

# Chemistry Program Review

Faculty of Science

## Dean's Summary

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Submitted by:

Dr. Lucy Lee, Dean of the Faculty of Science

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Accepted by:

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## Department of Chemistry Program Review

### Implementation Recommendations in Response to Reviewers' Suggestions and Unit Responses

prepared by Lucy Lee, Dean, Faculty of Science

July 17, 2014

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#### Executive Summary

The mission of the Chemistry Department at the University of the Fraser Valley is "to provide quality chemical education within the institutional framework". Their vision strives to provide students with an understanding of the natural world through a solid chemical education.

The Chemistry Department is a unit of the Faculty of Science, staffed by 9 permanent instructors (7 teaching instructors and 2 lab instructors), 2.9 Lab Technicians (1 full time, and 1 each at 0.8, 0.6 and 0.5), and a 0.3 departmental assistant, as well as a fluctuating number of 4 to 5 sessional instructors. The faculty, assisted by their competent staff, strive to offer exceptional chemistry education through experiential, hands-on learning in small classroom settings. They also strive to develop independent thinkers and creative learners that are ready to enter the workforce, or pursue future studies in professional fields or to further chemical specialties through graduate studies.

They provide instruction to about 15 BSc majors and 30 BSc minors as well as over 700 distinct students in other programs as service teaching. Total enrolments in all courses offered by Chemistry range between 1000 to 1200 students annually with roughly 95% being domestic students. Distinct course offerings range between 8 to 12 per semester and several of these are offered in multiple sections, with first year courses (CHEM 113/114) being offered the most with enrolments surpassing 500 students per year.

The Chemistry Department has produced graduates with solid credentials, but the number of graduating students has been few. Their students have had a high rate of placements either in the workforce or in continuing programs like Master's and Ph.D's, or into professional programs like medicine, pharmacy, or veterinary medicine.

The External Program Review Committee reviewed the Chemistry Program Review documentation and interviewed faculty, staff and students during a site visit on November 12-13, 2013. Their report was forwarded to the Dean's office on December 24, 2013, and subsequently released to the Department on January 8, 2014. Overall, the reviewers commended the Chemistry Department and the instructional delivery offered, but did note some deficiencies categorized under six headings: 1) program and curriculum; 2) faculty and staff; 3) facilities; 4) safety; 5) research; 6) University support and infrastructure. The unit prepared their responses and implementation plans to the review panel's recommendations and submitted these on June 5, 2014.

#### Action Plan on Recommendations and Implementation Schedule

The challenges identified by the department and concurred by the review panel were: 1) bottleneck experienced by students in their second year courses; 2) the related difficulty in taking upper-level chemistry courses in a timely fashion; 3) a need for more space for faculty and student research; 4) a need to enhance the department's nuclear magnetic resonance (NMR) capability; and 5) a need for better health and safety support.

Most of these boil down to infrastructure needs, a problem that is echoed through-out the Faculty of Science, and this is an issue that needs a major infrastructure fundraising campaign.

The Program Review Committee of the Chemistry Department has reviewed the report of the External Review Committee. Overall, the document is fair and balanced, identifying the major issues our department faces, and offering several reasonable recommendations. We will review their findings, respond to their recommendations, and correct a few minor omissions or errors that surfaced in their report.

### **Areas of agreement:**

The committee correctly identified several problem areas, focussing on the following:

- The student bottleneck that exists in high-demand second year courses, particularly organic chemistry
- The lack of space for faculty and student research, and for equipment
- The enrolment levels of upper level classes
- The need to hire an analytical chemist to provide proper leadership to the development of analytical chemistry courses, thereby providing for more choices in the upper level curriculum
- The need for more diversity in the upper level curriculum
- The desirability of developing a Biochemistry Major which would strengthen the Chemistry Department and increase student enrollment in upper level courses

The committee also identified several department strengths:

- Student expressions of appreciation for department faculty and staff
- Recent advancement in department research ability

### **Response to Committee Recommendations**

#### **1. Program and Curriculum**

##### **Recommendation 1.1: Develop a Biochemistry Major Program**

The Chemistry Department agrees fully with this recommendation, and support its implementation. A faculty member has been working on a Biochemistry Major proposal, and we will be assisting with its development. A Biochemistry Major would increase enrollment in upper level chemistry courses, would shift some students away from the over-crowded Biology degree, and would appeal to the many students who hope to pursue medicine.

##### **Recommendation 1.2: Continue to Reserve Space in Chemistry Courses for Chemistry Majors**

Since implementing this policy last year, we have noted a significant increase in the number of students who have declared a chemistry major or minor. We currently have 23 students enrolled in a Chemistry Major and 73 students enrolled in a Chemistry Minor, a significant increase from 14 majors and 30 minors a year ago.

##### **Recommendation 1.3: Allocate Resources to Solve the “Bottleneck Problem.”**

Over the past few years, we had noticed growing waitlists on second year organic and inorganic chemistry courses, coupled with complaints from students who were unable to enroll in these courses when they needed them. To solve this, we began to reserve spaces for chemistry majors and minors, and we shifted resources from our upgrading and first year offerings to create more sections of CHEM 213, 214, and 221. This has helped somewhat with the waitlist problem, but has not solved it

completely. Unfortunately, the number of sections of organic that can be offered are limited by the lab size, the number of special glassware kits we have, and our lab technician support.

It must be noted that offering Organic Chemistry in the new Chilliwack CEP lab is not a viable option. The new lab does not have the equipment or required plumbing to run organic chemistry, and we have estimated that to retrofit the lab and purchase additional glassware and/or equipment could cost in the range of \$60,000. Also, our lab technician support at CEP is shared with Biology. Therefore, it would seem most sensible to focus and future resources that might come available on the Abbotsford campus.

**Recommendation 1.4: That there be no Automatic Cancellation of Low-enrolled Upper-level Courses.**

As mentioned in the report, this is more of a student perception than a reality, in that we have only had to cancel a couple of sections due to low enrollment over the past 6 years. However, there have been numerous semesters where specific courses were “threatened,” when they had few students enrolled, and this unease about whether courses would run was felt by the student body. Unfortunately, Chemistry, along with other challenging disciplines, will always have a few upper level courses that only attract the most dedicated students, usually those in the Major program; and that is precisely why such courses must run. Fortunately, most of our upper-level courses have seen enrollment increases in the past few years. We attribute this to reserving seats for majors and minors, to spill-over from Biology students who cannot always get into their own courses, and to increased research options available to students in the department. But we feel very strongly that these key courses populated often by a handful of majors must run. The option of converting the course to a directed studies course is not appealing to faculty, as the workload, though reduced due to less grading is still very significant. Perhaps some other mechanism, such as reduced workload credit for very low-enrolled classes, could be implemented to give faculty more options to choose from.

**Recommendation 1.5: That the department offer an Honors Program which would include a Research Component.**

This is an idea we have been considering for some time, and will develop a proposal over the next year. The department currently has four research-active faculty, and thus could accommodate a number of honors students per year quite easily. Such an option would make the degree more attractive and be of benefit to students who wish to pursue graduate studies.

**Recommendation 1.6: Develop a Molecular Modeling Program**

The committee recognized the key role played by a faculty member and his molecular modeling lab in fostering student research within the department. We have recognized for years that a majority of our Majors spent time doing research with this faculty member, and this was one of the reasons we have worked very hard to develop a more comprehensive research climate in the department over the past 9 years. The faculty member is leading the development of a Modeling Major that will involve contributions from Math and Physics and CIS as well, and we will support and assist this effort.

**Recommendation 1.7: That there be decoupling of upper-level labs and lectures. And also that thought be given to rationalizing and streamlining upper-level lab experiments.**

We began this process with the inorganic chemistry upper-level courses about a year ago. We plan to restructure the organic courses in a similar manner. In addition, the quantum chemistry and physical chemistry courses will be restructured to fit into the Molecular Modeling Major. These changes should result in cost savings, and improve scheduling options.

**Recommendation 1.8: That a Masters degree in Integrated Science and Technology be developed.**

This is being developed by a working group struck by the Dean of Science.

**Recommendation 1.9: The committee affirms the use of problem-based learning.**

While all instructors utilize problem-solving in their classrooms and labs, we have not formally adopted the problem-based learning approach as a department, nor do we have faculty who have restructured their courses to utilize this approach. One of our faculty has expressed a desire to explore this mode of instruction, and the department would certainly support such an experiment and examine the results with interest.

**Recommendation 1.10: Examine all courses to ensure they are being offered at the proper level and with sufficient rigor.**

We do not have a large number of 400-level courses, and are confident that all are being offered at an appropriate level. As mentioned earlier, we are in the process of developing two new 400-level selected topics courses. Thus, now would be a good time to review our upper-level offerings as a department, especially as we will be restructuring several of the 300-level courses as well.

**Recommendation 1.11: That an internal curriculum committee be established.**

The Department does have a curriculum committee, which fulfills the roles suggested by the external committee.

**Recommendation 1.12: Troubleshooting of all classroom lab experiences should take place in the summer.**

This is an odd recommendation, as most of our labs have been delivered often enough that troubleshooting is not required. Of course, this is good advice for labs that need altering or for the introduction of new labs, and this would normally be done.

**Recommendation 1.13: The chemistry department should seek accreditation of their program with the Chemical Institute of Canada.**

This is a recommendation that the department will look into carefully. We were moving in this direction some 9 years ago under the direction of our previous Department Head, but at the time it was felt that we did not fully meet the criteria. We have not revisited this idea in some years, but clearly now is a good time to do so. If we do not meet the criteria for reasons that would require a capital investment, we would have to reconsider the idea in consultation with the Dean.

**2. Faculty and Staff**

**Recommendation 2.1: Hire an analytical (or environmental) chemist.**

The committee provides several excellent reasons why an analytical chemist should be hired immediately. We recognize that the university is in a difficult financial situation, and that new hires have been restricted because of this, but we stand in a good position to move forward with this recommendation. At present, two of our faculty members are planning to retire in the near future, and while retirement positions are not automatically filled, it is essential that these faculty members be replaced. One of these positions could be for an analytical chemist with experience or research interests

in the field of environmental chemistry. This would provide the department with an analytical chemist for the first time, allowing us to properly develop courses in this area, and allow us to develop courses that would fit in with the university's interests in environmental issues. The faculty of arts is currently developing a degree in environmental studies, and such a hire would allow Chemistry to contribute to such an effort.

Coupled with changes and new courses already under development, the hire of a new faculty member in the analytical chemistry stream, who could revitalize the upper level courses in this area, and develop new courses in environmental science, could lead to significant student interest in the chemistry program and be a draw for more students to make Chemistry their major.

**Recommendation 2.2: While recognizing budgetary constraints, the committee strongly recommends that any pending retirements be replaced.**

Our response to this recommendation is an integral part of the previous section. We need to replace both pending retirements, both to maintain our inorganic chemistry program, and to acquire expertise in the analytical/environmental areas. With a retirement not replaced a few years ago, the Department has had a greater reliance on sessional instructors. A further reduction would be problematic. Having these positions replaced would definitely strengthen the program moving forward and improve our ability to strengthen other academic disciplines, and improve Chemistry's importance to the institution as a whole.

**Recommendation 2.3: That the department employ senior undergraduate students and visiting graduate students as teaching assistants (TAs) in first year labs.**

In principle, this is a good idea. In practice, it may work on occasion as a way of giving upper-level students a broader education that includes some training in teaching, but we do not feel that it could be utilized, at present, as a way of reducing costs or increasing efficiencies in the first-year labs. We do not have a large enough pool of qualified upper-level students to be able to hire and schedule them into first-year instruction.

**Recommendation 2.4: Allow workload credit to faculty for teaching directed studies courses and for training, mentoring, and supervising research students.**

At present, faculty receive the tuition payments of directed studies students, and receive teaching releases to supervise students in research. However, the releases are contingent on faculty doing research, either with or without students, and are not at all dependent on the number of students supervised. A thriving research group of students requires a significant expenditure of time that goes beyond available releases. A system of receiving some workload credit for these activities would be very helpful, and would demonstrate the value of this type of instruction within the institution.

**Recommendation 2.6: Consider small but significant disparities for sessional instructors.**

There are many differences between permanent and sessional faculty, but some of them could be remedied to make the work environment of our sessional instructors better. These are beyond the control of the department, but we support any measures that can be taken to improve the situation for sessionals.

**Recommendation 2.7: As additional courses are added and as additional instruments etc. are required, consideration should be given to further technical support.**

The Departments and Dean are aware of this problem and the need for instrument replacement funds and further technical support for existing instrumentation. The university should consider reallocation resources to meet this need.

**Recommendation 2.8: Further training and certification for lab instructors and lab technicians.**

The suggestion that at least one lab technician should have first-aid certification is a good one that will be investigated. This should also be considered for one or more faculty involved in teaching labs, most likely a lab instructor, so that the department would have a back-up person available.

**Recommendation 2.9: There should be one individual within the department to whom all lab technicians report.**

The two Abbotsford lab technicians divided their workload by consensus, while our Chilliwack lab technician took care of all courses on that campus. Even with the arrival of a third 60% position in Abbotsford, this setup has worked seamlessly with no problems or concerns. We do not see any need for change at present. Also, the lab technicians do report to the Department Head, and there is clear communication between those parties.

**Recommendation 2.10: That there be a regular review of job descriptions within the department, particularly for the lab technicians.**

This is a reasonable idea, as the lab technician workload has grown over the past few years as we increased the number of organic and inorganic sections. In light of the recommendations for lab technicians to have first-aid training, a formalized review of job descriptions would be in order.

**Recommendation 2.11: That the department assistant appointment be moved from a 0.3-time appointment to at least a 0.5-time appointment and assigned only to Chemistry**

The Chemistry and Physics departments together have as many students as the Biology department, and thus should have a full-time assistant between them. Increasing the position from 0.3 to 0.5 per department would have several benefits besides providing increased support to the Heads.

### **3. Facilities and Equipment**

**Recommendation 3.1: Increase space for faculty and student research.**

Like the other science departments, the Chemistry Department suffers from a lack of space for the growing number of research faculty and their student researchers. One short term solution is to move the Student Science Center allowing Chemistry to use the space as an equipment room with additional bench space. This would significantly alleviate pressures and provide more bench space and instrument space. Eventually, the wall separating A373 from A385A (the organic chemistry lab instrument room) could be removed or have a door installed, connecting the two rooms and allowing for efficient use of all instruments. This would be an immediate and cost-effective solution, as initial renovations to A373 could be kept to a minimum.

**Recommendation 3.2: Improved nuclear magnetic resonance (NMR) capability.**

The committee recommends that our current functioning 250 MHz NMR spectrometer be maintained for the immediate future, but that eventually a newer 400 MHz instrument will be required. Such an instrument would be ideal for both teaching and research, but the department recognizes that such a

recommendation is not possible in the near-term in the current fiscal climate, unless external funding could be obtained. However, this could be put in long-term planning. Another option that is aimed solely at instruction would be to purchase a benchtop NMR, which operates with an electromagnet at much lower frequency (about 60 MHz). This would be much more affordable and not require continued purchase of cryofluids.

**Recommendation 3.3: Ensure proper functioning of the glove box.**

The glove box is not generally used as no faculty have current need of it. However, this could change in the future or with the hire of an analytical/environmental chemist.

**4. Safety**

**Recommendation 4.1: That a safety officer and a safety committee be established within the department.**

While the department does not have a safety officer, we do have a safety committee which includes several lab technicians and at least one other faculty member. Periodic lab inspections are made and problems identified. Inspections are sometimes made with members of the biology safety committee.

**Recommendation 4.2: Further support within the university's health and safety office.**

This was a call for the university to increase support for the Occupational Health and Safety Office, which we would support.

**5. Research**

**Recommendation 5.1: Enhance student and faculty research opportunities.**

Several sub-recommendations were made which can be summarized as:

1. More research space for faculty and students (a repeat of recommendation 3.1)
2. A dedicated Faculty of Science building
3. The choice between full-year sabbaticals every 7 years and one-semester sabbaticals every 3 years
4. Workload credit for the supervision of research students
5. A plan for the infusion of capital for the maintenance and replacement of equipment.

These are all very good recommendations, although many, in particular points 2 and 5, cannot be implemented immediately due to financial considerations. We have already voiced support for points 1 and 4. Point 3 is also a good one, as for some faculty, it would make maintaining a research program easier than the larger sabbatical every 7 years.

**Recommendation 5.2: Find links between chemistry research and community issues.**

There are not as many obvious points of contact between Chemistry and local community issues as there are with some other departments, particularly when consideration is given to current faculty research interests. However, the hiring of an analytical chemist with environmental training or research interests would greatly enhance the potential for such links.

**6. University Support and Infrastructure**



**Recommendation 6.1: That changes be made to the co-op program as it currently exists.**

To date, the co-op program has not functioned very well within the faculty of science. This appears to be due to the current structure of the program, and the available job postings in the area of science. The committee recommends giving a faculty release for someone to liaise with the co-op office, and for the department to give course credit for co-op placements. The former suggestion has merit, and the latter suggestion could perhaps be implemented. The curriculum committee will consider the latter idea further.

**Recommendation 6.2: Encourage the chemistry faculty to be more involved with the advising office.**

We feel there is good communication with the advising office and the first Chemistry Faculty Advisor has been appointed for a two year term coming this Fall.

**Recommendation 6.3: Plan for growth.**

We all hope that we and the university recognize conditions for growth if they present themselves, and that we will seize any opportunities.