

**External Program Report
Submitted as Part of the Program Review of the
Department of Chemistry at
Central Washington University**

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Summary

The Department of Chemistry at Central Washington University has achieved significant progress since its last five year program review. Specifically, the Department now offers a B. S. in chemistry which is approved by the American Chemical Society. This is a major achievement for the Department and the University.

In addition, the Department has continued over the last five years to work towards improving its graduate program, a program which offers an M. S. in chemistry. These efforts have been along the lines of increasing enrollment and increasing financial support of the graduate students. The need for an increase in the health and vitality of the graduate program was a common theme in many of the discussions I had during my visit. The Department and the University face a difficult decision with respect to the chemistry graduate program. It needs to either be substantially improved or eliminated. Its current condition is not tenable. It is my view that this program is worth upgrading. The additional resources necessary to achieve this upgrade are substantial.

The Department is clearly a cohesive unit working together with a shared vision. This is evident when talking with undergraduate students, graduate students, staff, and faculty. The demands on the faculty are high, and as the State of Washington prepares to deal with its financial shortfalls, significant negative results could fall upon this Department.

Overview

Prior to my visit I was provided a hardcopy of Chemistry Department Program Review 2009 - 2010 (2009 - 2010 CDPR). This document was organized along the lines of curriculum, program planning and assessment, faculty, students, library and information literacy, and future directions. It also contained several appendices with related material including a copy of a recent masters thesis.

I visited the Central Washington University on March 8 and 9, 2010. Over the course of these two days, I met with Provost Wayne Quirk, Associate VP for Undergraduate Studies Tracy Pellett, Dean of Graduate Studies Roger Fouts, Dean of Arts and Sciences Kirk Johnson, Chemistry Department faculty, staff, graduate students, undergraduate students, and a member of the CWU Biology Department. In all of these meetings, I found people enthusiastic about the Chemistry Department as well as candid in their views as to how the Department can maintain and improve its operation over the next five years.

I was asked by VP Pellet to prepare a written statement providing my perceptions in each of the major areas of the self study: curriculum, program planning and assessment, faculty, students, library and information literacy, and future directions. While VP Pellet specifically asked me not to provide a detail summary of what people told me during my interviews, I found in many cases it was helpful to recall a specific comment as a introduction to or illustration of a more general issue.

Curriculum

Undergraduate. The most significant improvement in the Chemistry Department undergraduate curriculum in the past five years has been the accreditation awarded by the American Chemical Society's Committee on Professional Development. This review by the American Chemical Society includes minimum standards concerning faculty, contact hours, professional development, support staff, instrumentation, computational capabilities, curriculum, and undergraduate research.

I met with a group of undergraduates during the second day of my visit. They were effusive in their praise of the Department faculty and staff. They commented on the friendliness of the faculty, the concern of faculty for students, and the accessibility of faculty. In addition, the students in my meeting were happy with the small class size (relative to UW where some had transferred from) at CWU.

The undergraduate students had several specific curricular concerns. First, the students detected a mismatch between general chemistry lectures and the corresponding laboratory. They noticed that different lecturers in the multiple sections of Chemistry 181 often are at different points in the syllabus at any given time in the semester. Laboratory exercises depend on material from the lecture. With lectures at different points in the syllabus at a give time, some students have covered needed material prior to laboratory class, some are covering it, and some have yet to cover it. This makes for a disjointed laboratory presentation where the preparation of the students is varied to this extent.

Second, the undergraduates expressed concern about the lack of feedback they received from some of their laboratory courses, particularly mentioning quantitative analysis. Several students

mentioned this as a problem, but I did not see it mentioned in the CDPT 2009 -2010 Appendix I where student evaluation comments were transcribed.

Third, as mentioned below in the Information Literacy section, students felt their access to computers and appropriate software was unacceptably restricted. They claim the computer labs that contain needed hardware and software are scheduled for classes preventing them from using the room (or rooms?). They also claim that computers in the lab (research?) are too slow to download .pdf versions of papers.

Four, students felt that expectations jump too dramatically between 100 level laboratories and 300 level laboratories. Apparently there are no 200 level laboratories which is odd at a four year institution where students generally expect the most significant digit in the course number to reflect the corresponding college year for that course.

Several students in our discussion group participated in the STEP program and found the program wanting. The main motivation for participating in the program appears to be the money available to participants. No alternative viewpoint was expressed on this subject. There appears to be a difference between what the students expect from the program and what they are finding in the program. It appeared to me that they expected to learn something about how research is conducted or how research proposals are written, but instead found themselves in a literature class.

In my conversation about curriculum with faculty, there was a discussion of screening students prior to their placement in first year chemistry courses. This is noble and difficult task. Most chemistry faculty can guess within a few minutes after watching a first year chemistry student struggle with algebra and pre-algebra concepts that this student will not successfully complete their first year chemistry course. Our discussion included taking advantage of screening that may already be happening in the Math Department and use this information to properly place incoming students. Chemistry often has a reputation on campuses of being a difficult course, but as the CWU chemistry faculty know, it is not usually the chemistry that students struggle with, but rather the mathematics. More recently, I have become suspicious that students are also struggling with reading, which is masquerading as difficulty with chemistry and math.

There seemed to be some confusion within the chemistry faculty as to whether or not the ACS offers both a certified chemistry and certified biochemistry undergraduate degree. My read of the ACS CPT material is that ACS offers only one certified undergraduate degree. Individual departments meeting the requirements for the certified degree appear free to label it as they choose.

I had the opportunity to talk to a biology faculty member. I was interested in learning about the coordination between the Biology and Chemistry Departments with respect to prerequisites, specifically, chemistry prerequisites for biology courses. I was pleased to learn from this biology professor that students taking biology with chemistry prerequisites are well prepared. This

faculty member shared with me a sense of enthusiasm for being able to concentrate more on biology topics without needing to cover basic chemistry. I missed the more subtle curricular changes that occurred in the Biology Department, but I sensed some change had occurred that made the prerequisite issue more suitable and acceptable to biology. The biology faculty member reminded me that the Biology Department links its labs and lectures and can only do this because the Chemistry Department is willing to unlink theirs.

Graduate. I met with six graduate students for approximately one hour. Their post graduation plans included working at a government laboratory, teaching at a community college, and further training at a Ph. D. granting institution. Four of the students in our meeting had received their undergraduate degree from Central Washington University. The students expressed concern about the lack of graduate courses offered each quarter. They pointed out that the catalog lists many graduate level courses, but the offerings each quarter are only a small fraction of the catalog courses.

Finances are also a concern for graduate students. Apparently, they receive \$900/month for 9 months but pay fees of \$600 per year. The graduate program will not be able to grow without being able to offer all graduate students a TA position, including a tuition waiver, for a least one year. I checked two other masters programs and found stipends of \$11,415/month for 9 months plus a tuition waiver and \$7200/year plus a tuition waiver.

An increase in the size of the graduate program faces many hurdles and not just financial ones. The chemistry graduate program at CWU does not receive many inquiries each year. The program will not expand until the inquiries increase. Increasing the inquiries is as much a marketing challenge as it is a curricular challenge. In my discussion with the faculty, we talked about the possibility of offering a more focused masters degree. This is something they have already considered and are aware of the advantages and disadvantages of such an approach. Such informal clustering of expertise has already occurred (see p. 66, 2009 - 2010 CDPR).

Once any changes to the curriculum are finalized, the next step is advertising. The only people who call sell this program are former students and faculty. Former students can be tough to keep track of, but current faculty can travel to appropriate undergraduate institutions and give seminars about CWU graduate chemistry in general as well as detailed descriptions of their own research opportunities. If the University is serious about selling the program, they will provide the funds and release time to put faculty on the road. Also, the Department might consider a full color brochure similar to what Ph. D. programs produced in the past (and may still). The brochure provides information (and pictures!) about the department and typically devotes one page for each of the faculty research programs.

In my small group meetings with faculty, I asked about the number one challenge the Department faces and increasing the size of the graduate program was a common theme. This means not just increasing the number of students but increasing the graduate courses offered in the program as well. This is an area where the graduate program could distinguish itself from other graduate

programs. There has been a trend in recent years to reduce the course requirements for the Ph. D. in chemistry. This has resulted in Ph. D. chemists with inadequate formal course work. A masters program with a significant course load may attract an audience. Getting all this course work done, along with research, in two years presents a challenge.

The Department and the University face a difficult decision with respect to the chemistry graduate program. It needs to either be substantially improved or eliminated. Its current condition is not tenable. The faculty recognize the need for change in this program. I did not speak to anyone who expressed satisfaction with the current condition of the chemistry graduate program. If the resources currently being directed towards the graduate chemistry program were to be redirected to the undergraduate chemistry program, this presents a powerful argument for eliminating the graduate program and realizing a strengthening of the undergraduate program. CWU would then find itself in an excellent position with respect to its already considerable undergraduate research program. As I'm preparing this report, I've received an announcement for the 2010 American Chemical Society Puget Sound Section Undergraduate Research Symposium to be hosted by CWU!

If eliminating the chemistry graduate program would produce no positive financial effects for the undergraduate program, then it makes more sense to invest in the graduate program and bring it up to an acceptable level. If this is the direction the Department and University plan to pursue, I would recommend the services of a consultant with expertise in chemistry masters programs. The main argument for upgrading the chemistry graduate program is that this is a distinguishing feature of the department that a significant number of young faculty have hired into. These faculty chose to come to an institution that supports a masters degree in chemistry. Eliminating this program could have serious repercussions with respect to faculty moral, the faculty's external funding prospects, and staffing of lower level chemistry courses with teaching assistants. This staffing has implications discussed below. The masters degree in chemistry is a time honored degree, and a department offering a quality degree will eventually have its share of students.

Based on my visit and my reading of the 2009 - 2010 CDPR, I believe the Department and University should commit to keeping and upgrading the chemistry graduate program.

Both the graduate and the undergraduate curricula depend on the upkeep of a significant number of advanced scientific instruments. For example, accreditation by the American Chemical Society requires "...a functioning NMR spectrometer that undergraduates use in instruction and research." (ACS CPT, Spring 2008) The Chemistry Department at CWU has an adequate inventory of appropriate equipment as well as qualified staff (1.75) to maintain this equipment. However, as was cited 5 years ago, and continues to be an issue in this review, the University has not identified how it plans to provide the needed funds for replacing this equipment as it becomes inoperable or obsolete. The investment in the qualified staff (1.75) is an excellent approach to getting maximum value out of the instrument inventory, however, in my conversations with staff and faculty, it appears that a 1.75 effort is too low and should be increased to 2.00. This support staff does more than simply maintain the instruments. They do

a significant amount of training (both for faculty and students) and troubleshooting.

Another important feature of both the undergraduate and graduate curricula is laboratory safety. Laboratory safety has features common to research laboratories and teaching laboratories while at the same time these two laboratory settings provide different safety challenges. At CWU, as in many other colleges and universities, an institutional safety office is maintained which has responsibilities for the entire campus. During my visit, I heard several individuals express concern about the lack of activity demonstrated by the university safety office with respect to Chemistry Department concerns. For example, audits and inspections of research laboratory space by the university safety office appear to be nonexistent. Chemistry departments across the country are keenly aware of the death of a UCLA chemistry student following a December 2008 accident. Fines in excess of \$100,000 have been levied against the university and the Los Angeles county is considering criminal charges against the university.

An additional safety issue was raised with respect to the staffing of the Chemistry 181 laboratories. Three separate rooms are under the supervision of a single faculty member with students TAs also present. Graduate students TAs, if available, provide an acceptable level of competence with respect to laboratory experience and safety awareness. However, relying on undergraduate TAs, regardless of their individual qualifications, to monitor the activity of 24 undergraduate students in a general chemistry laboratory is problematic. This is one area where an expanded graduate program could benefit the Department, namely relying on graduate students as the primary TAs and allowing undergraduate to fill a secondary TA role.

My overall impressions in the curriculum area are

1. the undergraduate curriculum is solid
2. there are recent student concerns about feedback on submitted work
3. the transition from a 100 level lab report to a 300 lab report is too abrupt
4. the equipment maintenance and upkeep issue remains unresolved
5. an increased role of the university safety office is needed in the Chemistry Department
6. the graduate curriculum needs to be expanded in terms of number and type of courses offered each quarter
7. the number of enrolled graduate students needs to be increased
8. graduate students with non-CWU undergraduate degrees need to be enrolled
9. small fixes are unlikely to achieve the desired graduate program improvements
10. A significant investment from the University is needed to upgrade the graduate program

Program Planning and Assessment

It is clear from the 2009 - 2010 CDPR that the Chemistry Department devoted a significant effort to compiling data and generating narrative. However, during my meetings with faculty (a large

departmental gathering and several small meal-centered meetings), I heard frustration expressed about the program review document generation. I expressed to the faculty my own frustration at trying to extract simple facts from the document such as how many graduate students graduate each year or what is the department budget. Several people expressed concern about the level of support given to the Chemistry Department by the University's office of institutional research. Chemistry faculty and others either could not get the information they needed or could not get it in a timely and useful manner from this office.

My overall impressions in this area are

1. the 2009 - 2010 CDPR document is not designed to enlighten an outsider
2. the university's office of institutional research should play a larger role in preparing documents like the CDPR
3. department faculty should be consulted prior to the design of the next program review document

Faculty

The best thing about the Chemistry Department at CWU is the faculty. They are well trained and committed to providing the students at CWU with a high quality education. They provide this education through traditional lecture and laboratory classes as well as research opportunities. Research, whether conducted with undergraduates or graduate students, is labor intensive for the faculty and expensive for the University. It is generally accepted in the scientific educational community that an undergraduate science curriculum that includes an appropriate research component provides students with the best training. The faculty at CWU are committed to this idea, and require publication with a CWU student author for tenure.

The faculty are committed to improving the graduate chemistry program. They are realistic about the challenges they face, but they present a strong argument for maintaining the program. In addition to the benefits that come to the graduate students (see **Students** section, below), having a graduate program at CWU allows the Department to be competitive when it comes to recruiting faculty. Faculty told me that they would not have come to CWU if it was an undergraduate only program.

My chief concern about the faculty is that they appear to be stretched too thin. They maintain a full scale quality undergraduate program as well as a small graduate program with a faculty size one would expect for a program offering only undergraduate degrees. Despite this, many of the faculty are able to secure external research grants and maintain active graduate research programs. However, the chemistry faculty at CWU is a young faculty, and their ability to work in this overdrive manner will fade with years.

I was especially pleased to hear about the tone and tenor of the faculty review process. The pre-

tenure faculty appear to have confidence in those doing annual or tenure reviews. This can be a tricky situation when a faculty is dominated by pre-tenure members as is the case in the Chemistry Department at CWU.

My overall impressions in this area are

1. the faculty remain the key to the high quality of the CWU Chemistry Department
2. the CWU chemistry faculty are spread too thin
3. the relationship between junior and senior faculty is healthy and constructive
4. the faculty are committed to the graduate program and want to see it improved

Students

Graduate Students. I met with six graduate students for approximately one hour. Their post graduation plans included working at a government laboratory, teaching at a community college, and further training at a Ph. D. granting institution. Four of the students in our meeting had received their undergraduate degree from Central Washington University. On the whole, students seemed pleased with their graduate training at Central Washington University. They cited faculty to student ratio, size of research group, class size, and staff support as the major factors contributing to their positive view of the MS program. In some cases, the CWU undergraduate advisor of these students encouraged them to stay at CWU and continue in the MS program, whereas in other cases the CWU undergraduate advisor encourage them to look elsewhere for further training. When asked what improvements could be made to the MS program at CWU, the students had a variety of suggestions. In no particular order, they listed more courses, improved finances, and more students.

Undergraduate Students

In my meeting with the undergraduate students, I was impressed with their enthusiasm for the Department and their insights into how things actually operate! They provided a number of helpful comments that I have incorporated into other sections of this document. Most of the students at my meeting were transfer students. I found this meeting far more useful than the written comments provided in the 2009 - 2010 CDPR. Perhaps the Department would consider asking a person from outside the Department to conduct an annual chat session with students to find out what's going on. The person leading this session could be a CWU person as long as the students sensed that the person was completely detached from the Department.

My overall impressions in this area are

1. students have a strongly positive view of the CWU undergraduate and graduate chemistry programs and faculty
2. students have a keen sense of where the Department's strengths and weaknesses are
3. written surveys may not provide the best feedback concerning Department operations

Library and Information Literacy

There appear to be several computer labs in Science Hall. In my discussion with undergraduate students, the students expressed frustration with their access to required software such as Spartan®. They also expressed frustration with the computers used in the labs throughout the building. It was not clear to me whether they were talking about research labs or teaching labs. The sense of the students was that the computers were outdated. When I asked if they thought these computers were purchased at the time of the new building construction, the students claimed these computers pre-dated the opening of the new Science Hall. They also stated that programs loaded on these computers have expired software licenses, and therefore are of even further limited utility.

The Chemistry Department has access to two critical library resources: ACS online journals and SciFinder. ACS journal subscriptions are necessary, along with many other benchmarks, to maintain ACS accreditation. The online version of the journals, as opposed to the paper version, is more convenient, reduces storage requirements, provides search capabilities, and provides more (over 40!) journal titles for less money. This is an important resource for both the undergraduate and graduate chemistry programs. The other critical library resource is SciFinder. This resource allows chemistry faculty and students to stay abreast of published work in chemistry and related fields. It allows searching using a wide range of input parameters including a portion of a molecular structure. From the 2009 - 2010 CDPR, it appears that SciFinder was not renewed at full strength in 2009. This is a serious step backwards for the Department, and every effort should be made to restore this critical library resource to its original level of service.

My overall impressions in this area are

1. the Chemistry Department has suffered through library cutbacks
2. new software (or licences) and hardware are needed in the Department for student use

Future Directions

The Chemistry Department faces significant challenges for the next several years as the State of Washington deals with large budget shortfalls. The Department is well aware of what the next important steps are in its continued growth and improvement. First, the graduate program, if it is to remain a part of the CWU offering, needs changes all of which involve increased expenditures. Second, the scientific equipment inventory needs to be upgraded, replaced, and expanded. Third, computers and appropriate scientific software need to be readily available to students. Fourth, staff needs additional positions to accommodate the large number of students currently being served by the Department. In the face of all of these demands, the University faces significant

reductions in funding. Given the state of affairs in the Chemistry Department, I would predict that even a small reduction in the funding on this Department will have a disproportionately negative impact on the Department and the University.

On page 77 of the 2009 - 2010 CDPR, the Department correctly points out the need for additional faculty but immediately reminds the reader that there isn't office or research space for additional hires.

The lack of a regularly schedule seminar program was mentioned five years ago as an issue to address. If the Department sees expanding the graduate program as its highest priority, it might better send its faculty out to give seminar rather than bring outsiders in to talk. Alternatively, the seminar series could be used to bring to the Department faculty from undergraduate institutions that are likely to provide the Chemistry Department at CWU with masters students. These speakers wouldn't necessarily be asked to give research talks. They could be invited to talk about curricular issues.

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