

An external evaluation of Sonoma State University's Chemistry Department
Undertaken in October 2021 by:
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GUIDELINES FOR EXTERNAL REVIEWERS

1. Understanding of students' needs, challenges, and characteristics and ability to effectively serve the program's students.
2. Sufficiency of resources and how they affect the quality of the learning experience; consider, for example, faculty, support, information resources, and research resources.
3. Curriculum coherency and currency.
4. Relevance and clarity of learning outcomes and integration with curriculum.
5. Meaningfulness of effectiveness of learning outcomes assessment. And use of assessment for program improvement.

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SECTION 1: OVERVIEW

Preamble

A key element of Sonoma's State's external review guidelines is 'resources'. All departments are perpetually in need of more tenure-track faculty, more laboratory space, more instrumentation, more University support. Meanwhile, administrators are rarely in a position to offer much relief in these areas. Indeed, in my discussion with the Dean of Sciences, Dr. Wade made the depth of SSU's financial challenges clear: there are few resources to go around, many other departments at SSU face crises of similar or greater magnitude than Chemistry's, and substantial changes in resourcing for Chemistry are unlikely. Furthermore, Sonoma State University does not have a clearly defined rubric, such as a post-review department-administration MOU, for measuring how recommended changes are implemented. These contexts challenge the reviewer to make meaningful, actionable recommendations. Therefore, I spend more energy in this report identifying key assets, successes, and needs, understanding that specific recommendations may not be given a great deal of weight as this continuous improvement cycle concludes.

Previous review cycle

Two artifacts not directly related to my site visit nevertheless were critical to my evaluation.

First, the previous external review report made a wide range of suggestions that could still lead to the stabilization of the department. Of these two items stand out. On the one hand, the reviewer recommended the Department focus on assessment and revision of the curriculum, and I concur that the curricular innovations made by the Department are quite strong. On the other hand, a range of problems related to budgets remain unresolved. From growth of the tenure-track faculty to faculty workload to instrumentation, the Department is hindered by insufficient support. Overall, the 2015 assessment remains a worthy guide to creating a strong department, but the current cycle takes place in the context of severe challenges that must be addressed to ensure the short, medium, and long term success of the Department.

Second, the Chemistry Department prepared an excellent self-study in 2020. In particular, the explanation of the status of learning outcomes assessment was instructive, and suggests that - while much has been learned - more work is needed to make comprehensive and coherent curricular changes. As well, the report helpfully includes a checklist of the previous external reviewers' suggestions. It is encouraging and interesting that this list has become a kind of guide for the ongoing work of the Department. More than any specific challenge or outcome, this approach suggests a Department open to truly continuous improvement. The self-study also highlights the serious interpersonal challenges facing the department, which I return to later in this report.

Success: student community

The Chemistry Department has created a set of curricular, physical, and relational student supports that result in an obviously and deeply present, engaged, collaborative, and mutually supportive student body. I emphasized the ***extreme rarity*** of such a sense of community, and how important the sense of belonging is to the educational outcomes of historically underrepresented populations in STEM. The structures that support this student cohesion should be recognized and reinforced. However, as in many areas, significant challenges highlight the fragility of this student community.

Challenge: faculty discord

Interpersonal conflicts have dealt the Chemistry Department a severe blow over the past few years. The damage is still very much apparent and the effects on personnel are ongoing. While some form of reconciliation process was undertaken to resolve the problems, ***it was wholly inadequate***. Indeed, the confusion and uncertainty about the nature of the conflicts and their 'resolution' demonstrate severe communication problems at all levels. It is absolutely vital that the administration take a much more active role in solving this problem; it is *not* solved. My primary recommendation is that the administration take the lead now and think much more creatively about what it will do to help the Chemistry Department rebuild a functioning and collaborative interpersonal work environment. Among the outcomes of failing to pursue healing are: an unsafe work environment for new and junior faculty; exceedingly difficult hiring and

retention of new faculty; and the relegation of the department to an atomized collection of individuals teaching classes that mostly serve other majors.

Challenge: instrumentation

The Departmental suite of instrumentation is functional but – aside from the recently acquired 400MHz NMR – consists in substantial part of ***used instrument donations***. Thus, much of the equipment is aging and in need of frequent repair. The list of instrumentation presented in the self-study shows clearly how important this instrumentation is to the student experience, but it does not convey the age of some tools, or the frequency of their repair needs.

Instrumentation is indispensable to lab classes such as organic and analytical chemistry. It is equally important in the course-based undergraduate research experiences that define the Department's curriculum. And of course - as the alumni quotes in the self study attest - training workplace-ready graduates with relevant hands-on experience are fundamental to student success after graduation. The Department should pursue a systematic catalog of instrumentation with the goal of identifying and replacing these weak links in Departmental infrastructure.

SECTION 2: STUDENTS AND THE CURRICULUM

Student interactions

I had multiple opportunities to interact with students during my visit. Student leaders took me on a tour of the lab facilities, and described the curriculum and the role of students in the program. Next, I had a meal with a broader swath of students. Finally, I had a brief, unscheduled interaction with a few students in the 'nerd lab', the conference room designated as chemistry major study area and social gathering space.

The first group of students clearly explained the curriculum to me, and emphasized how research is a centerpiece of the student experience. These students explained that several in their cohort are ready to move into industry and doctoral programs. It is clear that research experiences have been crucial to the development of student community, agency, and success.

At lunch, the sense of camaraderie was also apparent. Though we spoke a great deal about how everyone had adjusted to COVID closures, students were also eager to describe their favorite experiences, often involving projects they work on together, or the close working relationships they form with faculty in small classes and in research projects.

Later, I asked two groups of students, women of color, how they felt about representation in the department, and received a range of responses. Some students said their identities never played any role in their experience, and with these students it almost seemed that I had misstepped. It may be that these students felt so accepted and integrated into the University and Department that gender, race, and ethnicity had no impact in their interactions with faculty and students. Or perhaps these issues had simply never been raised with them in an academic setting before, and they felt uncomfortable in sharing difficult experiences. Another group of students stated that they saw the extant gender, racial, and ethnic diversity of the faculty - limited though it is - as a positive influence, that people of color on the faculty increased their sense of belonging. I do not believe this uncertainty to be unusual in a Chemistry Department. I bring this up as a reminder that the social context of the discipline - including students' own immediate experience - is an important aspect in the training of any chemist. The department *is* working to develop this curricular element, having introduced 301, 'Race and Sexism in Science' where they can address awareness of equity issues directly within their curriculum. Addressing and increasing that sense of belonging is vital in SSU's new context as a majority Latinx campus.

Curriculum

In any case, from the student perspective, Chemistry has created a highly coherent program of study, as is evident from the students' enthusiasm, contentment, and success. While across the Academy and the CSU, Chemistry curricula tend to be very standardized, SSU distinguishes itself in a number of ways. First, Introductory Chemistry 110 adopts a 'Chemistry Avengers' approach, in which iterative problem solving methods couple critical reasoning skills with basic chemical principles. And,

again, 310 illustrates how the department actively works to present Chemistry as closely coupled to society and all its challenges.

But the real crown of the Department's curricular structure is the focus on undergraduate research, by now universally recognized as one of the most important high impact practices that shape student success. SSU Chemistry's core research structure is highly inclusive: all majors are tracked through the same learning process, and so every student reaps the benefit of this experience. In 315, students spend a semester training to perform research, and developing a proposal. The following term, in 316, students execute this research project in teams, under the guidance of a professor. The course rotates among professors from term to term, and projects roughly follow the expertise of that term's instructor.

Instrumentation

The curricular gems of 316 and 401 place heavy demand on the Department's instrumentation infrastructure goals. Modern, functional tools are absolutely necessary to meaningful experiences, and the Department's suite of tools is sometimes astonishingly out-of-date and only kept running with the constant effort of a dedicated and highly creative instrument technician. As is elsewhere articulated, however, failure to update aging instrumentation will inevitably result in a degradation of this signature aspect of the Department's curriculum.

Weekly research meeting

Additionally, and critically for Departmental cohesion, SSU Chemistry holds a weekly department-wide research group meeting at which all faculty and many students present their work. This practice not only centers the importance of research in the curriculum and life of the department - emphasizing to students how important research is - it also creates another element of community. However, faculty reported to me that the intradepartmental conflict referenced elsewhere has badly frayed this practice, with some faculty only attending for their own presentations. The knock-on effect of the erosion of this departmental mainstay will logically be the *loss* of student community and cohesion.

Laboratory safety

A key responsibility of any Chemistry Department is the safety of its students. This is particularly true of the students engaged in undergraduate research. Commendably, the Department uses a safety agreement and training course which each research student is required to complete. Given my experience with Chancellor's Office laboratory safety audits, I recommend the Department ensure all students engaged in undergraduate research complete these every academic year, that staff routinely check enrollment rosters to confirm there is a record of their training, and maintain the records carefully.

- **Key takeaway 1: Physical infrastructure and integrated research structures have created a uniquely engaged and collegial atmosphere that is vital to**

student success.

- **Key takeaway 2: Discord among faculty is a threat to the sense of community.**
- **Key takeaway 3: Old instrumentation limits and threatens the stability and relevance of the research experiences available to all students.**

SECTION 3: CURRICULUM ASSESSMENT

Relevance/integration of learning outcomes

The previous self-study describes an ongoing process of curricular revision that, although based in part on clear assessment data, appears to be piecemeal. Some of these changes showcase the Department's flexibility: modifying the content of the senior seminar to incorporate student feedback, for example, is an important on-the-fly change.

Other elements of curricular development are long term projects. The previous reviewer recommended the Department use a standardized tool to evaluate how program learning outcomes (PLOs) are met throughout the curriculum. The Department duly followed this recommendation, trying the ACS's DUCK assessment. However, they found that Departmental PLOs cover a much broader territory than the sort of learning captured in the DUCK, and so they slowed down to develop new PLOs

The Department is to be commended for undertaking a comprehensive revision of PLOs. The new PLOs scale outcomes-expectations to the various developmental stages of students in the curriculum (self study, appendix A). The program is now poised to evaluate this more coherent set of PLOs, but plans for *that* study have yet to be created; it is not clear whether they will return to standardized assessments such as the DUCK. However, **I emphasize that the new PLOs and their comprehensive evaluation is really only the prelude to the real work:** development of a plan to respond to new PLO assessment data with a coherent set of curricular changes. The Department recently added this level of curricular planning to its list of program goals. Thus the Department is in an excellent position, in terms of data and preparation, to carefully revise or bolster its curriculum in accordance with its equally carefully designed PLO rollout.

On the other hand, interdepartmental discord means the cohesion required to undertake this kind of collective action is absent. This friction between faculty, the resulting loss of TT faculty, and Department's reliance on lecturer faculty with neither a sense of inclusion nor contractual obligation to coherent curricular design all point to likely struggles with meaningful curriculum development projects.

- **Key takeaway 1: The Department should follow through on PLO revision with a robust assessment designed to inform a comprehensive curricular review/adjustment/revision plan.**
- **Key takeaway 2: Instability and strife among the faculty will hamstring ongoing and coherent curriculum development.**

SECTION 4: RESOURCES

People - tenure-track faculty

The Department has 7 tenure-track faculty, however 2 of these are seconded to administrative positions, and one - the current chair - is planning to retire. Depending on whether the 2 faculty on leave return, the size could make retention of ACS certification a challenge. But the shortage could also mean some basic Departmental maintenance could also become a challenge: staffing electives, mentoring research students, and service tasks all require a critical mass of tenure-track colleagues.

People - lecturer faculty

The Department's lecturer faculty are a vital element of the Department. Lecturers reported feeling isolated from the tenure-track faculty community, that they are a separate class. They suggested developing alternatives to email communication and creation of team-building activities that build a sense of collegiality and include lecturers as part of the Departmental community. Lecturers describe some professional development activities, but assert that faculty evaluations are more box-checking than developmental; they would like to see a formative evaluation process coupled to the Department's pedagogical values. As well, lecturers feel as though the tenure-track faculty do not acknowledge the fact that lecturers teach more students and sections, and often teach large sections without additional compensation. They likewise feel that the assignment process is not collaborative, that the Department often makes assumptions about lecturer availability or interest. Finally, some lecturers reported feeling that their expertise is ignored, leaving them out of stimulating courses such as 315 and 316. Overall, lecturers would like to feel more integrated into the community, so that both the lifting they are doing for the Department *and* their potential for intellectual contribution are recognized. Given the difficulty the Department is having with collegiality, these sentiments are not surprising. But the erosion of tenure-track community described elsewhere means the lecturers are more important than ever. The Department should consider how to recognize lecturers as a pillar of the Chemistry community, and work with the administration to find the means to support their participation in the community.

People - staff

The Department employs one technician dedicated to running the stockroom, Mr. Bhattarai, and another dedicated to instrument maintenance and student training, Mr. Grumich. This technical staff is a remarkable asset which the Department should focus on retaining and sustaining. Mr. Bhattarai runs a highly professional stock room that makes the support and running of labs very smooth and seamless. Mr. Grumich frequently repairs instruments using even older dead instrumentals for parts, and even machines his own new parts when necessary. While the department is fortunate to have skilled and dedicated staff, it is risky to rely on them alone for instrument upkeep. Mr. Grumich is himself a former Chemistry major, and the Department should lean into that process by allowing both technicians space to train students who might one day augment Departmental staff.

Space

The Department has 5 teaching labs, through which all the department's lab courses rotate. One of these includes most of the Department's shared instrumentation. The labs are supported by a prep room, which stores and dispenses reagents and glassware for both teaching and research projects. Again, the prep room and instrument maintenance suites are highly organized and efficient.

Additionally, the Department has a total of 5 laboratory spaces in two buildings shared by faculty for their own research. Darwin 320 is shared among 5 faculty; Drs. Lillig and Bustos-Works share Darwin 314; Drs. Farmer and Fukuto share 317; Dr. Lares shares Darwin 306 with a biology faculty member; and Dr. Negru has a space in Salazar, since his laser safety needs are better served in a Physics-ready space. To the outsider, the solutions for space allocation and utilization appear idiosyncratic, though the Department seems to be making the most efficient use of the space it can, given its physical constraints. However, any significant growth will be well-served by a re-examination of how the department is making use of these laboratory spaces.

Equipment

The undergraduate research that lies at the heart of SSU Chemistry's curriculum relies on analytical instrumentation. These tools are mostly donations, and showing their age. The technical staff is an incredibly valuable resource, literally machining replacement parts that are no longer commercially available. Nevertheless, if the Department is to maintain undergraduate research as a viable pedagogical tool and a core of the major, a plan for updating the instrument suite **must** be developed to ensure long-term stability.

- **Key takeaway 1: Administration should evaluate the stability of the tenure-track faculty population, and assess what steps should be taken to repair damage to stabilize the Department. Most importantly, it must then take those steps.**
- **Key takeaway 2: Lecturer faculty need to be integrated into the life of the Department.**
- **Key takeaway 3: The staff and prep resources are excellent and serve courses and researchers well. The Department and administration should consider how to maintain these human resources for long term.**
- **Key takeaway 4: New and upgraded instrumentation is just plain required.**
- **Key takeaway 5: Distribution of lab space seems haphazard, with a significant amount of space underutilized and/or occupied by a unused instrumentation. The absence of 4 key senior faculty left the research spaces feeling empty.**

SECTION 5: RECOMMENDATIONS

Finally, I make two urgent recommendations and one suggestion that is entirely aligned with Departmental plans.

- 1) **The administration needs to spend energy and resources to help repair damage to faculty morale and safety. Failure to do so could result in the collapse of the department into a service entity.**

Based on my discussions with the Dean, the University's position is that due diligence has been done to address faculty discord in the Department. This is incorrect and a doomed approach. The process used to address the crisis and its aftermath **has not resulted in a functional resolution**. Indeed, the faculty have become even more atomized and are thus unable to work together to strengthen their program.

Although there is danger of the tenure-track faculty falling below the number required to maintain ACS accreditation, **hiring new faculty is not recommended unless and until the damage of the last several years. is addressed**. Attracting and retaining new faculty will be very challenging if not impossible in the current environment

- 2) **Aging instrumentation should be systematically replaced, and due consideration given to the upkeep of the new equipment.**

Hands-on experiences in high-quality lab courses, research-based courses, and student-faculty research projects all require constant access to high-quality and fully functional instrumentation.

Likewise, realization of students' goals (job placement, graduate studies) require experience with quality instrumentation.

A **plan** for replacement of aging tools would indicate a Department and University planning for and committed to the future.

- 3) **The Department should follow through on previous cycles of curricular assessment and PLO reform to arrive at a coherent and comprehensive plan for curricular development and revision.**

