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MEMORANDUM

ATTENTION: Senate

TEL

FROM: Jon Driver, Vice-President, Academic and Provost *pro tem*, and Chair, SCUP

RE: External Review Mid-Cycle Report for the Department of Chemistry (SCUP 20-02)

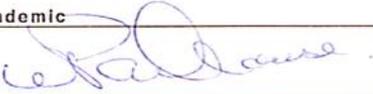
DATE: January 10, 2020

TIME

At its January 8, 2020 meeting, SCUP reviewed the Mid-Cycle Report for the Department of Chemistry which resulted from its 2016 external review. The report is attached for the information of Senate.

A handwritten signature in blue ink, appearing to read 'Jon Driver', written in a cursive style.

MEMORANDUM

ATTENTION: Jon Driver, Chair, SCUP	TEL
FROM: Wade Parkhouse, Vice-Provost and Associate Vice-President, Academic	
RE: External Review Mid-Cycle Report for the Department of Chemistry 	
DATE December 16, 2019	TIME

The External Review of the Department of Chemistry was undertaken in March/April 2016. As per the Senate guidelines, the Unit is required to submit a mid-cycle report describing its progress in implementing the External Review Action Plan. The mid-cycle report and the Unit's assessment of its Educational Goals are attached for the information of SCUP.

c: Vance Williams, Chair, Department of Chemistry
 Paul Kench, Dean, Faculty of Science



MEMO

Department of Chemistry

ATTENTION: Glynn Nicholls, Director, Academic Planning and Quality Assurance

FROM: Vance Williams, the Chair of Chemistry

RE: CHEM Mid-Cycle Report and Learning Outcomes

DATE: December 11, 2019

Dear Glynn,

Attached please find the Mid-Cycle Report for the Department of Chemistry which details our progress with the Action Plan stemming from the 2016 External Review.

The assessment of our Educational Goals is also attached.

Sincerely,

A handwritten signature in blue ink, appearing to read "Vance Williams", with a long horizontal flourish extending to the right.

Vance Williams
Associate Professor and Chair

Encl. Chemistry Mid-Cycle Report
Assessment of Educational Goals

External Review Update for the Department of Chemistry

Action	Progress Made
1. Programming	
1.1.1 Undergraduate	
<ul style="list-style-type: none"> The Department fully recognizes the urgent need to replace the equipment in the undergraduate physical/analytical laboratories - a situation that was identified in 2008 (the year of our last external review). During the last 6 years, \$450K has been invested to address the laboratory deficiencies identified at that time, but this is a fraction of the cost required to replace equipment and supplies, which is now estimated at \$2.8M. 	(see comments below)
<ul style="list-style-type: none"> In the absence of sufficient funding, and with the view to developing innovative programs, the Department spearheaded a proposal to establish the Centre for Self-Directed Studies that would partner the Department with a multi-national firm to equip, supply, and help maintain the Analytical and Physical Chemistry Laboratory, but more importantly, transform the way that our undergraduate students are taught in this core subject in an innovative way. This partnership requires both a 5 year+ University commitment to support the on-going needs of this undergraduate laboratory and internal contributions to match the industrial cash and in-kind contributions. Key components of this opportunity include the utilization of existing space, engaging students with industry-inspired and modern laboratory exercises, developing critical thinking skills and inspiring creativity, maintaining analytical integrity, training students to work as individuals as well as in teams, equipping students with their own supplies, encouraging an honest self-evaluation of skills 	<p>In 2017, the Department received \$1.3 M for the "Renewal of the Analytical and Physical Chemistry Undergraduate Laboratories at Simon Fraser University"; this project was funded jointly by the VP Academic, VP Research, and Dean of Science. These funds were used to introduce new equipment (e.g., GC-FID/MS, HPLC, plate readers, FAAS, TGA, DSC, UV-Vis-NIR, and sample preparation equipment) into this laboratory and to renovate the space. A member of our Department has spearheaded the initiative to purchase this equipment and to implement changes to the curricula of the analytical and physical chemistry laboratories (CHEM 215, 266, 316, 317, and 366).</p> <p>The Department continues to pursue funding opportunities to modernize our undergraduate teaching into order to better enhance the student experience, both through internal and external sources.</p>

and providing timely assistance to students to refine and improve their skills, training of essential skills to prepare samples for analytical processes, and replacing antiquated equipment with more robust, modern and industrially relevant equipment. Working closely on technological and industrial-relevant challenges, using pre-commercial instrumentation will better prepare the student for the workforce and foster future innovation and entrepreneurship.

The proposed Centre requires funding of \$8M over a period of 5 years to enable our Department to adequately teach essential skills required of analytical scientists (e.g., sample and data integrity, on-going personal skill refinement, and critical thinking in the laboratory) while also engaging more students (e.g., from other Departmental courses, as well as courses from departments beyond our own) than previously possible. This will be enabled through the installation of better equipment, improved maintenance of the equipment, access to sample preparation tools, implementation of an informatics system for process development, data handling and report management, and development of 90 new industry-inspired (real life) laboratory exercises. To this end, the Department has engaged a multinational partner that would provide \$4M in cash and in-kind contributions towards the Centre, but which is contingent on the University raising an additional \$4M (over 5 years).

The Department has formed a committee to oversee the plans to upgrade the equipment in both the Physical and Analytical Chemistry Laboratories and to implement the Centre for Self-Directed Studies with renewed vigor with the Dean of Science and the Vice Presidents. A detailed

<p>budget has been created for establishing this Centre; vision and mission statements have been prepared and shared within SFU; and promotional materials have been created. A commitment from the University is required to create the Centre; without this commitment the \$4M cash and in-kind contributions from potential partners cannot not be leveraged, and will not be realized.</p> <p>The Department continues to foster the relationships with these partners to maintain their interest, and will continue to work with members of the University to bring forward a plan for implementation by May 2017. It is proposed that the first phase of this initiative is to immediately secure funds (\$2.8 M) from the university to replace outdated equipment and supplies. Phase 2 is to raise an additional \$1.2M over the next 5 years, bringing the total to \$4M, to secure and leverage the \$4M in cash and in-kind contributions from the multinational partner, required to form the Centre for Self-Directed Studies.</p>	
<ul style="list-style-type: none"> The Departmental Information Technology (IT) committee has met to evaluate both the use of LON-CAPA and the role of the Director of LON-CAPA to ensure that the needs of the Department continue to be met. As a result, the Department is seeking approval from the Dean for a limited term Teaching Support Technologies position (projected to start August 2016) to maintain and further develop the LON-CAPA services used in the Department. 	<p>This position was not approved.</p>
<ul style="list-style-type: none"> The Department will review the number of first-year courses and the frequency of offering, and implement appropriate changes by September 2017. 	<p>A review of course offerings was undertaken. No significant modification in number of courses nor their frequency of offering was deemed warranted. These offerings are evaluated on an ongoing basis.</p>
<ul style="list-style-type: none"> The Department is developing a 1-unit course on scientific communications as a pilot project, projected for the Fall 2017 semester. 	<p>Due to logistical and scheduling challenges, this course has not been offered. We are examining ways in which communication skills can be incorporated into existing core courses.</p>

<ul style="list-style-type: none"> The Department recognizes the importance of communication skills and will work to ensure that students have improved opportunities in this regard. The Department is reviewing the implementation of its current W-designated courses to ensure that students receive appropriate instruction and timely feedback on written assignments. The Department is developing a complementary 1-unit course on scientific communication that focuses on developing oral presentation skills. 	<p>The Department strives to maintain consistency and standards in our course offerings.</p>
<p>1.1.2 Graduate</p>	
<ul style="list-style-type: none"> The Department is in the process of introducing modular courses at the graduate level. As a pilot project, a special topics course in Chemical Biology (CHEM 759) will be offered in modular form in the Fall of 2016. This will be followed by a staged introduction of further modular courses. The goal is to offer at least one modular course in each of the core scientific disciplines, with certain modules covering the core competencies of the field (preparing students for CHEM 802 and CHEM 808), and other modules serving to diversify the range of topics taught. The Department Graduate Studies Committee will work closely with faculty members to identify potential topics for inclusion in modular courses. 	<p>The Department explored two models for modular courses: (a) a series of independent 1-unit courses within a discipline and (b) 3-unit courses consisting of 2-4 modules, each of which is taught by a different faculty member. Because of the logistical challenges associated with scheduling and administering 1-unit courses at different times throughout a semester, model (a) has been adopted as the more practical approach. One such course, focusing on materials chemistry (CHEM 449/849) has now been offered twice, and the Department plans to offer variants in other subdisciplines.</p>
<ul style="list-style-type: none"> The Department wishes to be competitive and fair in regards to graduate student stipends. However, it should be recognized that the Department has no control over TA and graduate fellowship stipends, which supervisors must supplement from research grants. The Department Graduate Studies Committee has conducted a survey of stipends for chemistry students at universities across Canada. In terms of their net income (after subtraction of tuition fees), SFU Chemistry students are increasingly falling behind peers at comparable chemistry 	<p>Graduate student stipends were adjusted according to the following schedule:</p> <p>PhD Students: rate to the end of summer 2017: \$23,500/year Fall 2017 onwards: Increase of \$250/yr for the next 3 yrs. Fall 2017 = 23,750 Fall 2018 = 24,000 Fall 2019 = 24,250</p> <p>MSc student: to end summer 2017: \$20,000/year fall 2017 onwards: Increase of 3%/yr for next 3 years</p>

<p>departments. Over the last 5 years, the spending power of SFU's chemistry graduate students has decreased by 10 to 15%. Following this assessment, the DGSC will make a recommendation for increases in the stipend levels for M.Sc. and Ph.D. students that will be voted on at a Department meeting. It is planned to complete this process before the end of the Fall 2016 term.</p>	<p>Fall 2017 = 20,600 Fall 2018 = 21,218 Fall 2019 = 21,854.54 (\$21,855)</p>
<p>2. Research</p>	
<ul style="list-style-type: none"> The Department fully endorses this request as the current NSERC funding and allocation model disadvantages those researchers applying for small pieces of equipment. There is a constant and consistent need to upgrade small pieces of equipment for our undergraduate laboratories and for research purposes. 	<p>Securing funding for small equipment purchases, repairs and renewal remains a challenge. The Dean of Science has formalized a competitive process for funding both research and teaching initiatives, which has been very beneficial.</p>
<p>3. Administration</p>	
<ul style="list-style-type: none"> The Department recognizes the necessity of equity and diversity in the Department, Faculty, and University, and fully embraces this recommendation. A new Mentorship and Professional Development Committee has been approved by the Department (as of June) and will work with the proposed Equity and Diversity Committee at the Faculty level. The membership of this committee will be formalized by Sept 2016. 	<p>A Mentorship, Professional Development and EDI Committee was formed in 2016.</p>
<ul style="list-style-type: none"> The Department recognizes the issues faced by junior faculty and agrees with the suggestions that commitments should be firmed up, clarified, and documented as much as possible. The Mentorship and Professional Development Committee described above will serve to address the needs of new and junior faculty. A manual will be compiled to document frequently used procedures and policies in our Department, and kept up-to-date by 	<p>(see above)</p>

<p>this committee. This manual, along with information about professional development offered through the university, will be provided to new hires upon their arrival. The Mentorship and Professional Development Committee will also meet with the new faculty member to arrange for mentorship and to discuss other training opportunities in the University. Commitments made to a candidate prior to their arrival will be appropriately documented. The Department will recommend that new faculty begin their appointments on July 1st, if appropriate.</p>	
<ul style="list-style-type: none"> The Department will develop and consider the integration of adjuncts on a case-by-case basis, as opportunity arises. 	<p>We continue to seek ways in which adjunct faculty contribute to the teaching and research within the department. Most notably, adjuncts commonly participate as guest lectures in courses. We have not yet had the opportunity to include adjuncts in departmental administration, but hope to do so on search committees, as appropriate.</p>
<ul style="list-style-type: none"> While the Review Committee did not make any outright recommendations on this matter, the need to increase the Financial Assistant position to >0.6 FTE remains a high priority from the viewpoint of the Department. We continually fail to meet Departmental expectations in matters of finance in a timely manner. To state that this is a stressful situation for the group is an understatement. The Department has recently re-addressed and reconfirmed the need to increase the Financial Assistant position. The Department continues to address this issue. 	<p>The Department now has a full time Financial Assistant, which has proven critical to our operations.</p>
<p>4. Working Environment</p>	
<ul style="list-style-type: none"> For the past two years the Department has, on its hiring plan, recommended the hiring of a female faculty member using a targeted search. The Department will continue to pursue opportunities to hire female faculty members using any relevant provisions of the collective agreement. Each new hiring committee in the department will work with appropriate experts to minimize unconscious biases. 	<p>Two female faculty have been hired in Chemistry recently: one at the Assistant Professor, level, start date 2018, and a Lecturer, to start 2021. One female faculty retired in 2019. We recognize that there remains a considerable gender imbalance in our Department; redressing this remains a Departmental priority.</p>

<ul style="list-style-type: none"> The Department fully endorses the need to strive for, achieve, and maintain gender equity. The recommendation of placing more female faculty on onerous committees such as the TPC must be balanced against over-subscribing female faculty members on committees to the detriment of their research programs and teaching duties. The Department will explore the idea of creating internal department guidelines for the tenure and promotion committee that increase the number of female committee members on the TPC. However, it is recognized that there are ongoing negotiations between SFUFA and SFU's upper administration concerning the composition of TPCs. The Department is awaiting clarity on this issue. 	<p>The disproportionate administrative burden placed on female faculty in Chemistry remains a concern. Whenever possible and appropriate, we have reached out to colleagues from other departments to serve on committees.</p>
<ul style="list-style-type: none"> SFU Human Resources has initiated a Performance Development Program which includes an ongoing evaluation system for staff. The Department will be commencing its involvement in the program over the next year. 	<p>The Department has not formally implemented this process, but the Department managers regularly meet with their staff to discuss goals, assess progress, provide mentorship and give feedback on performance, as per the guidelines of the Performance Development Program.</p>
<ul style="list-style-type: none"> This situation has become more acute with the announcement that the Faculty glass blower is retiring at the end of July. The Department will review and update the glassblower job description to best fulfill the needs of the Department and Faculty of Science. A committee of faculty members and the Manager, Laboratory Operations will conduct a search for a suitable candidate, and an advertisement for the position will be posted in July. A tentative agreement has been made with our previous glassblowing technician to orient and train the new technician. The Dean has agreed to provide support for this training. 	<p>The Faculty hired a new glass blower in 2018</p>

<p>5. Space</p>	
<ul style="list-style-type: none"> • A new committee was approved by the Department at its June meeting. The committee will assess the allocation of space, with a view to providing recommendations that meet the Department's current and future needs. A comprehensive report will be provided to the Chair by May 2017. 	<p>In accordance with the Action Plan, the Space Committee provided a report on the space status to the Chair and the Department at the Departmental Meeting in July 17, 2017. A more comprehensive and up-to-date report is provided here.</p> <p>Since its establishment, the Committee has conducted a comprehensive assessment of the space allocation, and made the following recommendations to the Chair:</p> <ol style="list-style-type: none"> 1. Movement of the Sun lab to the North side of C7076: The move required renovation to provide more lab benches and more power and space for the existing fridges at the centre of the lab. 2. Movement of the Warren chemistry (wet) lab from C7076 into C8064, and relocation of the Warren group students to the office space (C8040) next to their chemistry lab. 3. Movement of the Kaake lab from C8085 and C8045 to C7076. This move required the installation of two fume hoods in C7076 with funding from the Dean of Science. 4. Movement of the Agnes lab items from C7076 to C8045 to facilitate the action of Item 3 above. 5. Downsizing of the Wilson lab along with the actions of Items 3 & 4 above to accommodate the new Ramogida lab. <p>These recommendations have been implemented throughout the 2017, 2018 and 2019 Academic Years. It is fair to say that, as a result of these actions, the present space allocation better meets the Department's current and future needs although our need for more space remains a challenging issue.</p>

SFU Department of Chemistry Educational Goals
November 2019

1.1 Undergraduate Educational Goals

In the course of the Chemistry Department's 2016 External Review, the Department formulated a set of nine educational goals, which are listed in Table 2 (EG1-9). We have carried out a preliminary inventory of how these goals are implemented in courses within our core curriculum. We have limited this inventory to core courses, *i.e.* those that students must take to complete a major (B.Sc.) in chemistry. The results of this inventory are summarized in Table 1, where "Y" (green shading) indicates that the course significantly contributes to and engages with the learning outcome, "P" (yellow shading) indicates that the course partially contributes, and "N" (unshaded) denotes that the course does not significantly contribute to this goal. In most cases, the Educational Goals are incorporated across a large number of our courses.

Table 1.

	EG 1	EG 2	EG 3	EG 4	EG 5	EG 6	EG 7	EG 8	EG 9
121	Y	Y	P	Y	P	N	Y	N	P
122	Y	Y	N	N	N	N	N	N	N
126	P	Y	P	Y	P	N	Y	N	P
215	Y	Y	Y	Y	P	N	Y	N	Y
230	Y	Y	N	N	N	N	N	N	N
236W	Y	Y	P	Y	P	Y	Y	N	Y
260	Y	Y	P	Y	P	N	Y	N	Y
266	Y	Y	P	Y	P	Y	Y	N	Y
281	Y	Y	Y	Y	Y	N	Y	N	Y
283	Y	Y	N	N	N	N	N	N	N
286	P	Y	P	Y	Y	Y	Y	N	Y
316	Y	Y	Y	Y	P	Y	Y	P	Y
332	Y	Y	N	N	N	Y	N	N	N
336	Y	Y	P	Y	P	Y	Y	N	Y
360	Y	Y	N	N	N	Y	N	N	N
366	Y	Y	P	Y	P	Y	Y	N	Y
380	Y	Y	Y	Y	Y	Y	Y	P	Y

N = no, does not meaningfully contribute to this learning outcome

Y = yes, significantly contributes to this learning outcome

P = partially contributes to this learning outcome

Table 2 Chemistry Undergraduate Teaching Goals

Goal	Description	Comment
EG 1	Have a solid foundation in the fundamentals of current chemical theories and their application to the physical world.	<i>Our curriculum focuses on foundational knowledge and skills. As such, this EG is central to most courses, although a small number of exclusively lab classes put less emphasis on theoretical considerations.</i>
EG 2	Be skilled at analytical reasoning, problem solving, and critical thinking.	<i>This educational goal is central to every chemistry course offered in the core.</i>
EG 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.	<i>Many of our lab courses require students to perform and record experiments. In lower division, students are not asked to design experiments. Hence, many of our lab courses are listed as P. In our next iteration, EG 3 will be subdivided to better capture these distinctions.</i>
EG 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.	<i>This EG is addressed predominately in laboratory courses, but is also often fulfilled in lecture courses.</i>
EG 5	Be able to communicate the results of his or her work to both chemists and non-chemists, in writing and orally.	<i>Communication skills are central to many of our courses, usually in the form of communicating to other chemists; for this reason, several entries are listed as P. Future iterations will differentiate between communicating to chemists and non-chemists, and differentiate between courses that emphasize oral and written communication.</i>
EG 6	Be able to use modern library search and retrieval methods to access information about specific chemical topics.	<i>Use of the primary chemical literature, (e.g. database searches and accessing peer-review papers) is emphasized increasingly from second year onward. Subsequent inventories will capture the case studies of how this EG is implemented across the offerings.</i>
EG 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.	<i>Safety training is integral to all courses that have laboratory components.</i>
EG 8	Be able to identify and solve chemistry-related problems and to apply this to the exploration of new areas of research.	<i>As seen in Table 1, this Educational Goal does not appear to be widely implemented across our program. This judgement may in part be due to ambiguity in the original wording, which has led to some differing interpretations. Subsequent inventories, which take a finer-grain approach than our Y/P/N ranking (see 1.2, below), will likely reveal places where this goal arises in courses.</i>
EG 9	Have the experience and ability to collaborate effectively as part of team to solve problems.	<i>Students routinely engage in group work projects, especially in labs.</i>

1.2 Next Steps

- We expect some variation in terms of educational goals depending on the instructors. All our core course are offered at least once a year, and many are offered more frequently. As such, almost all are taught by multiple instructors, and no faculty “owns” any of these courses. In order to assess this variation, the Department has struck a four-person Learning Outcomes Committee, chaired by Senior Lecturer John Canal. This committee is tasked with surveying every faculty involved in each core course, and reconciling the responses.
- As noted, there are several instances where the educational goals are either too broad to be properly assessed, or that need refining.
- Our second iteration of this survey will replace the Y/P/N scale with one that quantitatively ranks (on a scale of 1-5) instructors’ assessment of the degree to which the goals are satisfied for each course.
- We will extend the survey to non-core courses. In order to establish their likely impact on a typical major’s educational experiences at SFU, we will summarize the percentage of chemistry majors that take each course.
- We have begun to critically assess the results of this inventory on our program-level education goals. In particular, EG 6 and EG 8 both appear to be under-served at present. We will consider how these goals can be better reinforced within our program offerings.
- We are working towards establishing metrics by which we measure success. Currently we rely on grades as a measure of success, as the educational goals are closely integrated with the course grading (exams, assignments, etc.). However, we recognize that this captures only short-term effects; we need to establish a process by which to measure these over the entire program and after graduation. Guidance from CEE would be greatly appreciated in this regard.

2.1 Graduate Educational Goals

The following Graduate Educational Goals (G-EG) were identified for M.Sc. and Ph.D. students.

G-EG 1	Expand general chemistry knowledge. Students will continue to broaden and deepen their understanding of fundamental concepts in chemical theory and experiment as the basis for their sustained success as scientists and educators.
G-EG 2	Develop expertise in specific disciplines. Each student will acquire deep working knowledge in a chosen field of specialization in chemistry.
G-EG 3	Ability to effectively communicate and disseminate results. Students will learn to develop and articulate logical arguments with clarity. They will become confident and competent in writing for and speaking with expert scientific, general scientific and general public audiences on topics specific to their discipline.
G-EG 4	Ability to search, comprehend and dispute the literature. Students will have the ability to search, read and critically assess the primary peer-reviewed literature in order to understand the scientific context and concepts for their research and to synthesize new ideas in their field.
G-EG 5	Ability to rationalize complex data sets and to conduct meaningful analyses. Students will have the ability to produce, analyze and interpret chemical data and reduce their findings to sound conclusions.
G-EG 6	Ability for independent and original scientific research. Students will be able to conceive, design and execute projects in theoretical and/or experimental research in a chemical discipline. Students will learn how to solve significant, newly realized and hitherto unresolved problems in their chosen field.
G-EG 7	Responsible and ethical conduct in research. Students will understand and be committed to maintaining the highest standards of safety, honesty, ethical conduct and integrity.
G-EG 8	Teamwork and interdisciplinary collaboration. Graduates will have developed the ability to work effectively as part of a team; they appreciate the value of cross-cutting multidisciplinary research.
G-EG 9	Teaching and mentoring skills. Students will acquire skills to teach chemistry knowledge to undergraduate students and gain experience mentoring less experienced personnel in a research setting.

Assessment of these Educational Goals are carried out as part of supervisory committee meetings and qualifying course (CHEM 802 and 808). We are working to make the evaluation of individual Educational Goals an explicit part of these processes. Indeed, students in CHEM 802 and 808 are graded on criteria that are closely aligned with these goals. The Chemistry DGSC is reviewing the adoption of uniform grading criteria that capture these goals. We continue to assess whether these goals need modification or expansion.