

2014 Chemistry Program Review

I. Mission Statement and Goals of the Department or Program

The mission of the undergraduate degree program in chemistry is to offer a general and specific set of courses in several areas in chemistry that will provide students within its majors a fundamental understanding, through qualitative and quantitative reasoning, of matter and energy and the changes that they undergo. The program is designed to prepare students for advanced degrees in graduate or professional programs and for students who are seeking to immediately enter the work force as teachers and technicians. Because few students major in chemistry, graduates tend to find options for further study and career opportunities.

Goals for Student Learning in the Major

Both programs of study are designed to provide students with the following:

- A fundamental understanding of analytical, inorganic, instrumental, organic and physical chemistry.
- A basic understanding of physics.
- Basic knowledge of the differential and integral calculus and statistical analysis.
- Basic chemistry laboratory skills.
- Skills to do chemical research.
- The ability to engage in scientific inquiry.
- An understanding of the relationship of chemistry and the environment.
- The experience of preparing and presenting a seminar.

In addition, the Health Sciences Emphasis imparts to students a basic knowledge of anatomy, physiology, biochemistry, and genetics.

II. Secondary Accreditation (if applicable)

III. Executive Summary by Dean, Department Chair, or Program Chair (appendix A)

1. The results or impact of the prior program review. Progress by the department in meeting its action plan within the last MOU, progress by the administration in supporting the same action plan.
2. National trends in the major.
3. Growth or decline in the number of tenure-track or tenured faculty, instructors, or adjunct faculty since the last program review.
4. Notable trends since the last program review in the numbers of majors, enrollment patterns, student/faculty ratio, retention data, or enrollment caps.
5. Notable student successes –covered in more detail within subsequent sections.

6. Brief overview of faculty productivity in instruction, scholarship/creativity, and service to UH Hilo –covered in more detail in subsequent sections.
 7. Brief overview of significant community service – covered in more detail in subsequent sections.
 8. Deficiencies in departmental expertise, if any. Are you currently pursuing new faculty lines?
 9. Special accreditation or other external evaluation.
 10. Faculty commitment to diversity issues.
-

2. National Trends in Chemistry:

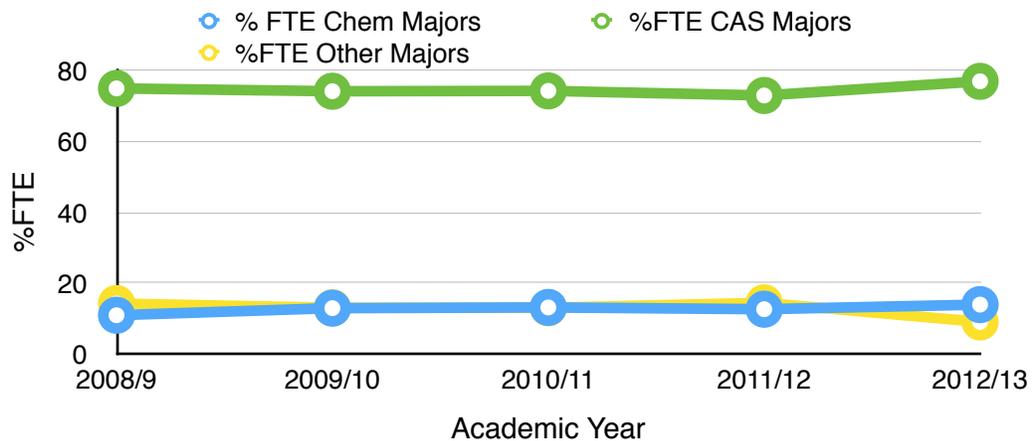
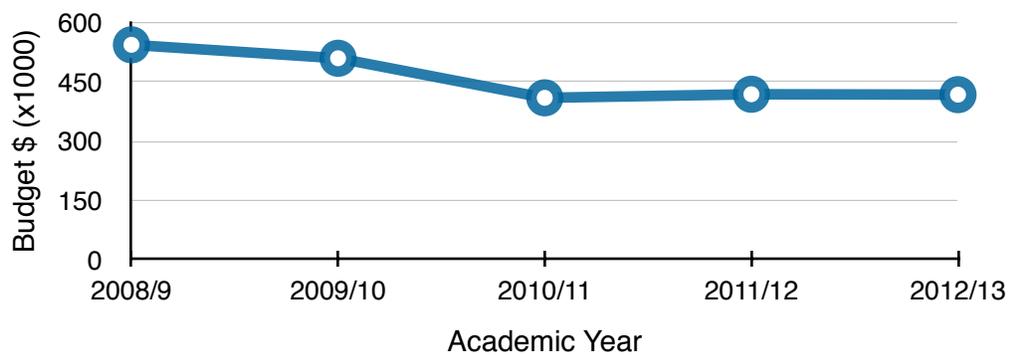
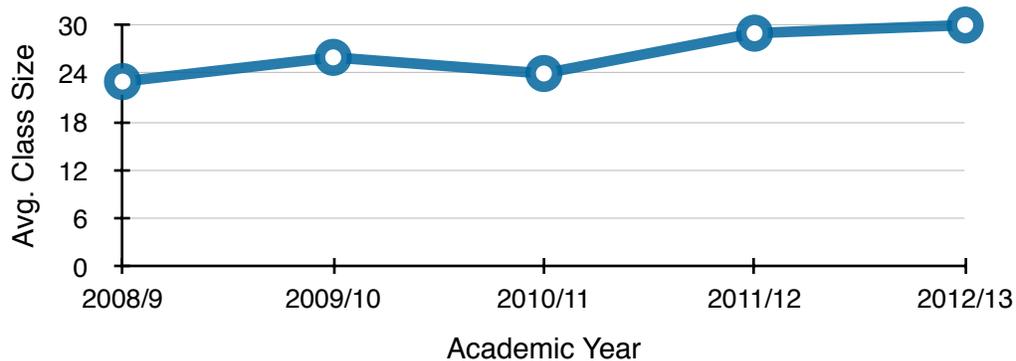
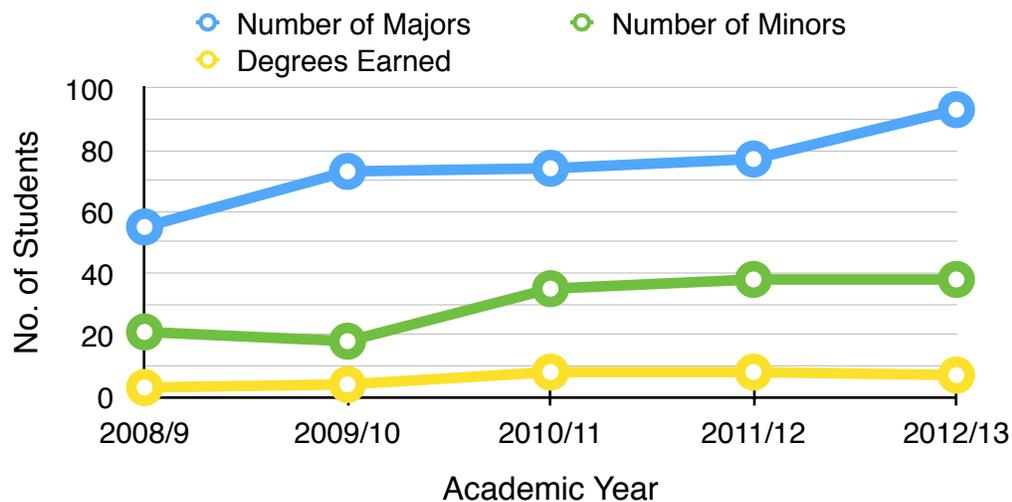
Based on data from the ACS, unemployment climbed from 3.8% in 2010 to 4.6% in 2011, this highest level since 1972 (first year ACS tracked this information). Overall unemployment in the US dropped from 9.7% to 8.8% in the same year. BLS data states that unemployment rate for chemists and material scientists was 6.1% for all of 2011 (ACS data for a specific point in time).

According to the ACS, the unemployment picture is bleakest for B.S. chemists. Unemployment numbers for ACS members. However, chemists' salaries are keeping pace with inflation. The median salaries for chemists at all degree levels increased, except for B.S. degrees, in 2011.

Unemployment of ACS Members from 2010 to 2011		
Degree	2010	2011
B.S.	5.1%	6.4%
M.S.	4.8%	5.2%
Ph.D.	3.2%	3.9%

Median Salaries Change since 2010		
Degree	Salary in 2011	% Change from 2010
B.S.	\$40K	0
M.S.	\$46.7K	+4%
Ph.D.	\$85K	+13%

4. The graphs below were compiled from institutional data found in the 100_Program Review-B.A. Chemistry.xlsx file.



Some notable trends:

- number of majors and minors increasing while number of graduates remains level
 - class sizes increasing
 - budget decreasing
 - SSH/FTE increasing (not shown in graphical form)
 - bulk of our FTE is for majors other than chemistry: 75% CAS, 13% CHEM, 13% other
-

Below are Strengths, Weaknesses, and Opportunities for Improvement for our department.

Strengths:

- Good commitment to undergraduate education
- New facilities
- Well equipped teaching laboratories
- Provide substantial teaching service for STEM majors
-

Weaknesses:

- Lack of research opportunities
- Unaccredited program
- No B.S. degrees
- Shortage of tenured/tenure-track faculty
- Few majors
- Underfunded
- Increasing class sizes

Opportunities for Improvement:

- Enlist more tenured/tenure-track faculty to teach laboratories
 - Convert B.A. to B.S.
 - Obtain accreditation from the American Chemical Society
 - Design upper level research courses for CHEM majors
 - Add biotechnology program to compliment KCC certificate program
-

Each bullet is a summary point from the Memorandum of Understanding of December 16, 2004. Each summary point is followed by the 2014/2015 response.

- The number of students in service courses offered by the department is increasing rapidly due largely in part to increases in natural science majors, especially marine science and

biology. This number is creating some challenging teaching and research loads for current chemistry faculty.

Increasing number of students requiring general and organic chemistry has been met with additional faculty hires at the tenure-track level (Drs. Furumo and Hamad) and at the instructor level (Ms. Vadulescu and Dr. Crist).

- Low student enrollment in the chemistry major is an important concern of the department.

The number of students enrolled in the major has increased since the last Program Review. A significant majority of these majors are enrolled in the Health Sciences track while very few have chosen the traditional Chemistry track. Upper level courses (Physical Chemistry I lecture and lab; CHEM 351/351L) for this track were last offered in the fall of 2013 with seven enrolled students. However, only three chose to continue with the sequence of courses required to complete the Chemistry track (Physical Chemistry II CHEM 352/352L and Intermediate Inorganic Chemistry, CHEM 421) in the spring 2014 semester.

Due to low enrollment, these courses were cancelled for spring 2014. PHYS 270, Modern Physics, was chosen a substitute for CHEM 352 while no substitutes were found for CHEM 352L or CHEM 421. There are a significant number of students interested in this difficult and rigorous track but they choose an alternative track (Health Sciences) or they transfer to another university to pursue their chemistry degree.

- Problems with the amount and quality of basic laboratory equipment continue to plague the department.

With the occupation of the new Sciences and Technology Building in the fall of 2012, new laboratory equipment has replaced the majority of the antiquated equipment. However, there is still a shortage of items required to bring our labs up to date. These items include three low-cost spectrophotometers and 10 digital thermometers.

- Curriculum revisions must be revisited in order to reflect both a better path toward graduate school for majors and current issues that attract research dollars, needs of the state, and student interest.

The current B.A. programs, Chemistry and Health Sciences, are well suited to prepare students for graduate or professional school. The department is formulating plans for a new program in biotechnology. This popular field will prepare students for employment in state agencies and local biotech industries with an emphasis in biofuels.

- Funding and specialized equipment for the chemistry program in the past two years has improved through faculty's acquisition of grant monies.

The Department has not acquired external funds for several years. Specialized equipment for laboratory courses, including a new biotechnology lab course, were secured with funds made available for the new Science and Technology Building.

- Assessment of student learning needs to rise to a level where it can guide department decision-making.

Current assessment of student learning involves the use of standardized exams at the end of general, organic, and analytical chemistry. Using data provided by the American Chemical Society the department can gauge how well UHH students perform compared to national trends. However, it is not known which specific concepts were problematic for students. Therefore, we will select current exam questions throughout the semester to assess how well our students' knowledge in a specific area are progressing in each course.

- Recruitment of highly qualified faculty in chemistry is difficult.

Since 2005, the department has been successful in hiring Drs. Furumo and Hamad, who are both tenured, and two instructors, Dr. Crist and Ms. Vadulescu, M.S. Hiring of qualified faculty in chemistry has become less difficult with the establishment of the College of Pharmacy and its graduate programs. This trend should continue when the General Engineering program begins in the fall of 2014. UHH programs requiring chemistry will elevate our profile which will improve recruiting highly qualified faculty.

- The department has developed good energy through self-evaluation and commitment to quality education.

The department will continue to perform self-evaluations and assess the effectiveness of our efforts to give students the best possible chemistry instruction.

The following numbered items are the "Plan of Action for the Chemistry Department" from the MOU of December 2004 and the 2014/2015 response to these items.

1. Work with appropriate personnel to fill a faculty position in chemistry when the provisionally approved College of Pharmacy is in the recruitment phase.

Several new faculty members were hired as indicated above.

2. Develop some options to recruit highly-qualified students to become chemistry majors, including, but not limited to, closer ties to the K-12 school systems via individual contacts and the College of Continuing Education and Community Service.

The Chemistry Department has fallen short of this goal. Currently, Dr. Hamad is serving as a science mentor for Ha'aheo Elementary School students. At this time he is the only faculty member involved in any type of outreach activity.

3. Continue to work with the Director of the Division of Natural Sciences via appropriate channels to help resolve issues regarding needs for basic chemistry laboratory equipment.

As outlined above, the Department has received new equipment upon taking residence in the Sciences and Technology Building in fall 2012.

4. Revise the curriculum for chemistry majors to include a capstone course, a revision that will allow the department to offer one B.S. degree to replace one of its two B.A. degrees. This B.S. degree should serve chemistry majors better in regard to qualifying them for graduate studies.

The Department has not taken any steps to convert either B.A. degree to a B.S. degree. Such a conversion may improve our students chances of attending graduate school, however, the B.A. does not exclude them. The current mechanism to convert the B.A. to B.S. degrees involves submission of an Authorization to Plan (ATP) followed by planning the new program. This will require two years for what will be essentially a change in title only. Both tracks are currently B.S.-level programs.

5. Shift the focus of the B.A. degree in chemistry to a greater thrust in the study of natural products and the environment. This thrust will take advantage of current research potential, student interest, and the needs of the state of Hawaii.

To date, the focus of the B.A. degree in chemistry has not shifted toward the study of natural products and the environment. Natural products and the environment are topics covered very thoroughly in both tracks via core courses and elective courses.

6. Continue to increase funding for the department by exploring potentially lucrative grant opportunities where UHH can be competitive, i.e. grants that target institutions with high numbers of students who (a) are first generation students, (b) have family income that falls below 150% of federal poverty guidelines, and (c) are underrepresented as a population.

The Chemistry Department is participating in two NSF funding activities to improve undergraduate education for under-represented students interested in STEM careers. The first program, a joint effort between Biology and Chemistry Departments, is Improving Undergraduate STEM Education (IUSE) program. The goals of this program are: 1) obtain research-based and research-generating approaches to understanding STEM learning; 2) designing, testing, and studying curricular changes; 3) the dissemination and implementation of best practices; 4) broadening participation of individuals and institutions in STEM fields. The second effort is the Research Internships in Science of the Environment (RISE) and is being spearheaded by the College of Pharmacy (Anthony Otsuka). This program is designed to fund minority students to conduct undergraduate research, with the ultimate goal of increasing diversity in the scientific workforce.

7. Concentrate on development of a viable assessment plan to measure the learning outcomes of chemistry students. This plan should address the question, "What evidence do we have that the department contributes to the improvement of chemistry and science proficiency in both chemistry majors and students from other majors?" This development should include both internal and external measures of success, with the data driving departmental decisions.

Currently the Department is using several standardized exams (as noted above) to assess UHH student knowledge compared to a national database. Newly acquired software will allow us to determine which concepts were the most problematic for our students. In addition to standardized exams, we are developing assessment questions in the areas of information literacy, written communication, oral communication, and quantitative and scientific reasoning.

8. Use the interests of faculty to involve highly-qualified students in faculty research. This strategy has the potential to recruit more students to the chemistry major as well as to offer positive learning experiences for all students.

Drs. Hamad, Michaud and Furumo have worked with undergraduate and graduate students in the area of chemical research. Currently the Department does not have a mechanism to involve undergraduate chemistry majors in research on a regular basis.

9. Increase the supervision of laboratory courses taught by lecturers in order to guarantee appropriate expertise in the oversight of health and safety concerns.

The department must do a better job of laboratory supervision. On several occasions students have complained of the laboratory instructor being absent during a laboratory session. This is beyond the instructor stepping out for a

minute or two. In some cases, this problem may be due to scheduling too many lab sections to an instructor.

It would helpful to have additional instructor positions to provide a more reasonable workload for laboratory courses.

10. Rely on UH Manoa and other better-funded entities for the use of highly-specialized technical equipment that is costly to purchase and equally costly to maintain until the department reaches a point where it is financially feasible to do otherwise.

With the College of Pharmacy in place, it is no longer necessary to rely on UH Manoa for instrumentation.

11. Consider strategies to become more cost-effective, including investigating the use of laboratory fees to alleviate the high cost of chemistry laboratories.

Laboratory fees are issued during the summer session but we have not issued them during the academic year. Implementation of fees will be investigated in the future.

12. With other departments in Natural Sciences, develop a consistent set of course offerings over a two-four-year cycle that students can depend on.

The Departments of Chemistry, Biology, Physics and Mathematics have coordinated efforts to schedule introductory courses during the fall and spring semesters with regular frequency and established class times.

13. Build on the momentum and energy brought by new faculty and continuing faculty over the past two years to market a re-energized department and to continue the good work already begun in self-reflection and evaluation.

IV. Program Organization (appendix B)

How does the department organize its curriculum to meet Major program requirements, provide service and General Education courses, and achieve program efficiency.

1. Provide a more detailed explanation of the growth or decline in the number of tenure-track or tenured faculty, instructors, or adjunct faculty since the last program review.
2. List curriculum changes since the last program review or give a short overview of how the program has determined that its curriculum is current and relevant. Discuss necessary changes anticipated for the future.

3. Are the department's programs fulfilling state, regional, and national needs and expectations?
4. Is the curriculum adequate to meet the needs of the diversity and number of student majors and students in service courses?
5. How up-to-date is the curriculum for current and future students seeking careers inside and outside of academia?
6. How does the quality of the curriculum (e.g. comprehensive and integrated among courses from 100-level through 400-level, within its stated goals) compare to those recognized as highly effective curricula by regional and national scientific and educational societies?
7. How does the curriculum compare with similar departments at 4-year liberal arts colleges, comprehensive regional universities, and major, tier 1 universities with Ph.D. programs?
8. Is the department serving non-majors to the satisfaction of the students and faculty across the campus?
9. How is the department ensuring it is in compliance with the UH Hilo Credit Hour Policy, particularly for its non-traditional courses, such as labs, directed readings, practica, internships, online or inverted lecture, service learning, etc? Note: the Credit Hour Policy states: Regardless of the type of academic activity, schedule, or method of delivery, one credit hour at UHH [UH Hilo] represents the expected amount of work a student must expend to achieve intended learning outcomes consistent with that of a traditional course (i.e. one that meets one hour per week, with a minimum of two hours additional work such as preparation, research, homework, investigation, etc. over the course of an approximate 15 week semester).

The following is from the catalog:

The Chemistry Program offers two majors designed to meet the differing needs of students:

B.A., Chemistry: A traditional curriculum with a strong physical science emphasis

B.A., Chemistry-Health Sciences: Combines the study of chemistry with 21 semester hours of selected biology courses

Either B.A. curriculum prepares the student for the job market immediately after graduation or for further education in graduate or professional school. As the name implies, the Health Science emphasis is designed for students who are seeking careers in health related fields such as medicine. Chemistry majors who also complete the UH Hilo Teacher Education Program may apply for initial basic teaching certificates in elementary and secondary education in the State of Hawai'i.

Goals for Student Learning in the Major

Both programs of study are designed to provide students with the following:

- A fundamental understanding of analytical, inorganic, instrumental, organic and physical chemistry.
- A basic understanding of physics.
- Basic knowledge of the differential and integral calculus and statistical analysis.
- Basic chemistry laboratory skills.
- Skills to do chemical research.
- The ability to engage in scientific inquiry.
- An understanding of the relationship of chemistry and the environment.
- The experience of preparing and presenting a seminar.
- In addition, the Health Sciences Emphasis imparts to students a basic knowledge of anatomy, physiology, biochemistry, and genetics.

New courses added since the last program review:

CHEM 415/415L Chemistry of Biotechnology/Laboratory

V. Evidence of Program Quality (appendix C, D, G, E, and J)

This is where programs have the opportunity to demonstrate their strengths. This section contains:

1. Quantitative Data and Tables
 2. Pre-formatted Quantitative Data are provided by the institutional research officer (See Appendix C). Programs are encouraged to include a brief analysis of the data.
 3. Evidence of Student Learning. Assessment-based evidence of Student Learning includes a compilation of Annual Assessment Projects, a Curriculum Matrix that aligns increasing levels of student learning outcomes with courses, and an Annual Assessment Plan (See Appendices D and G). Other Evidence of Student Learning (See Appendix E)
 4. Evidence of Faculty Quality (See Appendix J).
-

VI. Future Program Goals and Resource Requirements

1. Future Goals
2. Current and Future Resource Requirements (e.g. academic support for faculty, operating budget, space and facilities for teaching and research, new hires, lecturer/instructional support, equipment, library acquisitions, technological support, etc.)
3. Program Chair Evaluation

VII. External Reviewer's Report (appendix L)

VIII. Memorandum of Understanding (MOU) (appendix I)