, and SFU, benefit from very high-quality mentorship from the Department's international leaders in each of its three pillars (Biological and Medicinal Chemistry; Materials, Energy and Sustainability; Nuclear Science). Retention of excellence is equally urgent and important, and includes building relationships across multiple levels of the University to explore opportunities that enable retention of faculty member excellence across research, teaching and service.

▪ 6.2. Infrastructure: How should the Department seek funding support for aging infrastructure in core research facilities, while also identifying equitable ways to identify and prioritize specific support projects?

Research infrastructure available to researchers in the Department of Chemistry is appropriate for the research conducted therein, but many of the major instruments in departmental core facilities are in need of renewal. The NMR and Mass Spectrometry core facilities provide excellent service and access to researchers, with excellent technical support. However, most of the NMR instruments are 15-17 years old and their consoles can no longer be serviced due to lack of available parts. Given the fact that the magnets may still have another 15 years of useful life, it would be possible to modernize these instruments via the purchase of new consoles. Mass spectrometers and the lone X-ray diffractometer have also reached an age (15-20 years) when manufacturers no longer produce parts, and repairs thus become a function of being able to locate spare/used parts via online traders. The Review Committee noted the lack of a risk management strategy for major research infrastructure at either the University or Faculty level, with catastrophic instrument failures having been dealt with on an ad hoc basis in the past. Limited access to overhead/indirect cost of research recoveries by the Department (25%) limits its ability to manage risk. The Review Committee also noted the absence of a helium recovery system for the NMR facility, which has now become the norm in major Canadian research universities given the cost and increasing scarcity of this critical resource to operate superconducting magnets.

Chemistry Recommendation # 15. The Department is encouraged to expand awareness regarding various trusts and programs managed/implemented in the VPR office, thereby readying for a nimble response to any arising opportunities. In this vein, recent modifications to funding core facilities via the Canada Foundation for Innovation should be explored for research facilities such as nuclear magnetic resonance spectroscopy (NMR), mass spectrometry and X-ray facilities. Similarly, incorporation of facilities aligning with nuclear science could be considered as a means by which to be ready for institutional calls for proposals for major research instrumentation. Readiness strategies should include projects of multiple genres, sizes and areas of impact so as to be ready for multiple types of opportunities.

University Recommendation # 7. The University and Faculty of Science should consider developing a risk management policy and building a risk management funding pool to guard against the ongoing risk of catastrophic failures of major research instrumentation.

▪ 6.3. Undergraduate laboratories: How can the Department modernize, suitably equip, improve safety in, and make the best use of undergraduate teaching laboratories?

Members of the Department are to be particularly commended for the partnerships and initiatives that have led to improved instrumentation and learning experiences in undergraduate labs.

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However, some spaces were reported to be unacceptably hot at certain times of the year, a health and safety matter that is particularly acute in laboratory environments where PPE and heat-generating equipment are necessities. The modernization of undergraduate laboratory spaces could form a compelling case for support that the Department could present to SFU Chemistry alumni, other donors as well as industrial sponsorship prospects in a fundraising campaign.

University Recommendation # 8. The Review Committee recommends that SFU leaders work with the Department of Chemistry and the Health/Safety Office to ensure that learning environments meet expectations regarding room temperatures and air-handling: in addition to an audit being essential to ensuring suitable work and learning spaces, record-keeping and prior planning are key to being nimble when opportunities for renovation arise.

Chemistry Recommendation # 16. Building on successes regarding securing analytical instrumentation, the Department is encouraged to expand this partnership model by sharing with colleagues and brainstorming ways to effect department-wide acquisitions. This may include building and cultivating relationships with colleagues, and partnering with members of industry, communities and alumni. The Department should develop a close working relationship with the Faculty of Science Advancement team to build relationships with donor prospects, create a compelling case for support and assist Science development officers in fundraising for the modernization of undergraduate laboratories.

Chemistry Recommendation # 17. Building on successes partnering with colleagues across campus expert in building and cultivating relationships with alumni, the Department is encouraged to identify attractive possibilities for instrument/lab support: possibilities should be of multiple genres, sizes and areas of impact so as to be ready for multiple types of opportunities and partners' interests.

▪ 6.4. Space: How can the Department address limitations on hiring, staff retention, research capacity, and teaching posed by restrictions in laboratory and office space allocations, and make best use of available resources?

Chemistry Recommendation # 18. The Department is encouraged to conduct a space audit with the goal of ensuring all spaces are used appropriately and within safety guidelines. This includes undertaking a process of decommissioning older and unused equipment etc., and exploring the possibility of incentivised disposal via the Faculty of Science or Health/Safety Office.

Chemistry Recommendation # 19. The Department is encouraged to work with the Faculty of Science to implement a transparent space allocation and usage protocol, e.g., via a newly formed Faculty of Science space management committee.

Chemistry Recommendation # 20. Along with enhancing awareness of financial and resource-based limitations across the institution, the Department is encouraged to brainstorm for ways to move program offerings and/or instrumentation from one teaching space to another, with the longer-term goal of positioning where usage can be maximized and weekly needs to relocate are minimized. Examples include moving equipment from the undergraduate analytical lab into the inorganic/nuclear lab so that room temperatures are better controlled and so that equipment usage serves more than one sub-discipline.

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▪ 6.5. Support staff: Can the Department update and regrade staff positions to improve staff retention and better support its obligations to teaching, research, and community outreach?

The Review Committee was impressed by the commitment of staff in the Department of Chemistry, and were convinced of the significant impact of the contributions made by the individuals holding these roles. Long timelines and lack of transparency within support units for regrading of staff positions hinders retention strategies and jeopardizes relationship building and teamwork within technical and administrative staff groups. The Review Committee concluded that several positions are currently graded in a manner that is inappropriate for the role and skill level required.

Chemistry Recommendation # 21. The Department is encouraged to work urgently with Faculty of Science and Employee Relations talent management team members to find ways to accelerate job regrading such that recruitment and retention in pivotal student-facing positions is ensured. This includes technical and office staff positions.

External Review Action Plan

Section A

To be completed by the Responsible Unit Person, e.g., Chair or Director

Unit Under Review: Department of Chemistry

Date of Review Site Visit: 10 – 12 April 2024

Responsible Unit Person: Charles Walsby (Department Chair)

Faculty Dean: Angela Brooks-Wilson

Notes

1. *It is not expected that every recommendation made by the External Review Committee be covered by this Action Plan. The major thrusts of the report should be identified—some consolidation of the recommendations may be possible while other recommendations of lesser importance may be excluded.*
2. *Attach the required plan to assess the success of the Educational Goals as a separate document (Senate 2013).*
3. *Should any additional response be warranted, it should be attached as a separate document.*

1. PROGRAMMING

1.1	Action(s) (description of what is going to be done)
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Undergraduate:

- **Indigenization of Curriculum.**

Chemistry Recommendation #1. The Department and its EDI Committee are encouraged to partner with Indigenous experts whose workload and expertise is sharply focused on integrating, into the SFU environment, Traditional Knowledge and Teachings of Indigenous Peoples in Canada: First Nations, Inuit and Métis. The Review Committee feels there are opportunities for Chemistry to be a leading Department in the Faculty in this regard.

Chemistry Recommendation #2. In partnership with Indigenous experts on campus, the Department is encouraged to brainstorm ways for faculty and staff members to enhance their education and awareness

around indigenization, decolonization and diverse inclusiveness, and to develop and implement actions and curriculum innovations that align with workspaces and program offerings. Indigenizing curriculum is one aspect of addressing the Truth and Reconciliation Commission's 94 Calls to Action; others include, and are not limited to, examination of spaces/art/culture/infographics; mode of meetings/learning environments/speaking circles; using a broad (local, Canadian and global) diversity lens when identifying experts (and their work) to profile, invite or showcase in classrooms and seminars; and committing to reading and incorporating already-published work showcasing Traditional Knowledge that has relevance to the chemistry/science of program curriculum.

Response: The Department is working on indigenization of the Chemistry curriculum and recognizes that this is important to the future development of the undergraduate program.

Action: The first step towards these developments was the formation of a formal EDI committee in 2022. This committee has identified inclusion of indigenous ways of knowing in Chemistry instruction as their highest priority. Curriculum changes have started in SCI 300 (Science and its Impact on Society), where the course content has been infused with Indigenous Knowledge. Furthermore, a more holistic assessment approach has been developed that aligns better with the collaboration and community inherent in Indigenous cultures. Following the success of these developments, the Department will now focus on CHEM 371 (Chemistry of the Aqueous Environment) and CHEM 372 (Chemistry of the Atmospheric Environment), which are both suitable for redevelopment to include indigenization and traditional knowledge. These developments will include changes to: (1) course content, (2) methods of instruction, and (3) methods of assessment. Successful development of these courses will lead to similar updating and restructuring of other courses, potentially including some core courses. These developments will be coordinated through cooperation between the Chemistry EDI Committee, The Departmental Undergraduate Studies Committee (DUGS), and the instructors of the courses. Assistance with these developments will be sought from the Department of Indigenous Studies and the Associate Dean, EDI in the Faculty of Science.

- **Certificate/Specialization Programming.**

Chemistry Recommendation #4. The Department is encouraged to explore certificate/specialization programming to enable undergraduate Chemistry students to personalize their degree and marketability for career planning. Opportunities exist in the development of certificate programs that lie wholly within a Chemistry Major degree (e.g. Biological and Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science), thus enabling students to focus their interests – and gain a certificate – without the necessity of committing credits to a Minor program.

Chemistry Recommendation #5. The Department is encouraged to align the certificate/specialization programming for Chemistry students such that classes also attract non-chemistry students in the form of a

Minor specialization or a certificate that aligns with research strengths: Biological and Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science.

Response: The focusing of student course planning into certificates or specializations is potentially beneficial to Chemistry undergraduates. This could improve their competitiveness in securing rewarding careers.

Action: The Department Undergraduate Studies Committee (DUGS) is evaluating the viability of certificate programs or specializations in: 1) Chemical Data Science, 2) Chemical Biology, 3) Materials Chemistry, and 4) Forensic Chemistry. The Department is cognizant of issues facing certificate programs at SFU. Specifically, that these are unattractive to students if they require significant additional course work, but that they should not be awarded to students based on just completing a regular course in undergraduate chemistry. Thus, the Department plans to include additional courses in Certificate requirements from other Departments and to develop new courses relevant to the possible certificates described above, such as in Chemoinformatics. Specializations (i.e., Concentrations) provide a potentially useful alternative to certificates, since they are less prescriptive with regards to content and can balance time in the program with sufficient specialization. The Department Undergraduate Studies Committee will consider developing new certificates and concentration proposals, in consultation with interested faculty, for discussion with the Department as a whole.

- **Nuclear Science.**

Chemistry Recommendation #9. To enhance enrolment in this important pillar, the Department is encouraged to take a high-level look at accessibility to nuclear chemistry offerings. Suggested areas for consideration include the development of courses that are more accessible by virtue of a reduced math requirement, alternating on/off course offerings, and a chemical ethics class that includes a 360-degree look at nuclear science in communities

Chemistry Recommendation #10. The Department is encouraged to brainstorm and work together across all roles to overcome concerns regarding the limited/maximum enrolment in nuclear chemistry classes as a result of undergraduate laboratory access. Suggestions include incorporating nuclear chemistry instrumentation into analytical/inorganic chemistry laboratories and offerings, thereby reducing the time-consuming need to reposition equipment on a frequent basis.

Response: Nuclear Science and the Nuclear Science Minor continue to be highly valued and unique components of the Chemistry undergraduate curriculum. However, commitment of resources to courses within this program is limited by modest enrolments. Addressing these issues is particularly challenging for NUSC 346 (Radiochemistry Laboratory). Enrolments in this course have historically been low, and yet the costs involved in running the lab are significant due to the need to purchase radioisotopes.

Action: The Departmental Undergraduate Studies Committee is working with nuclear science faculty on strategies to increase enrolments. Two of these courses in particular, NUSC 341 (Introduction to

Radiochemistry) and NUSC 344 (Nucleosynthesis and the Distribution of the Elements) are of broad interest to science students, and potentially to students outside the Faculty of Science. Current proposals include:

- 1) Reducing or changing course pre-requisites,
- 2) Removing “gate keeping” content, such as advanced math,
- 3) Revision of course content to appeal to particular student groups. For example, NUSC 341 could include an increased focus on nuclear imaging, which would be relevant to students planning on careers in medicine.

The department is taking steps to increase enrolments that will enable future investments in NUSC 346, particularly updating of instrumentation. The first step will be to change the pre-requisites for NUSC 346, which currently requires NUSC 341 (Introduction to Radiochemistry). The Departmental Undergraduate Studies Committee will evaluate adding alternative pre-requisites such as second-year core courses, opening up NUSC 346 to a larger cohort of students at an earlier stage in their undergraduate programs. Concurrently, Nuclear Science faculty are working to redevelop the lab to be appropriate to this new group of students. Overall, the Department of Chemistry is focusing on creating a Nuclear Science curriculum that is of broader interest and increasing significantly the number of students taking our nuclear science courses.

- **Laboratory Teaching Resources.**

Chemistry Recommendation #16. Building on successes regarding securing analytical instrumentation, the Department is encouraged to expand this partnership model by sharing with colleagues and brainstorming ways to effect department-wide acquisitions. This may include building and cultivating relationships with colleagues, and partnering with members of industry, communities and alumni. The Department should develop a close working relationship with the Faculty of Science Advancement team to build relationships with donor prospects, create a compelling case for support and assist Science development officers in fundraising for the modernization of undergraduate laboratories.

Response: The Department has urgent needs for the upgrading and replacement of analytical instrumentation across its programs. This includes both research and teaching instruments, the majority of which have reached an age where they are no longer supported for service by their manufacturers. This issue is acute across the upper division teaching laboratories (e.g., Organic Chemistry, Inorganic Chemistry, and Nuclear Science) where addressing ongoing instrument failures has become a full-time commitment for the Chemistry Instrument Technician. The Faculty of Science has been supportive in providing annual funds for small equipment replacements (within the limitations of current University and Faculty of Science budget issues), but renewal of facilities beyond regular budget capacities are needed to address likely impending catastrophic failures.

Action: The Department is looking for creative ways to fund and support new instrumentation acquisitions. Recently, an agreement has been reached with PerkinElmer for the 2-year loan of an ICP-MS instrument that will be housed within the Department of Chemistry. This instrument will be invaluable to both researchers and for the development of new experiments in the advanced Analytical Teaching Laboratory (e.g., CHEM 317, Analytical Environmental Chemistry). The Department plans to work with the Advancement Team in the Faculty of Science to look for additional opportunities to partner with commercial instrumentation manufacturers. Likely more challenging will be seeking direct donations from donors, and support from the Faculty of Science Advancement Team, as well as the Marketing and Communications Group, will be essential to the success of these developments.

Graduate:

- **Graduate Completion times.**

University Recommendation #1. To align excellence with timely graduate programs, leaders at SFU should determine the reasons behind extended times to completion for MSc and PhD programs at the University, and consider enabling discipline-specific requirements so that graduation timelines can be flexible to diverse training goals.

Chemistry Recommendation #6. The Department should identify and address the origins of extended times to completion for MSc and PhD programs. Notwithstanding individual circumstances, the Review Committee believes these timelines are too long given that these programs must align with trainees' goals and also that they face (inter)national competition from programs with much shorter times to completion.

Response: The Department agrees that average completion times for both MSc and PhD students in Chemistry can be improved. As outlined in the Self Study Report, this was addressed in the previous review period through the creation of the Graduate Seminar and Proposal Writing Courses CHEM 801 (Student Seminar, MSc and PhD), CHEM 802 (MSc Research Proposal and Examination, MSc), and CHEM 808 (PhD Candidacy Examination, PhD). These courses provide training in scientific writing, presentation skills, and other skills to aid in successful graduate research. They also assist graduate students with the preparation of their theses. The introduction of these courses has been successful in decreasing the average completion times for MSc students by almost one semester (9.4 semesters in 2023). However, average completion times during the same period for PhD students have increased (18.5 semesters in 2023). While the Department is motivated to reduce completion times, these are largely determined by expectations from individual supervisors and students. Correspondingly, there are significant differences in average completion times between different groups and subdisciplines, suggesting that a change in departmental culture may also be required.

Actions:

- 1) The Department has instituted a policy that limits Teaching Assistant (TA) appointments that can be requested by Graduate Supervisors to a maximum of two full-time equivalent positions per year. This

ensures that all graduate students receive at least one full semester to focus entirely on research. If graduate students request additional appointments, these will be assessed according to the regulations in the TSSU collective agreement.

- 2) The Departmental Graduate Studies Committee (DGSC) will send reminders to students and supervisors earlier than is done currently; this will now be done at 5 semesters for MSc and 10 semesters for PhD students. At this time a clear completion plan will be required for approval by the student and the student's supervisory committee.
- 3) The chair of the DGSC, together with the graduate program assistant, will monitor the individual residence times of students approaching 9 semesters (MSc) or 18 semesters (PhD). Students and supervisors will receive notice of the requirement to apply for an extension. The extension application will require an up-to-date committee meeting and a detailed outline of the steps that will be taken to ensure timely completion of the research program and submission of the student's thesis.
- 4) CHEM 801, CHEM 802, and CHEM 808 will be reviewed to ensure they are fulfilling their intended purposes. This will involve a standardized curriculum and regular assessments for these courses being completed by the DGSC. Furthermore, graduate student feedback will be sought to evaluate the effectiveness of these courses in preparing students for the graduate program and for writing their graduate theses. The latter will be evaluated via graduate student exit surveys, after their final thesis defense.
- 5) CHEM 802, which is currently completed in semesters 2 – 3, will be moved to semesters 4 – 5. This will enable its original purpose, to help write the introduction to each student's thesis, to be better realized. Also, this will benefit students intending to transfer to the PhD program, since they can transfer before the requirement for CHEM 802, which is only credited to MSc students, thus saving them valuable time.
- 6) The Department plans to initiate an Accelerated MSc Program that allows our top SFU undergraduate students to take 1-2 graduate courses in their final year that count for both their BSc and MSc course requirements. This will reduce completion times for this subset of students and provide additional recruitment opportunities for our program.

- **Communicating Graduate Expectations.**

Chemistry Recommendation #7. The Department should develop, and share with incoming and in-program graduate students, process and documentation regarding expectations in graduate programs. The process should enable updates and flexibility as per each trainee's needs and goals. Elements should include written confirmation of course requirements, and individualized expectations regarding research achievements and timeframes. In developing this process, the Department of Chemistry is encouraged to seek input from SFU colleagues whose insights include viewpoints of other graduate programs.

Response: The Department agrees with the External Review Committee that communication with graduate students can be improved. Particular areas that need more clarity are: 1) The roles of Student Committees

and the DGSC, 2) Expectations on completion times, 3) clarity on TAing expectations and corresponding student funding, and 4) expectations on conduct.

Actions: The Department Chair and the Chair of the DGSC have had several meetings with the leadership of the Chemistry Graduate Caucus to discuss the issues above. This has been assisted greatly through surveys conducted by the Graduate Caucus, with anonymized results shared with Department. This consultation process has led to the following action plan:

- 1) As described above, the Department has instituted a policy for TAing frequency and pay. This specifies a maximum of two TA full-time equivalents per year that can be requested by graduate supervisors for graduate students. If graduate students request additional appointments, these will be made according to the TSSU collective agreement.
- 2) Student support and pay details have been clarified and are now explained clearly at the introductory meeting with new graduate students. A clear policy is now in place within the Department and is consistent with the TSSU collective agreement.
- 3) At the introductory meeting with new graduate students, and in CHEM 801, the roles of graduate committee members will now be explained more clearly. In particular, the role of committee members who are not senior supervisors will be highlighted with respect to conflict resolution.
- 4) The introductory meeting will also address appropriate conduct and interpersonal interactions. This will ensure that students from diverse backgrounds are aware of appropriate behaviours in both research and teaching laboratories.
- 5) In order to further minimize conflict, the DGSC, in consultation with the Department and Graduate Student Caucus, is developing an expectations document to be jointly filled out by students and supervisors in the first semester of graduate studies.
- 6) As described above, the DGSC is working more proactively to guide and accelerate the thesis completion process for graduate students.

1.2 | Resource Implications (if any)

- Since the proposed actions are procedural, there are no resource implications.

1.3 | Expected Completion Date(s):

- Addressing completion times is an ongoing and complex process. The Department plans to evaluate the effectiveness of the initiatives described in the Fall of 2026.
- Improvement to communicating expectations will target a completion by the Fall of 2025.

2. RESEARCH

2.1 | Action(s) (description of what is going to be done)

- **Major facilities.**

University Recommendation #7. *The University and Faculty of Science should consider developing a risk management policy and building a risk management funding pool to guard against the ongoing risk of catastrophic failures of major research instrumentation.*

Chemistry Recommendation #15. *The Department is encouraged to expand awareness regarding various trusts and programs managed/implemented in the VPR office, thereby readying for a nimble response to any arising opportunities. In this vein, recent modifications to funding core facilities via the Canada Foundation for Innovation should be explored for research facilities such as nuclear magnetic resonance spectroscopy (NMR), mass spectrometry and X-ray facilities. ... Readiness strategies should include projects of multiple genres, sizes and areas of impact so as to be ready for multiple types of opportunities.*

Chemistry Recommendation #17. *Building on successes partnering with colleagues across campus expert in building and cultivating relationships with alumni, the Department is encouraged to identify attractive possibilities for instrument/lab support: possibilities should be of multiple genres, sizes and areas of impact so as to be ready for multiple types of opportunities and partners' interests.*

Response: The Department strongly endorses the need for Faculty of Science and University support to prepare for inevitable catastrophic failures of the Department's aging research instrumentation. These expenses, particularly for the NMR and the Mass Spectrometry facilities will be far beyond the financial resources of the Department. Optimizing strategies for identifying funding opportunities and responding rapidly will be critical to renewing and maintaining critical research infrastructure. One such strategy for smaller repairs is to build up a contingency fund from user fees, but the department would need assurance that these funds would be safeguarded for the facility and not subjected to institutional rebudgeting for this approach to be practical. Furthermore, *the funds available from this approach will never reach levels close to the needs for major replacement or repair costs, and this will redirect limited faculty research funding to repairing aging infrastructure.*

Action: The Department plans to work with the Faculty of Science and the VPRI to identify opportunities to renew Chemistry research facilities. Within the Department, the Research and Funding Committee will work with diverse groups of researchers to generate a series of "shovel ready" proposals at different cost levels in preparation for funding opportunities that may arise.

- **Faculty hiring.**

University Recommendation #6. *The Review Committee recommends that SFU leaders work with the Department to ensure succession planning, including a strong understanding of endowed/special Research Chairs and possibilities for revenue streams such as to improve Departmental proactiveness in identifying opportunities that align with institutional goals. Strengthening expertise in nuclear chemistry is critical to maintaining this unique edge. Enabling recruitment of early-career faculty members means that next*

generation colleagues, and SFU, benefit from very high-quality mentorship from the Department's international leaders in each of its three pillars (Biological and Medicinal Chemistry; Materials, Energy and Sustainability; Nuclear Science). Retention of excellence is equally urgent and important, and includes building relationships across multiple levels of the University to explore opportunities that enable retention of faculty member excellence across research, teaching and service.

University Recommendation #2. SFU leadership should identify ways to strengthen and safeguard nuclear chemistry expertise (people and infrastructure) in order to maximize opportunities across research output, student enrolment and partnerships with industry, government and communities.

Response: The Department has identified hiring of early-career researchers as the highest priority in departmental planning. Minimal hiring since the previous external review have resulted in an extreme imbalance in faculty ranks: 1 Assistant Professor, 6 Associate professors, 20 Full Professors (as of September 2024). There has also been an overall decline in research faculty numbers (from 30 to 27).

Action: As part of the regular hiring cycle, the Department has requested two additional Assistant Professor positions in 2024. These positions: (1) Biomolecular Discovery, and (2) Energy Materials for Hydrogen Technology, leverage strategic links to core facilities (the Centre for High-Throughput Chemical Biology, and the SFU Clean Hydrogen Hub) and align with University priorities and Departmental research pillars (Biological and Medicinal Chemistry; and Materials, Energy and Sustainability).

New faculty in Nuclear Science are also critical as part of the on-going hiring plan of the Department. Nuclear science is a unique, strategically important feature of Chemistry at SFU, and plans for the ongoing success of this research and teaching concentration need to be developed. The Department will prioritize a nuclear science hire as part of the Department's 5-year plan, in consultation with the Dean. This will include the potential for a joint hire with TRIUMF, with a focus on Radiochemistry, and alignment with research strengths within the Department and SFU's research priority areas outlined in the Strategic Research Plan.

2.2	Resource Implications (if any)
	<ul style="list-style-type: none">Establishing a pool of funds to shield the Department from catastrophic equipment failure will require on-going investment from the University and the Faculty of Science.Larger funding opportunities, such as CFI, will require matching contributions from the University.New faculty positions will require start-up funds, CFI JEFL contributions, support for renovations, and additional salary costs.
2.3	Expected Completion Date(s)
	<ul style="list-style-type: none">Addressing issues with aging infrastructure is a complex and long-term process. Expected completion date: Fall 2029Faculty hiring requests for 2024 are currently under review by the Dean of Science and, if successful, will result in new faculty member(s) joining the Department in the Fall of 2025. However, with 5 faculty already

beyond the regular retirement age and 7 more reaching this age by the next external review (1/3 of the department in total), an ongoing process of faculty renewal and hiring will be needed.

3. ADMINISTRATION

3.1 Action(s) (description of what is going to be done)

- **Support Staff.**

***Chemistry Recommendation #21.** The Department is encouraged to work urgently with Faculty of Science and Employee Relations talent management team members to find ways to accelerate job regrading such that recruitment and retention in pivotal student-facing positions is ensured. This includes technical and office staff positions. The Review committee further notes “several positions are currently graded in a manner that is inappropriate for the role and skill level required”*

Response: The Department strongly agrees with this assessment by the External Review committee, with the current salary grading of key positions insufficient for the work and expertise required, which is impacting recruitment and retention. Three positions have been identified as particularly urgent for regrading: Graduate Assistant (CUPE), Instrument Technician (CUPE), Manager, Laboratory Operations (APSA).

Action: The Department is revising the job descriptions for these key positions and will then submit the revised positions to Human Resources for regrading. The Department has completed this process for the Graduate Assistant position and is currently waiting to receive the outcome from SFU Human Resources. Unfortunately, interactions with Human Resources are largely non-collaborative, and the Department appreciates the support of the Faculty of Science in navigating this process.

3.2	Resource Implications (if any)
	<ul style="list-style-type: none"> Additional salary grades for staff, as described above, will increase salary expenses.
3.3	Expected Completion Date(s)
<ul style="list-style-type: none"> Regrading of the Graduate Assistant position will hopefully be completed by the Fall of 2024 (depending on the evaluation by Human Resources). Regrading requests for the other two positions will be submitted within the next 18 months. Expected completion date: Spring 2026. 	
4. WORKING ENVIRONMENT	
4.1	Action(s) (description of what is going to be done)
	<ul style="list-style-type: none"> Teaching Laboratory Temperatures and Ventilation. <p><i>University Recommendation #8. The Review Committee recommends that SFU leaders work with the Department of Chemistry and the Health/Safety Office to ensure that learning environments meet expectations regarding room temperatures and air-handling: in addition to an audit being essential to ensuring suitable work and learning spaces, record-keeping and prior planning are key to being nimble when opportunities for renovation arise.</i></p> <p><i>Chemistry Recommendation #20. Along with enhancing awareness of financial and resource-based limitations across the institution, the Department is encouraged to brainstorm for ways to move program offerings and/or instrumentation from one teaching space to another, with the longer-term goal of positioning where usage can be maximized and weekly needs to relocate are minimized. Examples include moving equipment from the undergraduate analytical lab into the inorganic/nuclear lab so that room temperatures are better controlled and so that equipment usage serves more than one sub-discipline.</i></p> <p>Response: As described in the External Review Self-Study Document, poor ventilation and extreme heat in Chemistry Teaching Laboratories are leading to health issues for undergraduate students, TAs, technicians and faculty. Support from the University is essential to redress this issue with upgrades to air handling; this is required to ensure a safe instructional environment for students, TAs, and instructors.</p> <ol style="list-style-type: none"> 1) The most significant heat issue is in C8055, the Analytical/Physical teaching laboratory. Not only does this space have insufficient air handling, but it also contains many heat-generating instruments that exacerbate an already bad situation. While the comments from the external review committee tacitly acknowledge also the inevitable damage to instruments in SSC C8055, the suggestion to move instrumentation to different laboratory spaces is impractical. Teaching spaces that do have some air handling are not close or compatible with needs for power, ventilation, and uncontaminated environments. 2) The Surrey Chemistry teaching lab SRYC 2780 also has insufficient ventilation for the number of students in the laboratory space. This led to three student fainting incidents in 2023, which clearly demonstrates an unhealthy learning environment.

3) The Inorganic/Organic/Nuclear teaching labs in SSB 8120/8148 have experienced significant heat issues due to a non-functioning chiller loop. There continue to be ventilation issues, with detectable solvent smells often present in the adjacent hallway.

Action: Out of concern for our undergraduate students' and colleagues' health, the Department will begin cancelling lab classes when internal lab temperatures exceed safe levels and/or ventilation is judged to be insufficient. These conditions will be evaluated in collaboration with SFU Environmental Health and Safety (EHS). We anticipate this will lead to regular lab cancellations during the Summer Semester, but in the absence of support from the University for air handling upgrades we will be left with no other options. The cooling loop in SSB 8120/8148 has been repaired after a significant delay, and the cooling issues in these spaces have become less extreme. However, SSB 8148 remains too hot for students wearing personal protective equipment (PPE), and additional work is urgently required by SFU facilities.

The University needs to commit resources to renovating the cooling and ventilation in the affected chemistry teaching laboratory spaces within the next year.

4.2	Resource Implications (if any)
	<ul style="list-style-type: none">Given that the cancelling of classes will be due to resource allocation decisions made by the University, it would be appropriate for the University to provide a pro-rated tuition refund to affected students. This would be consistent with the SFU policy for course cancellations in general.Renovation of ventilation and cooling in Chemistry Teaching Laboratory spaces will require a financial commitment from the University.
4.3	Expected Completion Date(s)
	<ul style="list-style-type: none">Cancellation of laboratories under unsafe heat and ventilation conditions will commence during the current semester, Summer 2024.The timeline for the renovation of the Chemistry Teaching Laboratory spaces is dependent on the Dean of Science and SFU upper administration.

5. SPACE (OTHER)

5.1	Action(s) (description of what is going to be done)
<ul style="list-style-type: none">• Space Allocation. <i>Chemistry Recommendation # 18.</i> The Department is encouraged to conduct a space audit with the goal of ensuring all spaces are used appropriately and within safety guidelines. This includes undertaking a process of decommissioning older and unused equipment etc., and exploring the possibility of incentivised disposal via the Faculty of Science or Health/Safety Office. <p>Chemistry Recommendation # 19. The Department is encouraged to work with the Faculty of Science to implement a transparent space allocation and usage protocol, e.g., via a newly formed Faculty of Science space management committee.</p> <p>Response: Given very limited space resources, the Department is continuously evaluating space usage and exploring creative options to optimize space allocations. These activities are led by the Departmental Space Committee in consultation with the Department Chair. The Department would welcome collaboration with the Faculty of Science with respect to space allocations. The formation of a Faculty of Science Space Management Committee, comprised of representatives from each of the Departments, is endorsed by the Department of Chemistry</p> <p>Action: Following the recommendation of the External Review Committee, the Department will conduct a detailed space audit of spaces within the Chemistry Building. This will be performed by the Departmental Space Committee.</p>	
5.2 Resource Implications (if any)	
<ul style="list-style-type: none">• Given that the recommendations are largely procedural, there are no resource implications.	
5.3	Expected Completion Date(s)
<ul style="list-style-type: none">• The space audit and allocation process with the Faculty of Science will have a completion date of Fall 2025.	

The above action plan has been considered by the unit under review and has been discussed and agreed to by the Faculty Dean.

Unit Leader (signed)	Date
Name (signature) Charles Walsby 	26 July 2024
Title Associate Professor	

Section B

DEAN'S COMMENTS AND ENDORSEMENT OF THE ACTION PLAN

I thank the review committee for a thoughtful analysis of the activities, strengths and challenges of the Department of Chemistry. The reviewers were pleased with the strong engagement they felt among Department members, and the candid input that was shared with them.

It is very positive that the Review Committee found that the quality of the Department of Chemistry's programs (graduate and undergraduate) is high and that there are measures in place to ensure evaluation and revision of the teaching programs. They found that the quality of faculty research is high, and faculty collaboration and interaction provide a stimulating academic environment. They were impressed by the Department's 3 interdisciplinary strategic areas of research (Biological & Medicinal Chemistry; Materials, Energy and Sustainability; and Nuclear Science), with the latter based on a strong relationship with TRIUMF.

I comment here on a few areas of the Department's Action Plan:

Undergraduate Programming: While the Review Committee assumed that there were lab capacity limits to enrolment in nuclear science courses, the Department has clarified that it is enrollment that is limiting. I appreciate the Department's efforts to create a nuclear science curriculum that is of broader interest to students, including students interested in health-related careers.

Aging research equipment: It is clear that the Department of Chemistry has a time-sensitive need to renew and upgrade its major research equipment, particularly nuclear magnetic resonance (NMR) but also nuclear science, mass spectrometry (MS) and X-ray equipment. The Reviewers' suggestion to engage with the Faculty of Science Advancement team is being implemented but cannot be relied on as the main strategy. While replacement of such large-scale research equipment is clearly beyond the financial resources of a Department (or the scale of core facility user fees), it is ALSO beyond the resources of the Faculty of Science and likely the university. **I strongly urge the Department to build a strategic grant planning team for the core facilities stream of the next CFI Innovation Fund competition in 24-26 months, including a strategy for matching funds. I and the Faculty of Science Office will strongly support an aggressive grant preparation effort.**

Aging teaching equipment: Across our 8 departments, the Faculty of Science is currently providing about half the amount of funding that is required to keep our undergraduate teaching equipment functioning well. While Advancement is being undertaken in this area, teaching equipment renewal is a yearly expense that would be best resolved by budget allocation methods that take disciplinary differences into account.

Graduate completion times: The Reviewers commented that graduate completion times are too long. I am very impressed with the operational and cultural ways the Department is trying to reduce completion times.

Kudos to the department for this worthwhile ongoing effort, which involved consultation with the Chemistry Graduate Caucus.

Faculty hiring: Thanks to a sufficient number of hires approved for the Faculty of Science this year, and the Strategic Research hires stream, it was possible to approve hires for Chemistry in the areas of Biomolecular Discovery, and Energy Materials for Hydrogen Technology; importantly, these hires will leverage Chemistry's leadership of the Centre for High-Throughput Chemical Biology, and the SFU Clean Hydrogen Hub.

Support staff: The ER team recommended acceleration of job regrading to promote recruitment and retention of student-facing departmental staff positions. The Faculty of Science supports appropriate regrading of positions and will assist with this effort.

Temperature control in specific undergraduate teaching labs: The Shrum C Chemistry building is the only space in the crumbling Shrum Sciences Centre that was renovated relatively recently. While physical infrastructure issues (flooding, envelope issues, temperature) are chronic and frequent in the Shrum Biology and Physics wings, and temperature control is ineffective in the office areas of Math and Statistics, Chemistry is overall functionally MUCH better. Nevertheless, there are heat issues in the Chemistry Analytical/Physical teaching lab, C8055. **Because this is a safety issue that affects students, it clearly must be resolved.**

However, that resolution MUST be done in a way that does not involve sudden cancellation of classes. Instead, advance planning must be done, including: 1) systematic documentation and record-keeping re air flow and temperature in teaching labs as well as other factors that may contribute to fainting, 2) exploring relocation of certain heat-emitting equipment to other locations, 3) use of portable air conditioning units (in progress), 4) relocation of the summer lab sessions to spaces with better air handling, if possible, 5) rescheduling of summer lab sessions to the fall and spring; until the air handling and temperature control can be upgraded for that space.

Faculty Dean (signature)	Date
	Sept 03, 2024

MEMORANDUM

ATTENTION: Department of Chemistry; SCUP; Senate

FROM: Paul Kingsbury, Associate Vice-President, Learning and Teaching pro tem
and Alice Campbell, Senior Consultant, Program Assessment, Learning Experiences Assessment
and Planning

RE: Department of Chemistry Assessment Plan for Educational Goals associated with 2023/24 External
Review

DATE: October 2, 2024



The Department of Chemistry has recently submitted its Educational Goals (EG) assessment report and plan to SCUTL following its recent External Review. We have reviewed your assessment plan in conjunction with the external review report and draft action plan.

We appreciate your aim to assess all of the undergraduate program's Educational Goals and that you have identified a range of courses where the goals are addressed. A number of these are lower level courses. Upper level courses would provide stronger evidence of how well students demonstrate achievement of these goals when are at, or approaching, the end of their programs. It is mostly in those instances where there is evidence that students, in aggregate, are struggling to meet a given goal, that we would recommend 'digging deeper' to relevant lower level courses to further assess how well students are demonstrating learning of the goal at a foundational level.

We note that while the assessment method is to look at student performance, you mention that you will elicit this using instructor feedback. The nature of this feedback isn't specified. As part of this feedback, we strongly encourage you and your instructors to gather information such as aggregate data of student performance on particular exam questions or aspects of an assignment. If instructors in the courses you are looking at use online grading tools, such as Crowdmark, this data should not be too onerous to gather.

You plan to collect all assessment data in Fall 2026. This may be ambitious, and we recommend first having a pilot semester where you collect data for one or two goals.

Lastly, we applaud your inclusion of a new Educational Goal on students "becoming knowledgeable about Indigenous ways of knowing in the context of modern Chemistry." The action plan indicates that this important work will be developed with the assistance of the Department of Indigenous Studies and the Associate Dean EDI in the Faculty of Science. We also see that Chemistry has the opportunity to be a leader in this work not only in Science but at SFU more broadly. In addition to the careful development

work to create learning opportunities in support of this goal, we strongly encourage careful assessment of this initiative, as it will likely provide important lessons and a model for other units who want to embed Indigenous ways of knowing into their programs.

As you begin to carry out your Educational Goals assessment, staff in the AVPLT portfolio are well equipped to support you and want to help ensure it is meaningful and manageable for the Department. The LEAP (Learning Experiences Assessment and Planning) team supports program and Educational Goals assessment. Their supports include assessment design, quantitative and qualitative data collection and analysis, and support with data interpretation. The Centre for Educational Excellence can help with program revisions and course re-designs that you may be planning.

Educational Goals Assessment Plan Template

Unit/Program: Department of Chemistry

Contact name: Charles Walsby (Department Chair)

Date:

This template is designed to help units implement assessment of Educational Goals after receiving feedback from their External Review. Units are not expected to assess every Educational Goal every year. *(Textboxes will expand as you type)*

1) Who were the members of your Educational Goals Assessment team? Outline who has worked on the assessment.

Dr. John Canal
Dr. Byron Gates
Dr. Sophie Lavieri

2) Are your program's Educational Goals current, or do any of them need to be revised?

In some cases, Educational Goals may need to be revised to keep apace with changes in the discipline or in the program's course offerings, or to ensure they continue to align with a unit's mission and values. Feedback from the External Review may inform revision of Educational Goals.

The Educational Goals are current.

3) Is your program's curriculum map up to date?

A curriculum map may need to be updated to reflect any major changes to the program's course offerings (i.e. new or substantially revised courses, courses that have been removed).

Yes. Most recently revised for External Review in 2023.

4) Assessment Plan

For each Educational Goal, outline what data you will use to assess student learning. Indicate what direct evidence you will draw on - which key courses you will sample from and, if possible, the course-based assessments you plan to use. These can be described in general terms (e.g. research paper, final exam questions targeting a particular Educational Goal). Indicate also whether or not you plan to gather indirect evidence (e.g. surveys, focus groups, interviews, etc.). The same indirect evidence method (e.g. a survey) can be used for multiple Educational Goals. Describe what would indicate to you that students had met the Educational Goal. Add or delete rows as needed.

Educational Goal 1: Have a solid foundation in the fundamentals of current chemical theories and their application to the physical world.			
Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students) Student performance on course work from course(s) that covers this educational goal (e.g., Chem 126, 316, and 380).	What would indicate that students had met the EG? Feedback from instructors that most of the students have a solid foundation of the fundamental aspects of chemical theory.	Is this direct or indirect? direct	When do you plan to collect the data? Fall 2026
Educational Goal 2: Be skilled at analytical reasoning, problem solving, and critical thinking.			
Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students) Student performance on course work from course(s) that covers this educational goal (e.g., Chem 230, 332, and 360).	What would indicate that students had met the EG? Feedback from instructors that most of the students have a solid foundation of analytical reasoning, problem solving and critical thinking.	Is this direct or indirect? direct	When do you plan to collect the data? Fall 2026
Educational Goal 3: Be able to design, perform and record chemical experiments and be capable of analyzing the results of these experiments. This includes the ability to critically assess results, identifying and quantifying experimental uncertainties and evaluating methodological limitations.			
Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students) Student performance on laboratory course work from course(s) that covers this educational goal (e.g., Chem 126, 236W, and 316).	What would indicate that students had met the EG? Feedback from instructors that most of the students have a solid foundation to design, perform and analyze the results from chemical experiments.	Is this direct or indirect? direct	When do you plan to collect the data? Fall 2026
Educational Goal 4: Have hands-on experience with a broad range of experimental methods and be able to use a variety of modern instrumentation and standard techniques.			
Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students) Student performance on laboratory course work from course(s) that covers this educational goal (e.g., Chem 216, 266, and 316).	What would indicate that students had met the EG? Feedback from instructors that students had a hands-on experience in the laboratory, using a variety of instruments and techniques.	Is this direct or indirect? direct	When do you plan to collect the data? Fall 2026

Educational Goal 5: Be able to communicate the results of his or her work to both chemists and non-chemists, in writing and orally.

Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students)
Student performance on course work from course(s) that covers this educational goal (e.g., Chem 236W, 286, and 366W).

What would indicate that students had met the EG?

Feedback from instructors that most of the students can communicate their results to different audiences.

Is this direct or indirect?
direct

When do you plan to collect the data?
Fall 2026

Educational Goal 6: Be able to use modern library search and retrieval methods to access information about specific chemical topics.

Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students)
Student performance on course work from course(s) that covers this educational goal (e.g., Chem 236W, 336, and 366W).

What would indicate that students had met the EG?

Feedback from instructors that most of the students can obtain information from published sources to correctly explain theory, answer questions or characterize data.

Is this direct or indirect?
direct

When do you plan to collect the data?
Fall 2026

Educational Goal 7: Be knowledgeable about chemical safety procedures, including proper methods and regulations for the safe handling, use and disposal of chemicals and the safe use and handling of chemical instrumentation.

Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students)
Student performance on laboratory course work from course(s) that covers this educational goal (e.g., Chem 236W, 281, and 316).

What would indicate that students had met the EG?

Feedback from instructors that most of the students are knowledgeable of the proper safety standards expected in a chemistry laboratory.

Is this direct or indirect?
direct

When do you plan to collect the data?
Fall 2026

Educational Goal 8: Be able to identify and solve chemistry-related problems and to apply this to the exploration of new areas of research.

Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students)
Student performance on course work from course(s) that covers this educational goal (e.g., Chem 230, 316, and 360).

What would indicate that students had met the EG?

Feedback from instructors that most of the students can identify chemistry problems and apply theory to new areas.

Is this direct or indirect?
direct

When do you plan to collect the data?
Fall 2026

Educational Goal 9: Have the experience and ability to collaborate effectively as part of a team to solve problems.

Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students)
Student performance on course work from course(s) that covers this educational goal (e.g., Chem 126, 281, and 336).

What would indicate that students had met the EG?

Feedback from instructors that most of the students can work effectively as part of a team.

Is this direct or indirect?
Direct and indirect

When do you plan to collect the data?
Fall 2026

Educational Goal 10: Be knowledgeable about indigenous ways of knowing in the context of modern Chemistry.			
Description of Assessment Methods: (e.g. Term paper from Course X, will randomly sample 20% of student work; exit survey of graduating students) Student performance on course work from course(s) that covers this educational goal (e.g., Chem 371 and 372).	What would indicate that students had met the EG? Feedback from instructors that most of the students can view chemistry from different perspectives.	Is this direct or indirect? Direct and indirect	When do you plan to collect the data? Fall 2026

5) How do you plan on sharing your findings within your unit?

The results of the analysis of Educational Goals will be shared via a report circulated via email and with a presentation by the Chair of the Department of Chemistry Learning Outcomes Committee at a Departmental Meeting.

6) Assessment Timeline

Next Mid-cycle Review: 2027/28 Academic Year

Next External Review: 2030/31 Academic Year