



Chemistry Department Spring 2023 Program Review

Submitted by:

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Guiding Questions from the dean are noted in **blue** and department responses in **brick**.

Dean's Comments on the Self-Study:

1. The Chemistry program's self-study is a comprehensive review that covers the current curriculum, completed programmatic and core competency assessments, faculty contributions, progress on previous recommendations, and challenges. The last review for Chemistry occurred in 2014.
 - a. The Chemistry program at UH Hilo trains students in the fundamental areas of analytical, inorganic, instrumental, organic, and physical chemistry, utilizing hands-on learning in the laboratory.
 - b. Chemistry offers three different tracks to a Bachelor of Science in Chemistry: Chemistry, Biosciences, and Health Sciences.
 - c. Over the last five years, Chemistry has averaged around 7 graduates each year and has one of the university's most popular minors, awarding an average of 22 each year.
 - d. The Chemistry program serves other majors both within and outside of CNHS with the year-long sequences in General Chemistry and Organic Chemistry, as well as their semester-long survey classes.
 - e. Students in Chemistry classes learn the fundamentals of the subject using both lecture and hands-on laboratory experiences. Some classes have opportunities to work in the community and bring back samples for analysis in the laboratory.
 - f. There are six faculty members in Chemistry: Four tenure track and two instructors. Chemistry has a dedicated educational support position (APT) to help manage purchasing and laboratories. In the recent past Chemistry has been staffed with up to seven full time faculty.
 - g. Faculty members in Chemistry are active in scholarly activities, securing several large grants to support research and equipment, and have served UH Hilo in administrative positions.



2. The Chemistry department has six faculty members: Four tenured faculty and two instructors. Chemistry employs lecturers as needed to cover both lecture and laboratory classes.
 - a. Two long term tenure track faculty have recently retired.
 - i. If Chemistry were to hire another faculty member, what type of specialty, if any, may Chemistry want to consider? What type of collaborations may be possible with other programs in CNHS like Biology, Marine Science, and TCBES, and those outside like Environmental Science and DKICoP?
Department comment: The department faculty discussed the specialty of a potential new hire and generally agrees that a specialty in environmental chemistry would be the first choice. This specialty replaces one recent retiree and allows continued instruction in a couple of upper elective courses. The External Reviewer echoed that an environmental chemist would be a good choice but recommended opening up the possibilities up to include backgrounds in specialties such as biogeochemistry, climate science, and marine chemistry. A candidate with the potential to carry out an interdisciplinary research program with Biology, Marine Science, and or DKICoP would be an important factor as well.
 - b. Chemistry is a large service department and is integral to the success of students in degree programs both in and out of CNHS.
 - i. What type of faculty development has been historically done in the department? If funds are available within CNHS to support continued faculty development, where might be an initial area of focus?
Department comment: The Department of Chemistry provides a collegial, collaborative environment. For example, recent syllabi and schedules are shared by faculty onto a department-wide shared Laulima site, so new instructors can peruse recent syllabi prior to offering a new course. Class notes, exams, and assignments are also commonly shared. Department faculty are also encouraged to engage in university service activities that promote faculty development. During Summer 2023, the Department of Chemistry invited a guest speaker with a Ph.D. in Chemical Education to give a talk about student engagement in chemistry courses. This was an excellent learning opportunity but it only happens on rare occasions. Our faculty need more opportunities to interact, engage, and have discussions with chemistry faculty and working professionals from around the world. There are excellent opportunities for this kind of engagement at conferences, but attending these requires travel that costs time, money,



and long-term planning. Funding for travel and conference fees would be appreciated. A budget to invite speakers from other universities would also be beneficial. Whether having our faculty travel out to conferences or inviting speakers to visit with us at UH Hilo, it is important to consider the time required to meaningfully engage in these activities.

- c. Chemistry faculty provide undergraduate research opportunities for students.
3. The Chemistry program offers three pathways towards a Bachelor of Science in Chemistry. It also offers a Minor in Chemistry and a Pre-Pharmacy Certificate.
- a. For the Spring 2023 semester Chemistry had 32 declared majors (29 Primary, 3 Secondary) with a distribution of: Chemistry 12, Biosciences 15, Health Sciences 5.
 - i. How often does Chemistry see students transfer from one track to another? If a student does change track after two or three years, how might this affect their completion timeline?
Department comment: Most chemistry majors change tracks. When new students join UH Hilo, they just declare "chemistry"; and some say they do not realize there are different tracks. After spending a year or two learning about the different programs, they will often change tracks. Luckily, the tracks are set up in such a way that changing tracks does not delay completion timeline; and often a reason to change tracks is there is an opportunity to decrease the completion timeline. The Department of Chemistry has been working recently with UH Hilo Advising in an effort to encourage chemistry majors to select the track that best meets their needs.
 - ii. How far do students generally make it through the Health Sciences track before moving to DKICoP?
Department comment: It varies. Some students will strictly take only the pharmacy prerequisite classes in an effort to minimize the time and cost it takes to get to pharmacy school. Students that complete the Pre-Pharmacy certificate and go no further still require an additional 23 credits to complete the major, plus they must earn the minimum of 120 overall credits to earn the BS in CHEM: Health Sciences. On the other hand, some students complete the BS in CHEM: Health Sciences prior to successfully transitioning to either DKICoP or other Pharmacy programs.
 - iii. What required upper division classes are unique to each track and what percentage of students in these pathways would generally take it each time it is offered?



Department comment: CHEM 351/351L, CHEM 352/352L, and CHEM 421 are unique to the BS in CHEM (no track). There are no courses unique to the BS in CHEM: Biosciences track and no courses unique to the BS in CHEM: Health Sciences track. Some courses are somewhat unique in that they are required by two out of three of the tracks. For example, CHEM 350/350L is required by the Biosciences and Health Sciences tracks, but not the BS in CHEM (no track). Since CHEM 351/351L is not offered very often, students in the BS in CHEM (no track) can substitute CHEM 350 for CHEM 351, if they prefer. Other courses required by 2 out of 3 tracks are CHEM 320 and CHEM 431/431, which are not required by the BS in CHEM: Health Sciences track. Regarding percentages, the Department of Chemistry strongly encourages all eligible students to take upper level chemistry courses when they are offered; that is, if students meet the prerequisites, then they should prioritize registration in any upper level CHEM courses that they need, since some may not be offered for another two years. It is difficult to accurately estimate the percentage of students that would take upper level CHEM courses each time they offered.

iv. Is there one track that is preferred for students intending to be secondary teachers?

Department comment: Most recently, it seems that the BS in CHEM: Biosciences track has been selected as the preferred track for students intending to be secondary teachers. Students in this track receive a high level of training in both Chemistry and Biology and could potentially teach either subject at the secondary level.

- b. The BS-Chemistry degree is close to meeting the ACS guidelines for ACS accreditation.
- c. The core Chemistry curriculum is scaffolded where students take the two, year-long sequences CHEM 161-162 and CHEM 241-242.
- i. How is the graduation timeline affected if a student misses a class in either of the year-long sequences? In other words, how would a delay of completing CHEM 242 affect the student taking advanced, upper division chemistry classes? Are there any consequences for students completing this sequence in the Fall?

Department comment: This would not be much of a problem in terms of missing a longer sequence that would cause longer than expected delays. Since CHEM 161, CHEM 162, CHEM 241, and CHEM 242 are all offered in both Fall and Spring semesters, students can quickly make up a course



that is missed. Furthermore, several higher level courses, such as CHEM 274/274L and CHEM 320 only require CHEM 162 as the prerequisite, so a student could be taking these courses concurrently with the organic chemistry courses (CHEM 241 and CHEM 242).

- ii. How well do transfer students integrate into the current Chemistry 4-year pathway? Is there a particular area where students get stuck or start behind?

Department comment: Students do well transferring in from other colleges. Most of the CHEM courses at UH Hilo are comparable to courses at other colleges and universities. Therefore, transfer courses can be credited to the UH Hilo student's account. Problems may arise when a student transfers from a university on the quarter system and receives, for example, only 2.67 credits for a 3 credit course. In these cases, the 0.33 deficient credits may be waived.

- d. Chemistry is a participating program in the 495A/B senior seminar shared among the physical science departments.

- i. Has there been a recent discussion on how this class is delivered to meet programmatic and applicable core competencies for all participating programs?

Department comment: The involved departments, GEOL, PHYS, ASTR, and CHEM, have been discussing potential modifications to the 495 A/B course. A recent suggestion is to remove the two credits of 495 A/B and add 3 credits of NSCI 476 Communicating Science to each program. The NSCI 476 course would emphasize science writing, public speaking, and different forms of communication; whereas the 495 A/B courses tend to focus on just the public speaking part of communication. The recent discussions have not focused on meeting programmatic and applicable core competencies. A key chemistry program SLO that appears to be met by the 495 A/B course and the NSCI 487 course is "Independently prepare and present scientific findings or research at a seminar". On the other hand, another chemistry program SLO "Engage in scientific inquiry" may be better served by the NSCI 487 course, since that course will be able to devote more time to lecture and discussion on scientific inquiry.



4. Over the last five years, the Chemistry program has graduated around 7 students a year with around 22 chemistry minors.
 - a. Chemistry graduates continue on to graduate school or enter the workforce as chemists or laboratory technicians.

- i. **How are alumni of the Chemistry program tracked?**

Department comment: Alumni of the Chemistry program are not officially tracked in any way beyond simply keeping in touch via email or personal social media sites. The External Reviewer suggested a plan for tracking alumni and sharing career prospects. Quoting from the External Reviewer's report, the "suggestion is to create a LinkedIn group for department alumni, and encourage alumni and current students prior to graduation to join. This helps the department to track what students are doing after graduation and will capture professional successes. The information could be used to better advise chemistry majors about possible career paths in Hawaii and elsewhere. It may help these students understand how a chemistry degree from the UHH fits within their career and personal goals.

- b. The overall number of Chemistry majors has decreased over the last few years, following trends in DKICoP. In this time the number of completed Chemistry degrees has remained around 6-7 a year.
 - c. Similar to other sciences, Chemistry may gain declared majors after students complete introductory classes.

- i. **What recruiting efforts, if any, are done in introductory chemistry classes to support this type of student?**

Department comment: The chemistry department has seen a small number of chemistry majors transfer in from other programs over the last few years. There are no official, department-wide recruiting efforts that are currently carried out; although each chemistry instructor may have some things they do to support recruitment. The External Reviewer suggested including field trips as a recruiting tool in chemistry classes. Chemistry instructors have made recent efforts to increase the quantity and quality of field trips. Another idea from the External Reviewer regarding recruitment was to eliminate weak or dull points from the chemistry labs, and replace them with engaging activities geared toward non-majors.



- d. Retention is identified in the self-study as an area of concern and rates listed on online dashboards are skewed with pre-pharmacy students leaving for DKICoP with no intention of completing a BS-CHEM degree.
 - e. With the current scheduling scheme, upper division Chemistry classes have frequently been classified as small, enrolling fewer than 10 students.
 - i. **What are Chemistry's recommendations to help these important classes run on a regular cadence and with enough students to not be classified as small?**
Department comment: The Department of Chemistry recently decided to put some classes on an every other year basis. Every other year classes include CHEM 320 and CHEM 431/431L. Furthermore, courses that continue to be offered on an annual basis will not overlap with one another and will also encourage registration from students wishing to earn the Minor in Chemistry.
 - f. Chemistry promotes opportunities for students through its Lulima page
 - g. The Chemistry program has worked with campus offices to update its marketing materials to reflect updated course requirements and focus.
5. The Chemistry program's instructional offerings support students working towards a degree in Chemistry, students in the sciences with major specific Chemistry requirements, students planning on applying to the Daniel K. Inouye College of Pharmacy, and students interested in completing their general education lab or physical science requirement.
- a. Chemistry offers several regularly scheduled upper division courses as Writing Intensive (WI).
 - b. A majority of Chemistry classes are offered with a face-to-face modality with a few DL lecture sections.
 - i. **COVID shifted many lectures and labs to an online modality. As of Spring 2023 most Chemistry lectures and labs are back to an in-person modality, with a handful being offered as distance learning. Given the heavy service nature of the Chemistry schedule, has there been discussions about what classes, if any, may continue as DL?**
Department comment: There will no longer be any labs taught as DL and the Department of Chemistry is also discussing the possibility of shifting some of the remaining hybrid labs to 100% face to face labs. Some DL lectures may remain in cases where there are two or more sections per course. However, the department faculty need to discuss how to ensure DL courses are academically equivalent to in-person courses.



- c. Course capacities in lecture classes have varied over the past decade. In the past few semesters there has been a shift in service course offerings from fewer very large lecture sections to more sections with lower capacities.

- i. What measures are being considered to help determine the appropriate size of these classes? (For example, room capacity, modality, student success & equity.)

Department comment: This question is easier to answer for labs, since the room size and safety is the key determining factor. For lecture courses, the key determining factor is engagement and quality of interaction between student and instructor. This engagement is difficult to measure, but when class sizes were large (i.e. greater than 60), the students did not seem as engaged as when the lecture sizes became smaller (i.e. less than 40). It may be possible to assess institutional data to determine if DFIW rates have decreased as class sizes have gotten smaller. The current goal is to keep lecture class sizes for courses such as General Chemistry and Organic Chemistry at enrollment levels of 40 or below.

- d. Students intending to transfer to DKICoP often complete Chemistry's Pre-Pharmacy certificate, but don't apply for the credential when graduating.

- i. Has Chemistry explored ways to identify these students to encourage them to apply for certificates they are eligible to receive? (STAR, Institutional Research, DKICoP)

Department comment: Chemistry is still exploring ways to do this. It seems logical to advertise to chemistry majors through advising and to ask CHEM 241/242 instructors to reach out to students in these classes since these are pharmacy prerequisite classes.

- e. Chemistry collaboratively works with Kilohana, the academic success center at UH Hilo, to support the academics of first and second-year students taking Chemistry classes.

- f. The Chemistry course list includes electives in Environmental Chemistry, Chemistry of Biotechnology, and Environmental Toxicology.

- i. Are there new interdisciplinary areas that may be popular for both Chemistry students and students from larger programs (BIOL, MARE, ENSC, CBES?)

Department comment: Yes, there certainly are emerging interdisciplinary areas that may attract students from larger programs. One proven example was the success of dual listing CHEM 487 Environmental Toxicology with CBES 665 Environmental Toxicology. As new courses



are developed, the goal will be to appropriately dual list the courses to encourage registrations from other programs.

6. The Chemistry program effectively utilizes their facilities and lab space to deliver instruction.
- a. Chemistry supports its Fall and Spring laboratory classes using funds received from the CNHS Dean's office derived from student tuition. Summer laboratory classes are supported by approved fees charged to each student in the class.
 - i. If courses during the academic year had access to extra fees for enrollment, what type of enhancements to the student experience might be expected?

Department comment: With additional funds, the Department of Chemistry would be able to improve the quality of the lab experience for the Introductory, General, and Organic Chemistry students. In some cases, there is equipment, such as ring stands and clamps, that are beyond their useful life and simply need to be replaced with new equipment. In other cases, there are exciting new technologies, such as IR non-contact thermometers, that can be utilized to monitor temperatures of solid objects in current labs. Each lab that is currently taught should be assessed for potential improvements; and some current labs, such as dry labs, may need to be replaced by engaging new lab activities to make overall quality improvements in the lab experience.

- b. Chemistry laboratories have been outfitted with computer workstations.
- c. Faculty in Chemistry have a successful record of securing grants to purchase high end equipment that is used for both research and enhancement of the student educational experience.
 - i. Is there equipment that is no longer functional or needed, or needed that requires repair? If so, is there a plan to move forward with these items?

Department comment: The Department of Chemistry does have equipment, such as laptop computers, that are so old and slow that they are difficult to use and should be sent to e-waste if newer computers can be acquired. The department has disposed of several large pieces of equipment over the past few years but continues to have an older spectrometer and expensive balance that are not working properly. The department will continue to discuss how to manage these items; but since most research equipment was primarily acquired by a Principal Investigator (PI) on a research grant, the decision on how to move forward usually comes down to what that PI wants to do with the equipment.



d. High end equipment requires regular maintenance and periodic repair. A faculty specialist partially supports maintenance in Chemistry.

i. The faculty specialist is in process of being moved from the Office of Research to CNHS in Chemistry.

Department comment: The Department of Chemistry welcomes additional support from the faculty specialist. It is not likely that the faculty specialist will be able to repair the aforementioned non functioning equipment; but will be able to maintain current functioning equipment to ensure the equipment continues to function properly.



Draft Considerations:

1. With the interdisciplinary opportunities for UH Hilo students and previous retirements the Chemistry program should begin conversations on what areas of expertise it may want to target for future hires.
2. Continue to develop programmatic assessments, both core competencies and SLOs, and utilize them to guide any changes to the Chemistry curriculum. Review/identify where core competencies may be addressed. Consider if ACS accreditation is a goal and what appropriate changes should be considered.
3. Work with other physical science programs (PHYS/ASTR, GEOL) in CNHS to review the Physical Science seminar: Does the current offering fit into Chemistry's SLOs and how does it service the department's core competencies and programmatic outcomes?
4. Discuss program and course scheduling. Identify what cadance, modality, and capacities allow classes to meet consistent enrollment, and support student need, success and retention.
5. Work to identify students who transfer out of the BS-CHEM program that may be eligible at graduation for credentials offered through the Chemistry department.
6. Identify large, one-time new and replacement lab instructional needs and work with the dean's office to help find funds for their procurement. Discuss the possibility of laboratory fees for certain classes that may enhance student learning and experience.
7. Target high impact areas of faculty professional development for both tenure track and non-tenure track faculty.



Strategic Goals for next Program Review

1. With previous retirements and opportunities for interdisciplinary education and research the Chemistry program should continue conversations on what areas of expertise it may target for future approved positions.
2. Continue to develop and administer programmatic assessments, both core competencies and SLOs, and utilize them to guide any changes to the Chemistry curriculum. Review and identify where core competencies may be addressed. Consider if ACS accreditation is a program goal and what appropriate changes should be considered.
3. Coordinate with other physical science programs (PHYS/ASTR, GEOL) in CNHS to review how the current physical science seminar meets program core competencies and programmatic outcomes. Consider how alternative classes, like NSCI 476: Communicating Science, may meet these outcomes.
4. Monitor student success, equity, engagement, and retention in Chemistry's lower division classes to guide scheduled course capacities and modality.
5. Plan out a cohort-style schedule for advanced, upper-division Chemistry classes that supports meeting enrollment targets and maintains a regular scheduling cadance for students.
6. Identify students who transfer out of the BS-CHEM program that may be eligible at graduation for credentials offered through the Chemistry department.
7. Identify large, one-time new and replacement laboratory instructional needs and work with the dean's office to help support their procurement. Discuss the possibility of laboratory fees for certain labs that may enhance the student experience.
8. Maintain successful intradepartmental instructional collaborations and target high-impact external professional development opportunities for both tenure track and non-tenure track faculty. Consider using some of Chemistry's summer revenue sharing funds and/or potential dean's office support for these initiatives.