UNIVERSITY OF SAN FRANCISCO

Department of Chemistry

Academic Program Review
Self-Study Document

September 2021

Index

Academic Program Review: Self Study – Fall 2021

Department of Chemistry, University of San Francisco

I. Introduction

A. Mission (approved Fall 2011)

The mission of the Chemistry Program at USF is to deliver a broad-based, challenging, chemical experience that will train students to participate effectively as professionals in a variety of careers including graduate programs, health professions, government or private industry, and teaching. The program will foster a culture that: values strong student-faculty-staff interactions, strives to help students become self-learners, creates opportunities for students to discover the excitement and creativity of chemical research, and values an understanding of social responsibility with ethical behavior as part of a chemical community.

B. History

The Department of Chemistry has been offering an ACS accredited degree in Chemistry for over 50 years and an ACS degree with a concentration in Biochemistry for over 25 years. More recently, in fall 2016 the department introduced a new concentration in Medicinal/Synthetic chemistry. In addition, it offers minor programs in chemistry, biochemistry, and chemical physics. For the past 60 years, USF has maintained an active, laboratory/thesis-based, Master of Science degree program. The MS students are integrated into research projects and are supported by TA salaries in undergraduate laboratory sections with waiver of tuition. Introductory courses serve our majors as well as Biology, Environmental Science , and Kinesiology students. In the past 15-20 years, the department has delivered many different general education or “core” courses for non-science majors that help students understand the nature of the physical world, the uses of the scientific method, and the implications of technology.

Since the last review in 2012, six faculty searches led to hiring five new tenure-track assistant professors and one tenure-track associate professor (no longer at USF). In addition, four years ago a new organic chemistry lab coordinator was hired as a staff replacement. Finally, several new small instruments were purchased via external grants and foundations. The department is enthusiastic about these changes and about our current goals, details of which are discussed later in this report.

C. Learning Goals and Outcomes

The Program Learning Goals for the B.S. Degree in Chemistry are:

1. To offer a coherent program of coursework in the core areas of chemistry and biochemistry that provides a modern foundation for subsequent in-depth course work or research experiences

2. To challenge student teams with hands-on laboratory and computational experiences, using modern, sophisticated instrumentation supported by qualified staff that encourages students to extend their chemical understanding via the scientific method
3. To emphasize the building up, retention and transfer of scientific concepts and skills throughout the curriculum, where faculty members accommodate a variety of learning styles and use personalized feedback to help students become responsible problem solvers and self-learners
4. To foster a community of chemists that values the excitement and discovery inherent in teaching, learning and researching all the areas of chemistry and biochemistry.
5. To help students attain the professional skills necessary to succeed in their chosen career with an integration of safe, ethical and socially conscious behavior.

The Program Learning Outcomes (PLOs) for the B.S. Degree in Chemistry are:

1. Students will demonstrate their mastery of the principal core disciplines and/or areas of emphasis: analytical, biochemistry, inorganic, medicinal, organic and physical chemistry.
2. Students will recognize and understand the concepts and skills learned in prerequisite courses at or before the start of the new course or laboratory.
3. Students or student teams will demonstrate mastery in problem solving by performing a broad variety of analytical, computational and synthetic procedures, using proper safety protocols, and will critically evaluate the results.
4. Students will demonstrate effective scientific communication skills in both written and oral form. Students will be able to write reports and present results while following professional policies regarding intellectual property, plagiarism, and ethical group work.

The Program Learning Goals for the M.S. Degree in Chemistry are:

1. Students will demonstrate competency in two subdisciplines of chemistry relevant to their research goals.
2. Students will acquire and analyze data demonstrating safe, proficient laboratory practice / instrumental techniques, and analyze that data as necessary for their research area
3. Students will be able to communicate their own research project, in written and oral forms.
4. Students will guide undergraduates in laboratory work.

The Program Learning Outcomes for the M.S. Degree in Chemistry are:

1. Students demonstrate a broad knowledge in areas of chemistry relevant to their research interests.

2. Students will become safe and proficient in laboratory practice and instrumental techniques necessary for their research area.
3. Students will be able to communicate the subject of chemistry, especially their own research project, in written and oral forms including: correspondence, reports and short presentations that may utilize multimedia tools that support effective communication
4. Students will become critical thinkers who are able to judge scientific arguments and make their own arguments based on experiments conducted during their research project
5. Students who graduate with an MS degree in chemistry from USF will be well prepared to pursue further graduate studies or employment in chemistry or related scientific fields.

D. Recommendations and Response to 2012 Outside Review

The department is happy to report that many of the recommendations from outside reviewers have been implemented or are in process. Here are their recommendations and our response to each:

Undergraduate Program:

1. Emphasize group supplemental instruction more (formal groups like POGIL and informal groups during class).

Since the 2012 outside review, the department has encouraged faculty-led review sessions along with sending new faculty to POGIL national training or active-learning workshops. In 2013 the department partnered with the Learning Center to start peer-led team learning (PLTL) workshops for General Chemistry and Organic Chemistry. The Organic Chemistry PLTL workshop was canceled due to a lack of student participation.

2. Minimize undue scheduling stress for undergraduate students, while being supportive of students' growth.

We have adapted courses such as Analytical Chemistry and Organic Chemistry II Lab to ease the pressure on second-semester sophomores, who used to feel overwhelmed during that term.

3. Add some seminars from professionals at local companies or alumni.

More speakers ranging from USF alumni to academic and industrial chemists are giving seminars on campus (the von Soosten seminar and course-based speakers).

4. Develop systematic ways of tracking the students after they leave USF.

USF alumni from our department are tracked informally via email and LinkedIn. Moreover, many students stay in touch with faculty members.

5. Establish and implement twice-a-year undergraduate symposia and student recruitment weekend(s).

In May 2014 the department hosted the 26th Northern California ACS Undergraduate Research Symposium (co-chairs: Meloni and Bolitho). More than 100 students from Northern California schools participated. The department is unable to fit an undergraduate symposium course in the curriculum and has not initiated a recruitment weekend other than participating in USF weekend visiting student events. Every spring undergraduate researchers present posters or talks at the Northern California ACS Undergraduate Research Symposium. Finally, the College started CARD (Creative Activity and Research Day), a USF forum for students to present research every spring.

Graduate Program:

6. Strongly recommend at least a modest increase in the master's student stipend/compensation and that it be done through summer research stipends.

A modest increase in the master's student TA compensation since 2012 raised the only source of support to ~$4000/semester. In addition, the department, with help from the administration, created the Von Soosten Fund (~ $20,000/year) from endowment interest that is equally divided for student travel or merit pay between the MS research-active groups (currently 5 groups).

7. Carefully consider the possibility of adding some formal course requirements to the graduate program.

Due to the shortage of faculty members, the department cannot offer a graduate course every year. As of Spring 2021, the department is short by 1-2 full-time faculty due to sudden retirements. In Fall 2019, for the first time in several years, the department offered a graduate course (CHEM 686: Spectroscopy). All MS students took the course. Our goal is to implement one required course in the future, so that if we offer at least one course every two years, all MS students have a chance to take a graduate-level course.

8. More focus on the TA training of the graduate students.

With the hiring of a Safety Officer, all research students and TAs attend yearly safety training. We run a full-day TA training in the fall supplying instructional reading material, active group practice teaching and training on the Science Writing Method in General Chemistry (which includes writing about safety in student pre-labs). TAs maintain a teaching journal as part of their weekly TA duties.

Faculty:

9. Hire more junior research-active faculty members.

Until recently, new hires were approved by the administration only when a retirement occurs (these lines now revert to the College). Since the last review, the department hired four replacements on the tenure track (West, Yang, Evbuomwan, Stevenson) and were granted one new line based on the last review (Prof. Li, who left and was replaced by Nikolayevskiy in Fall 2019). These new hires have had immediate impact in creating active research opportunities for students and re-thinking of courses and curriculum.

10. Consider designing new approaches to fulfill the need for student-research positions until new hires of research-active faculty can be made.

Local opportunities have been promoted, such as summer research positions in the San Francisco Medical Examiner's Office, Gilead, and UCSF, as well as through NSF REU programs. Mainly, as the junior faculty have come on board, they have actively and enthusiastically taken on undergraduates as research assistants.

11. Consider having senior faculty members adopt teaching schedules and loads that allow for the appropriate development of junior faculty.
Junior faculty have input into their schedules and teaching assignments prior to workload being submitted to the Dean's Office. In consecutive years, the department tries to have them repeat courses to minimize the number of new course preps. In addition, the department has been successful in recent years in ensuring that junior faculty get to teach Chem 397 and/or Chem 698 at least twice (and usually three times) before tenure/promotion.

Other Resources:

12. Develop formal mechanisms to support faculty who obtain grants and conduct research.
Research-active faculty members who take undergraduate or Master's students have the opportunity to teach the Research Methods courses, CHEM 397 and CHEM 698 (4 units). This is recognition for the time needed to mentor research students.

13. Establish an undergraduate research office.
An undergraduate research office has not been instituted. However, the College of Arts and Sciences created a Student Development Fund to provide partial travel funds to undergraduates presenting at scientific conferences. The Faculty Development Fund is a limited internal funding source for equipment/supplies and summer student stipends. The Center for Research, Artistic, and Scholarly Excellence (CRASE) supports and promotes faculty engaged in research. The Office of Contracts and Grants assists in the preparation of grant proposals and the administration of grants.

14. Re-examine design of older classrooms with a focus on using active-learning techniques.
The opening of the Lo Schiavo Center for Science and Innovation has enabled the department to update the laboratory curriculum. The department has two organic chemistry labs, one inorganic chemistry lab, and one analytical/biochemistry/integrated chemistry lab in this building. Students now have increased safety (hoods), can break out into small groups, and mini lectures/projectors are available during lab.

15. Develop a ten-year replacement and maintenance plan for instrumentation and faculty replacements.
The absence of a capital budget for our equipment is a weakness; the administration allocates the budget, not the department. Funds remaining at the end of each fiscal year cannot be carried over into the next fiscal year. Some funds are allocated for maintenance contracts, but there is no formal mechanism for equipment replacement.

II. Curriculum

II.A. Introduction

Degrees and Curriculum Development. In response to a changing student body, the Department now has three B.S. degree tracks—Standard (or Traditional), Biochemistry, and Medicinal/Synthetic Chemistry. The latter two are "Concentrations" within the Chemistry major that students can declare. In all three tracks, students can choose the option of an ACS-certified degree. The requirements for these degree tracks are summarized in Figure 1. Two upper-division courses—Inorganic Chemistry I and Physical Chemistry I—are required of all tracks, and the remaining 3-4 upper-division courses vary by track. All three tracks require at least one upper-division laboratory course beyond Inorganic Chemistry I. Our current program is distinguished by small upper-division lab courses and small research groups led by faculty members using advanced instrumentation.

In addition, in recent years the Department has examined the curriculum to determine what changes could be made to better meet our students' needs. To this end, Physical Chemistry I was extensively redesigned with an eye toward students who might take only one semester of P-Chem (those in the Biochemistry or Medicinal/Synthetic tracks). The senior-level one-semester Inorganic Chemistry course with lab was re-structured to a junior-level foundational course with lab, which does not require P-Chem. Planning is underway to create an in-depth lecture/lab course to cover advanced topics in inorganic, macromolecular, and materials chemistry, along with experimental techniques in those areas plus physical chemistry and instrumental analysis.

In addition to the undergraduate Chemistry Major we offer Minors in Chemistry and Biochemistry. The graduate program provides an MS degree in Chemistry with a written thesis.

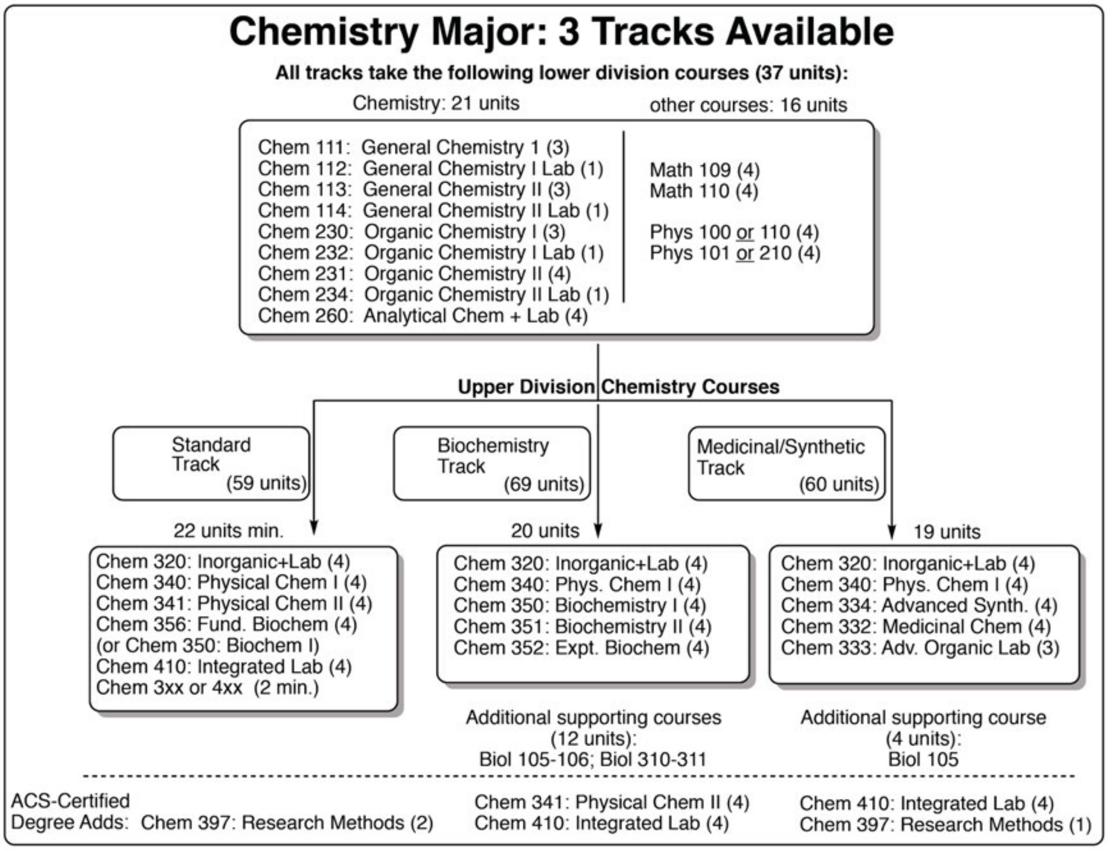


Figure 1. Summary of requirements for three Chemistry degree tracks, plus ACS-certified degrees.

II.B. Undergraduate Program

The number of Chemistry majors per year is shown in Figure 2. Following an unexplained dip in numbers during 2015-2017, the number of majors has increased substantially in the past two years.

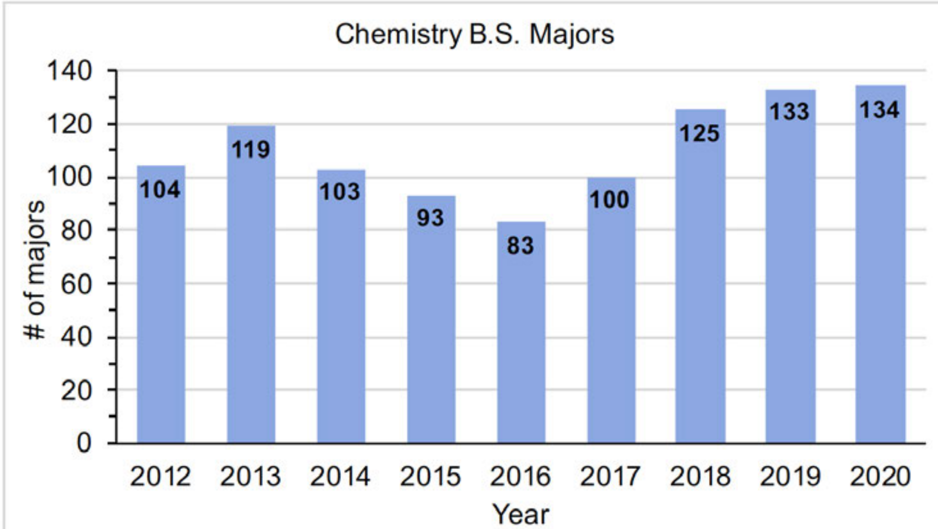


Figure 2. Number of Chemistry majors per year.

As shown in Figure 3, the number of B.S. degrees awarded declined recently for three straight years but bounced back in 2019. The large number of majors in 2018-2020 (Figure 2) will likely lead to a substantial increase in degrees awarded during the next 2-3 years. We anticipate 21 graduates in spring 2021, and an uncertain number in fall 2021.

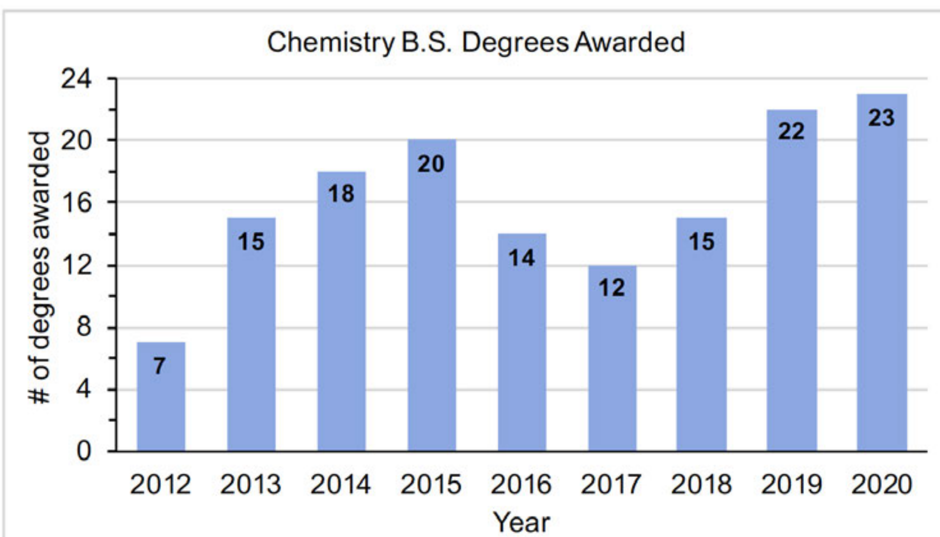


Figure 3. Chemistry Degrees Awarded per Year.

As shown in Figure 4, the number of Chemistry and Biochemistry Minors has fluctuated. The reasons for this are unclear. The number of minors is substantial, and the students taking the minor help to populate some of our upper division courses such as Biochemistry I, Fundamentals of Biochemistry, and others.

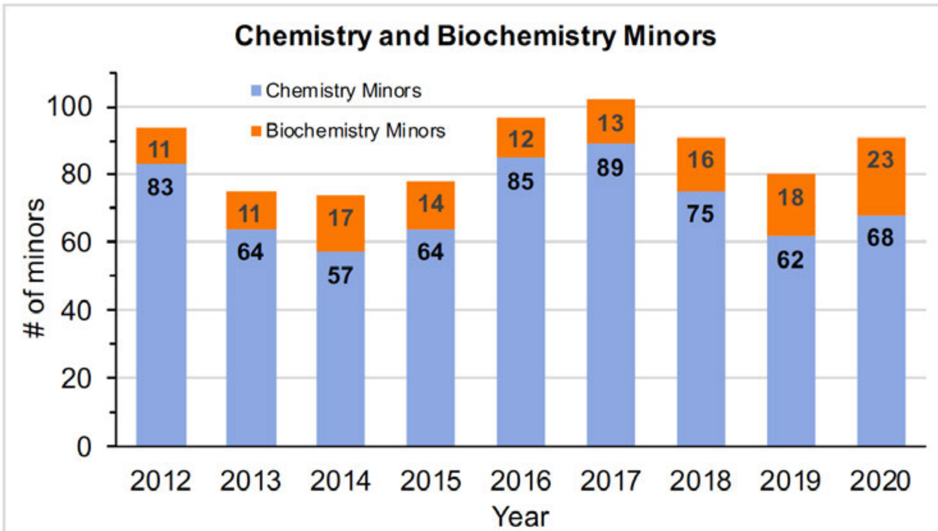


Figure 4. Number of Chemistry and Biochemistry Minors per year.

Another factor that may affect our number of majors in coming years is the increase in Biology Majors--from 306 in 2012 to 488 in 2019. A significant number of Chemistry majors begin at USF in Biology, and then switch to Chemistry. The large number of declared Biology majors in 2019 will likely spill over into Chemistry. While this is in many ways a good thing, it also presents challenges in terms of delivering our curriculum, including both courses primarily for Chemistry majors and courses that are also taken by Biology majors, such as General Chemistry and Organic Chemistry.

Undergraduate Curriculum

Overview: The degree requirements for the B.S. degree in Chemistry are comparable with most undergraduate chemistry programs nationwide. Our curriculum consists of a series of foundational and supporting courses common to all three degree tracks, followed by upper-division in-depth courses (Figure 1). All majors take a year of General Chemistry with lab, a year of Organic Chemistry with lab, Analytical Chemistry with lab, a year of Calculus and a year of Physics (either algebra-based or calculus-based). Two upper-division courses--Inorganic Chemistry I and Physical Chemistry I--are required of all tracks, and the remaining 3-4 upper-division courses vary by track. Two of the tracks require additional supporting courses. For the Medicinal/Synthetic Track, students take General Biology I. For the

Biochemistry Track, students take a year of General Biology and a semester of Genetics.

The expertise of the current Chemistry faculty covers all the principal subdisciplines and enables the Department to offer the necessary range of courses in all the degree tracks. As faculty backgrounds span physical, inorganic, analytical, organic, biochemistry, and materials, we have at least one faculty member (and usually at least two) who is well qualified to teach any given course required for the major. Recent departures have left us short-staffed in general chemistry, analytical chemistry, physical chemistry, and biochemistry. Very recently we hired two term faculty members to help with general, analytical, and biochemistry, and we are just beginning a search for a tenure-track position.

Another staffing challenge is the need to cover an increasing number of lab sections in several courses: General Chemistry I and II, Organic Chemistry I and II, Analytical Chemistry, and Inorganic Chemistry I. As there are not enough MS students in the department to TA all sections, the Department relies to a significant extent on adjuncts, which constitutes a twice-yearly staffing challenge.

The frequency of course offerings is planned so that Chemistry majors can meet the degree requirements within four years. Both General Chemistry I and II and Organic Chemistry I and II (and associated labs) run annually as fall-spring sequences, with an additional section of General Chemistry I every spring. Analytical Chemistry runs every spring. Most upper-division courses are offered annually, with a few exceptions. Integrated Lab is offered every other year. Experimental Biochemistry has typically been offered every other year, but we are now trying to offer it annually. We are also attempting to offer other upper-division courses annually, such as Physical Chemistry II, Advanced Organic Synthesis, and Medicinal Chemistry. However, the annual running of these courses is difficult due to the administration's new Under-enrolled Course Policy, which requires at least 12 students enrolled to insure against cancellation. That policy presents numerous problems, including uncertainties in staffing and faculty workload, pedagogical disadvantages for students, difficulty for some students to graduate on time, and increased administrative burden. Similar concerns apply to chemistry elective courses the Department would like to offer; if ten students sign up, the course may still be cancelled.

With respect to class sizes, General Chemistry I lectures are capped at ca. 55 students and we run 4-5 sections. The corresponding 14 lab sections are capped at 18 students each. We typically run four sections of Organic Chemistry I lecture, with 45 students per section, plus nine lab sections capped at 16 each. Other majors that take General and Organic Chemistry are those from Biology and Environmental Science (Gen Chem only), as well as students pursuing a health-professions path. Analytical Chemistry has typically had ca. 20 students, but that more than doubled in spring 2020, requiring us to offer three lab sections that semester. Upper-division courses required of all tracks have 20-25 students. Upper-division courses specific to the Standard and Medicinal/Synthetic tracks usually have 10-12 students, close to the new threshold for potential cancellation. All upper-division lab classes are limited to 12 students per section. Due to significant interest from Biology majors, all our biochemistry lecture courses populate easily; for example, in fall 2019 there were 45 students in Biochemistry I (two sections for the first time ever), and in spring 2020 26 students completed Biochemistry II. For reasons of staffing we went back to one section of Biochem I in fall 2020 (23 students). There have been 76 students who took Fundamentals of Biochemistry in the past two years. Starting fall 2021, the Department is offering one semester of "General Chemistry for Engineers and Scientists" (lecture/lab) to ca. 35 students in the new Engineering program.

The department has occasionally offered courses for non-science majors that satisfy the university's Core requirement for lab science, such as Molecular Gastronomy and Chemistry and the Community. Offering these courses has been unpredictable in recent years due to the department being understaffed. Until recently, the department also offered Foundations of Chemistry to help prepare students for taking General Chemistry. Recent policy changes in the Biology Department led to the cancellation of this course in fall 2019, and it is uncertain whether it will be offered again; the university's Enrollment policy has prevented us from offering it. Finally, we have offered upper-division electives, including Environmental Chemistry, Kitchen Science, and Chemistry of Biomedical Imaging. Such electives count toward the Chemistry Minor and thus are often taken by Biology and Environmental Science majors. These courses could also count toward the Chemistry major, but recent changes in our degree requirements largely eliminate the need for electives. This fact, combined with new course enrollment policies from the upper administration, make it extremely difficult for us to offer these electives on a regular basis.

Additional details about our courses can be found in the Course Descriptions section of the Appendix.

Undergraduates are encouraged to participate in research. In such cases, research students typically enroll in CHEM 397: Undergraduate Research Methods and Practice. This 1-unit course, offered every semester, provides an opportunity for students to write a detailed research report summarizing their work, prepare and present a poster at a local conference, and learn about research done by fellow students in the department.

The Chemistry Department does not have an honors program. Rather, there is an Honors College within the College of Arts & Sciences that students can participate in. Opportunities that we offer our most outstanding students include the ACS-certified degree option. We also encourage excellent students to participate in research. In addition, to recognize outstanding achievement, we give the following awards each year, most of them at our annual spring banquet:

- CRC General Chemistry Award
- ACS Organic Chemistry Award
- ACS Analytical Chemistry Award
- ACS Inorganic Chemistry Award
- Department Awards for achievement in Organic Chemistry, Physical Chemistry and Biochemistry
- American Institute of Chemists Achievement Award, BS Undergraduate
- American Institute of Chemists Achievement Award, MS Graduate
- Graduate Award for Achievement in Teaching at USF
- ACS USF Student Chapter Achievement Award
- Chemistry Department Student Service Award
- Mel Gorman Award to the senior with the highest GPA in their science courses
- USF Award: Arthur Furst Award (former Professor of Chemistry Arthur Furst). USF Scholarship awarded annually to an undergraduate science major who demonstrates outstanding academic ability and a strong desire to pursue research.
- Two travel awards from department funds to present at national meetings

Self-Identified Strengths of Our Curriculum:

- Faculty working together to develop a more cohesive curriculum with agreed upon outcomes and assessments
- Ongoing experiment revisions to keep the lab courses relevant
- Vibrant research opportunities for majors, and opportunities for them to present their work
- Solid ACS-certified degree program with hands-on work with research-level instrumentation
- Placement of numerous students into excellent graduate programs. The table below summarizes where our BS graduates have gone since 2012.

# of Students	School	Degree program
3	USC School of Pharmacy	Pharm D
2	Touro University	Pharm D
1	Univ. of Colorado, Denver	Pharm D
1	NYU College of Dentistry	Dental student (DDS)
1	UC San Francisco	MD
1	St. George's University	MD
1	Mayo Clinic	MD/PhD
1	North Carolina State Univ.	PhD, Applied Math
1	Columbia	PhD, Neuroscience/Biology
2	Northwestern	PhD, Chemistry
2	UCLA	PhD, Chemistry
1	UC San Diego	PhD, Chemistry
1	UC Davis	PhD, Chemistry
1	UC Irvine	PhD, Chemistry
1	UC Santa Cruz	PhD, Chemistry
1	Princeton	PhD, Chemistry
1	Univ. of Wisconsin, Madison	PhD, Chemistry
2	Univ. of Washington	PhD, Chemistry
1	Univ. of Texas, Austin	PhD, Chemistry
1	Univ. of Oregon	PhD, Chemistry
1	Univ. of the Pacific	PhD, Chemistry
1	Loyola University Chicago	PhD, Chemistry
1	Friedrich-Wilhelms-Universität Bonn	PhD, Chemistry
1	University of Southern California	PhD, Chemistry

Self-Identified Weaknesses with Our Curriculum:

- Need for more full-time tenure-track faculty (due to two sudden retirements) to help deliver analytical chemistry, physical chemistry, and general chemistry courses, and to provide more research opportunities for students.
- Uncertainty of course offerings—especially for required upper-division courses—due to upper administration's new Under-enrolled Course Policy, and associated difficulties in staffing and workload.
- Lack of staff primarily dedicated to supporting the organic chemistry labs.
- Lack of sufficient support staff for delivering upper division labs in inorganic chemistry, biochemistry, and Integrated Lab
- Lack of upper division in-depth lecture/labs for inorganic and analytical and the faculty to deliver it, especially inorganic.
- Lack of support staff to maintain/repair the NMR spectrometer for teaching and research purposes.
- Inability to offer Foundations of Chemistry for students needing extra preparation before General Chemistry, due to the Under-enrolled Course Policy.
- Uneven delivery of first-year labs: TA training, policies, lack of experimental development and consistent oversight when different faculty teach the course.

C. MS Program

1. Mission, Background, Admission and Student Financial Support

The Chemistry Department currently offers a full time, research-based Master of Science degree. The mission of the program is similar to the BS program, except on a higher, research-focused level.

Mission: *To deliver a broad-based, challenging research experience that will train students to participate effectively as PhD researchers, health professionals, government and industry professionals, or as teachers. The program will foster a culture that: values strong researcher-faculty-staff interactions and strives to help researchers become self-learners and to discover the excitement and creativity of chemical research. We strive to instill values of social responsibility with ethical behavior as part of a chemical research community culminating in the writing of a research thesis.*

Our research-based MS program differentiates us from other local MS programs that are course-based (San Jose State, Cal-State East Bay, some students at SF State) or are in PhD programs (Stanford, Cal, UC-Davis, U of Pacific). The college has an Office of Graduate Programs that helps us produce a brochure, conducts mailings, open houses, and guides students through the application process. The chemistry graduate program director works with that office and the department administrative assistant to review applications, screen them for qualifications and pass selected files to other research advisors for review. Students are admitted using multiple criteria and only if there is a match in a research group. There are February deadlines for fall and October deadlines for spring semesters. Students must have the equivalent of a BS chemistry degree with GPA 3.0 or higher, GRE general test (GRE Chemistry subject exam is optional). Almost all admitted students have research experience. In many cases our overseas applicants have difficult-to-evaluate transcripts, so we look for research experience, teaching or tutoring experience, plus GRE scores above the mean >153 Verbal, 158 Quant, 3.8 Writing, plus TOEFL score >90 for English as a second language.

At the beginning of the program, students take two ACS standardized exams and must score above the 60th percentile. Students who do not pass must take an upper-division course to satisfy the requirement or self-study before retaking the test. If a student does not meet these requirements and is not making progress in research, they are asked to leave at the end of the second semester, although this is rare. Students are full-time (6 units/semester) in Chem 698: Research Methods/Practice unless they are taking a formal course. The last semester requires at least 3 units of Chem 699: Thesis Writing. 24 units total are required to graduate. There is faculty workload credit for teaching Chem 698 for MS research active faculty in spring only. Prior to Fall 2019, we had not offered a graduate level elective course since fall 2013 due to faculty shortages. Faculty participants in the MS program value the close mentoring relationship with students and generally feel that a year-round presence of graduate students adds to the undergraduate research experience via mentoring in the research labs and in the teaching labs.

USF does not give stipends to graduate students, only the hourly wage for TA work. Chemistry is one of the few programs at USF where all graduate students are funded through teaching assistantships. Our students receive 6 units/semester tuition remission (program limit to a specific budget currently covering 11 students per semester) and those with adequate spoken English receive two semesters TA salary ($9,860 a year; additional TAs are hired for summer courses).

MS students do not register for classes in summer, but do research full-time and are not paid, unless the PI has funding. Obviously, this is not an inviting financial package and student recruitment is an ongoing challenge given the cost of living in the city. We are looking at other sources of paying for student research, such as larger donations to the “Departmental Gift Fund” for research awards, securing more external funding for summer research salaries (these tend to be PI dependent and do not benefit all MS students), and increasing the research assistant hours limit of 150 hours per semester from the USF Faculty Development Fund. We were successful in obtaining an increase in hours on a case-by-case basis starting in 2010. In our view a 12-month stipend-based system with yearly cost of living increases seems the standard practice and would help us in recruiting and retention. We are open to any suggestions on how to fund this program to a reasonable level.

2. Program requirements, departmental resources

The research-active faculty train students in the lab, and work with students on an original research project. To complete the MS degree students must write a thesis that is approved by the research advisor, thesis committee (two other faculty members), and the Dean. Some students accept jobs or go to PhD programs promising to finish the thesis on time, but about 10-15% of these students do not. Most graduate students present posters at least once at regional or national meetings. Many graduate students also publish a peer-reviewed paper.

3. MS Students

The two graphs below show the total number of students in the MS program each semester and the gender and ethnic makeup since the last review.

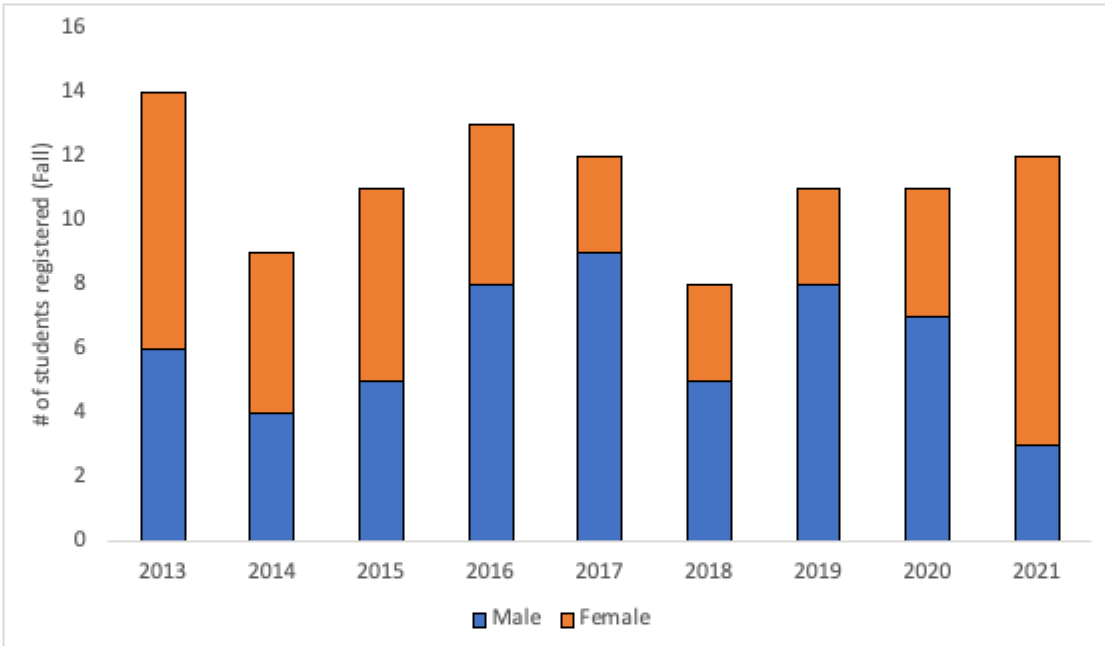


Figure 5. Total number of MS students per year by gender.

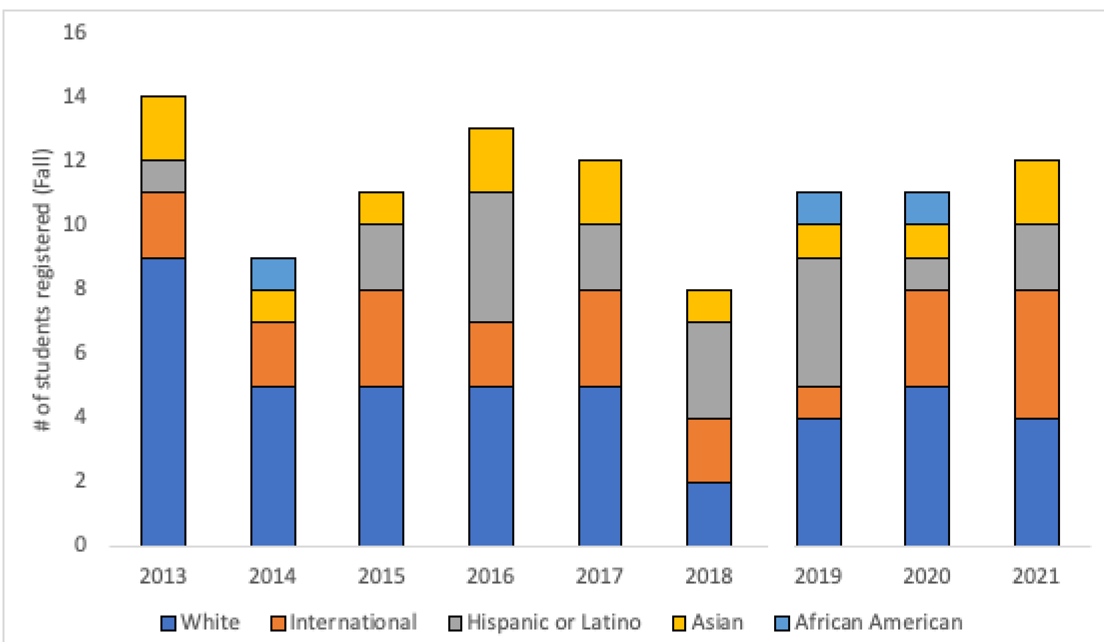


Figure 6. MS students by ethnicity per year.

The dip in totals in fall 2014 and spring 2015 corresponds to Curtis's last MS student and Bolitho's decision not to take any MS students. After hiring Li (F 2013), West (F 2015), and Yang (F 2016) the total number of MS students started increasing again. The numbers are very small for detecting any major trends since the last review.

The quality of students entering the program is uneven (see **Appendix, MS Assessment**). Most students who apply could not get into PhD programs, but view an MS as a pathway to that goal. Some do not want a PhD, but desire additional research training for their careers. Although our tracking is not complete, >95% of students who complete the research (thesis or not) have chemistry related jobs or get into PhD programs. With the caveat that some students volunteer to leave, or stay for 3 years but do not submit a thesis, about 80-85% of entering students leave with an MS degree. The table below summarizes where our recent MS graduates have gone on to PhD programs.

# of Students	School	Degree program
2	UC Davis	PhD, Chemistry
1	Univ. of Pennsylvania	PhD, Chemistry
1	Brown University	PhD, Chemistry
1	Univ. of the Pacific	PhD, Chemistry
1	Univ. of Melbourne, Australia	PhD, Chemistry
1	UC Riverside	PhD, Chemistry
1	Boston College	PhD, Chemistry
1	University of South Florida	PhD, Chemistry
1	Johns Hopkins	PhD, Chemistry
1	University of Colorado, Boulder	PhD, Chemistry
1	University of Maryland	PhD, Chemistry

The following table lists representative employers that have hired our MS graduates since 2012.

Bachem	Genentech	Peregrine Pharmaceuticals
BioMarin Pharmaceutical Inc.	Gilead Sciences	Pfanstiehl Inc.
DiscoverX Corp.	Kennedy High School	Theravance Biopharma
Emery Pharma	Medronic	Zymergen, Inc.
Evoxe Laboratories	Merso Labs	Zymo Research Corp.

The main desire for faculty in the MS program is to increase the financial package to students. As outlined above the current USF model for graduate programs (working adults pay full tuition) does not work in lab sciences. Our location and the Bay Area high-tech job market certainly help attract applicants that have their own source of funds, but many students must find outside jobs to stay in school. An MS Alumni survey (see **Appendix** for full survey) gives us more insight into our MS students (n = 6, 40% response). The data indicate about 83% (strongly/slightly) agree that financial concerns interfered with their studies.

As a department, we value the role our MS graduates play as TAs and mentors to USF undergraduates. Our MS graduates agree they had an impact (see full survey in the **Appendix** that 83% of respondents felt very positive about their graduate experience).

D. Advising

Declared incoming chemistry majors are assigned a faculty advisor based on the track they have chosen in the major (Chemistry, Biochemistry, or Medicinal/Synthetic). We attempt to evenly distribute the advising load among all tenured and probationary faculty in the department. Since it is a small department all chemistry majors are required to meet with their advisor twice a year. These meetings occur a week before class registration for the following semester. To assure that all students attend an advising session the online class registration system will not allow them to register for classes until their advisor has removed their hold. Advisors help students determine which track is appropriate for them, assist in selecting courses for the next semester, and help students plan for the longer term. One of our primary aims is to make sure they stay on track in the major and with their University core requirements so that they can graduate in four years. This goal is facilitated with check-sheets for the major tracks (with and without ACS certification) and the University core requirements that both faculty and students have access to (these are available online and student advising folders and schedules are prepared by Deidre Shymanski, the program assistant.

Over the years we have developed a strategy to identify those students who might not successfully complete the BS program (2.0 GPA minimum in the major to graduate). Our program assistant tracks the success of our students with an annual inventory of all of majors' GPAs. In addition, once per semester, there is a department meeting in which faculty discuss the best course of action for those students who are poorly performing in their classes. In the past we attempted to deal with such students by requiring them to meet with their advisors, the Department Chair, and, in particularly vexing cases, asking the Dean's office to intervene. Despite these efforts, in recent years, some students did not improve their major GPA and/or refused to change their major, convinced that somehow they will redeem themselves. Sadly, in a small number of cases this led to the unfortunate situation of a student taking four years of classes without ultimately earning a USF diploma. As a result of this and based on tracking data, we agreed on standards and rules in 2010 that require students who are struggling in the major to either improve their GPA or choose a more appropriate major earlier in their college careers. For example, we email our majors an advising letter that reminds them of major requirements, course and grade pre-requirements (now a C or above for all courses) and we implemented a new "two-strikes rule" (required courses for any chemistry major can only be taken twice). If the minimum required course grade to progress on to the next course in the major is not achieved on the second attempt, the student must change his or her major. The department agrees that these changes set clearer expectations and allows us to advise struggling students out of the major. Along with teaching our classes and mentoring students in research labs, many members of the faculty view themselves as professional role models for our students. As a small department, many of our majors are involved in research with chemistry faculty and/or serve as TAs, lab preps or stockroom and office help. Thus, there is ample opportunity for less formal interaction with students. Whether formal or informal, advising plays an important role in our department beyond simply keeping students on track in the major.

Majors often seek advice about study abroad, internships, jobs and their career paths after graduation, including specifics about graduate programs in chemistry. Ultimately, we aim to help each of our students succeed as chemistry majors while at USF and to find a professional or career path that is appropriate for them, whether as a technician in an industrial lab, pursuing a degree in pharmacy, or a Ph.D. in chemistry.

III. Assessment

Every year the department undergoes an assessment to evaluate whether our students are meeting our learning outcomes. We concluded that students were meeting our standards in most areas, but we identified other shortcomings like poor retention of previous course materials. Our assessment chair, Margerum, is compiling all the information and has devised an assessment scheme (see below, curriculum map) for our program learning outcomes.

A. BS Program Learning Goals (2011-):

1. To offer a coherent program of coursework in the core areas of chemistry and biochemistry that provides a modern foundation for subsequent in-depth course work or research experiences
2. To challenge student teams with hands-on laboratory and computational experiences, using modern, sophisticated instrumentation supported by qualified staff that encourages students to extend their chemical understanding via the scientific method
3. To emphasize the building up, retention and transfer of scientific concepts and skills throughout the curriculum, where faculty members accommodate a variety of learning styles and use personalized feedback to help students become responsible problem solvers and self-learners
4. To foster a community of chemists that values the excitement and discovery inherent in teaching, learning and researching all the areas of chemistry and biochemistry.
5. To help students attain the professional skills necessary to succeed in their chosen career with an integration of safe, ethical and socially conscious behavior.

B. BS Chemistry Program Learning Outcomes (PLO) and Methods: (2016-)

1. Students will demonstrate their mastery of the principal core disciplines and/or areas of emphasis: analytical, biochemistry, inorganic, medicinal, organic and physical chemistry.

(*Knowledge, Application*) *Nationally Normalized American Chemical Society (ACS) exams in Chem 113, 260, 420: Benchmark is the National Median (varies by exam). Embedded final exam questions: Chem 230/231 and 340 (benchmark > 60% correct). For Chem 350/351 (same quiz/same students: in 350 and post 351: Benchmark: 70% correct)*

2. Students will recognize and understand the concepts and skills learned in prerequisite courses at or before the start of the new course or laboratory (*Knowledge and Comprehension*) *Required Pretest and posttest/problem set at the beginning of the course: Benchmark established by instructor is generally pretest: 60% or above and retake/post-test after 2-3 weeks of class (generally > 80% correct). Subject to revision as more data are collected.*

3. Students or student teams will demonstrate mastery in problem solving by performing a broad variety of analytical, computational and synthetic procedures, using proper safety protocols, and will critically evaluate the results (*Application, Synthesis and Evaluation*) *Lab practical or written report of activities scored by rubric. Benchmark 65% or above. Laboratory safety map and quiz: Benchmark 90% or higher.*

4. Students will demonstrate effective scientific communication skills in both written and oral form. Students will be able to write reports and present results while following professional policies regarding intellectual property, plagiarism, and ethical group work. (*Comprehension and Analysis*) *Poster presentation rubric: Benchmark: "Meeting Standard" in 8 out of 10 categories. Oral presentation rubric: Benchmark: average of 3 over ten categories (scale of 1-4). Standardized Professional Lab Report format adopted in lower division courses: Benchmark 65%*

The latest BS Assessment Report is in the Appendix.

Table 1. BS Chemistry curriculum map: PLO → Courses: Years 1-3 (Fall 2016 – Spring 2019)

Chemistry Program Learning Outcomes I = Introduced U= Utilized **A=Assessed**	**113**	**114L**	**230**	**232L**	**231**	**234L**	**260**	**340/341**
Year 1: AY 16-17 **Year 2: AY 17-18** **Year 3: AY 18-19**	**General II**	**General Lab II**	**Organic I**	**Organic Lab I**	**Organic II**	**Organic Lab II**	**Analytical + Lab**	**Physical I/II**
LO #1: Student will demonstrate his/her mastery of the four principle disciplines: analytical, organic, physical, and inorganic chemistry	I		I		**A**		**A**	**A**
year of assessment					1-3		1-3	1-3
LO#2: Students will recognize and understand the concepts and skills learned in prerequisite courses at or before the start of the new course or laboratory	I		**A**		U	U	**A**	**A**
year of assessment			1				1	2
LO#3: Students or student teams will demonstrate excellent problem solving skills in performing a broad variety of analytical, computational and synthetic procedures using proper safety protocols, and will critically evaluate the results		I		I	U	U	**A**	
year of assessment		1-3					1-3	
LO#4: Students will demonstrate effective scientific communication skills in both written and oral form. Students will be able to write reports and present results while following professional policies regarding intellectual property, plagiarism, and group work		I				**A**	**A**	U
year of assessment (written)		1				2	2	
year of assessment (oral)								2-3

Table 2. BS Chemistry curriculum map: PLO → Courses: Years 1-3 (Fall 2016–Spring 2019)

Chemistry Program Learning Outcomes I = Introduced U= Utilized A=Assessed	320 (formerly 420)	332	333	334	350/351	352L	410	397	Electives
Year 1: AY 16-17 Year 2: AY 17-18 Year 3: AY 18-19	Inorganic Chem I	Medicinal Chem	Adv. Org. Lab	Adv. Org. Synthesis	Biochem I/II	Experimental Biochem	Integrated Lab	Research Methods	
LO #1: Student will demonstrate his/her mastery of the four principle disciplines: analytical, organic, physical, and inorganic chemistry	A			U	A		U	U	
year of assessment	1-3				1-3				
LO#2: Students will recognize and understand the concepts and skills learned in prerequisite courses at or before the start of the new course or laboratory	A	U	U	U	A	U	U		U
year of assessment	3				2				
LO#3: Students or student teams will demonstrate excellent problem solving skills in performing a broad variety of analytical, computational and synthetic procedures using proper safety protocols, and will critically evaluate the results	A		A			A	A	U	
year of assessment	3		2			2	3		
LO#4: Students will demonstrate effective scientific communication skills in both written and oral form. Students will be able to write reports and present results while following professional policies regarding intellectual property, plagiarism, and group work	A	A	U			U	U	A	
year of assessment (written)	3							1-3	
year of assessment (oral)		2-3						3	

C. MS Program Learning Goals (2011-)

1. Students will demonstrate competency in two subdisciplines of chemistry relevant to their research goals.
2. Students will acquire and analyze data demonstrating safe, proficient laboratory practice / instrumental techniques, and analyze that data as necessary for their research area
3. Students will be able to communicate their own research project, in written and oral forms.
4. Students will guide undergraduates in laboratory work.

D. MS Program Learning Outcomes and Methods

1. Students demonstrate a broad knowledge in areas of chemistry relevant to their research interests.

- Students will score at or above the 60% percentile on two American Chemical Society (ACS) subject exams by the end of their second semester on campus.
- Students will organize and summarize relevant resources in the chemical literature pertaining to their research area via progress reports and/or a research thesis.

2. Students will become safe and proficient in laboratory practice and instrumental techniques necessary for their research area.

- Students can safely operate and analyze results from research quality instruments necessary for their research project.
- Students practice and/or enforce safe laboratory techniques, including waste disposal procedures, during their teaching and research projects.

3. Students will be able to communicate the subject of chemistry, especially their own research project, in written and oral forms including: correspondence, reports and short presentations that may utilize multimedia tools that support effective communication

- Students will exhibit and employ good communication and teaching practice as assistants in undergraduate laboratories.
- Students will exhibit the ability to prepare professional reports and/or multimedia presentations in formal (seminars, courses, professional meetings) and informal (group meetings) settings.
- Students will exhibit the skills and competencies necessary for professional and effective oral presentations.

4. Students will become critical thinkers who are able to judge scientific arguments and make their own arguments based on experiments conducted during their research project

- Students will be able to discuss, in a written research thesis or scientific publication, a clear understanding of their research problem, other perspectives, key assumptions, data collection/analysis and conclusions.

5. Students who graduate with an MS degree in chemistry from USF will be well prepared to pursue further graduate studies or employment in chemistry or related scientific fields.

- Students will formulate and execute a plan to identify and secure a position in industry or academics.
- Students will obtain appropriate entry-level scientific jobs with reasonable chance for advancement or will be accepted into PhD programs in chemistry related fields.

The latest MS Assessment Report is in the Appendix.

Table 3. MS Chemistry curriculum map: PLO → Courses: Years 1-3 (Fall 2016–Spring 2019)

MS CHEMISTRY	PLO1	PLO2	PLO3	PLO4
Program Learning Outcomes X Courses	Students will demonstrate competency in two subdisciplines of chemistry relevant to their research goals.	Students will acquire and analyze data demonstrating safe, proficient laboratory practice / instrumental techniques, and analyze that data as necessary for their research area.	Students will be able to communicate their own research project, in written and oral forms.	Students will guide undergraduates in laboratory work.
Courses or Program Requirement				
Entrance Examinations	I,D,M			
Opt 1: Diagnostic Test	x			
Opt 2: Independent Study	x			
Opt 3: Undergraduate Coursework	x			
CHEM 698: Graduate Research Methods		I, D, M	I, D	I, D, M
CLO1		x		
CLO2			x	
CHEM 699: Thesis Writing			M	
CLO1			x	
CLO2			x	
Teaching Assistantship				I, D, M

Key:
I = Introductory
D = Developing
M = Mastery

IV. Faculty

The Department of Chemistry currently (as of fall 2021) consists of eight full-time faculty members: three tenured Professors, three tenure-track Assistant Professors, and two Term Assistant Professors. Following two sudden retirements in spring 2020, we recently lost two more faculty--one left USF in summer 2021, and one is now Associate Dean for Sciences and Engineering. In addition, following retirement in May 2017, Claire Castro is continuing on with an appointment as Research Professor. Faculty who may be mentioned but are no longer teaching in the department or no longer at USF include Ryan West, Osasere Evbuomwan, Lawrence Margerum, William Melaugh, Jaime Anguiano, Kevin Sibucao, Megan Bolitho, Jack Li, and Jeff Curtis. One of our former staff members, John Hendrix, also taught some lecture courses. The alphabetical list below summarizes the specialties and current teaching roles of the current faculty.

Professor – Specialty	Past or Current Teaching	Past or Current Research	Status
Ganguly, Shreyashi Term Assistant Professor Materials/Inorganic/ Physical	• Gen Chem I and II lecture & lab	Synthesis of inorganic nanomaterials for renewable energy applications such as photovoltaics, thermoelectrics and transparent conductors	Inactive
Karney, William Professor Organic/Computational	• Organic Chem I & II lect & lab • Adv. Organic Chem Lab • Elective: Environ Chem lect • Research Methods (UG)	Annulenes, nitrenes, reaction mechanisms, tunneling in organic reactions	Active
Meloni, Giovanni Professor Physical Chemistry	• Gen Chem I & II lecture & lab • Physical Chem I and II • Integrated Lab • Research Methods (UG & MS) • Elective: Materials Chem lecture	High-temperature physical chemistry; characterization of reactions of fuels and biofuels using synchrotron radiation	Active
Nikolayevskiy, Herman Assistant Professor Organic	• Organic Chem I & II lect & lab • Medicinal Chem lecture • Adv. Organic Synthesis lect	Self-immolative small molecule dyes for theranostic applications; “turn-off” chemotherapeutic warheads	Active
Spector, Tami Professor Physical Organic	• Organic Chem I & II lect & lab • Adv. Organic Synthesis lect • Adv. Organic Chem Lab • Elective: Kitchen Science	Molecular aesthetics; interactions of art, science, and aesthetics	Active
Dimitrijevic Stamenov, Aleksandra Term Assistant Professor Biochemistry	• Gen Chem I lect. • Biochem. I lect.	Aging and repair of microbial proteins; chemistry and biochemistry education research	Inactive
Stevenson, Michael Assistant Professor Biochemistry/Inorganic	• Gen Chem I and II lect. • Biochem. I and II lect. • Inorganic Chem lecture & lab	Elucidating the effects of metal ions on antimicrobial peptides (AMPs)	Active
Yang, Janet Assistant Professor Biochemistry	• Biochemistry I and II lectures • Experimental Biochemistry • Fund. of Biochemistry • Gen Chem I and II lect & lab • Research Methods (UG & MS)	Study of the mechanism of ATP Binding Cassette (ABC) transporters	Active

Below are the two faculty who have very recently left the department, to show the courses they taught.

Professor – Specialty	Past Teaching	Past or Current Research	Status
Evbuomwan, Osasere Associate Professor Inorganic (now Associate Dean for Sciences and Engineering)	• Inorganic Chem I lect & lab • Integrated Lab • Gen Chem I & II lect & lab • Elect.: Chem. of Biomed. Imaging • Research Methods (UG & MS)	Biomedical imaging probes for early diagnosis of cancer and assessment of chemotherapy	Active
West, Ryan Associate Professor Physical/Analytical (no longer at USF)	• Gen Chem I and II lect. & lab • Analytical Chem lect. and lab • Physical Chem I and II • Integrated Lab • Research Methods (UG & MS)	Developing multimodal chemical and biological sensors to detect biomarkers, pollutants and chemical warfare agents.	––

Faculty Achievements

The highlights from our research and service activities since the last review are presented below. Details may be found later in the Faculty section and in the faculty CVs in the Appendix.

External Funding and Proposals Since 2012

- One NIH grant (Yang), three NSF grants (Karney/Castro group), one ACS-PRF grant (Meloni group), multiple Advanced Light Source (Berkeley) Beamtime Allocations (Meloni), two Swiss Light Source (Switzerland) Beamtime Allocations (Meloni).

Internal Funding

- Multiple Faculty Development Fund grants for Research, Travel, and Teaching Effectiveness, plus three Lily Drake Cancer Research Fund grants (Yang, Nikolayevskiy, Evbuomwan).

Publications, Meetings, Invited Talks since 2012

- 47 peer reviewed publications with 27 different undergraduate authors. These have come predominantly from the senior faculty, as the junior faculty are still establishing their research programs.
- 30 Master's Degrees with Thesis
- Numerous Presentations (including invited talks) by faculty and sponsored students at national, international, and regional meetings, universities.

Service Highlights since 2012

- Department Chairs: Spector, Margerum, Meloni, Karney
- Graduate Program Research Directors: Meloni, Spector, Bolitho, Margerum, Li, West, Nikolayevskiy
- Student Affiliates ACS Advisor: Meloni, West, Hendrix, Nikolayevskiy
- Organization of Northern California ACS Undergraduate Symposium (2014): Meloni and Bolitho (Co-Chairs)
- Development and implementation of new curricular track in Medicinal/Synthetic Chemistry (primary author Castro)

- Development of three new courses: Advanced Organic Synthesis (Spector); Advanced Organic Lab (O-Chem faculty); Physical Chemistry I (redesigned by West)
- Various USF Committees: Faculty Development Fund, University Scholars Mentor Program, Tenure-Promotion, Policy Board, University Budget Advisory, Harney Space Committee, Dean's Medal, Undergraduate and Graduate Research Committee, Faculty/Staff Searches (Chemistry, Biology, Physics, Chemical Safety Officer, Chemistry Lab Coordinator, Instrumentation Specialist for Sciences), Board of Trustees Faculty Representative
- Professional services: referees (ACS, Wiley, and Elsevier journals), NSF, PRF, and DOE proposal reviewers, editor (International Journal of Spectroscopy, Leonardo Journal)

As shown in the table above, the Chemistry faculty currently covers all sub-disciplines of chemistry in teaching and in some research projects (analytical, biochemistry, inorganic, physical, organic), with many of us having overlapping interests in multiple areas. In the subsections below we will focus on faculty teaching workload, research, and faculty development.

A. Demographics

At this time, our faculty is bimodal in terms of career stage. We have three Full Professors and five Assistant Professors. Of the eight full-time faculty, four are women. Women comprised two of the last five tenure-track hires in the department.

B. Teaching

The department chair runs the teaching workload discussion and is responsible for submitting final documents to the college administration. Full-time tenured and tenure-track faculty have an average of 9 units of teaching obligation per semester, but since 9 is not divisible by 4, they teach an extra course once every two years. Term faculty used to teach 12 units every semester; however, now term faculty must teach 16 units each semester (4 courses) for their first two years. Over the years the chemistry faculty have collaborated to find a fair balance of workloads in our disciplines in conjunction with the union contract that calls for a two-year sequence of 8-8-8-12 units/semester. The department has course rotations and workload credit for many different situations: from 'normal' 3x65 min MWF lecture only courses, to oversight of labs in large lab or lecture-lab courses, to running an entire lecture-lab course. We generally try to have faculty in most lecture-lab courses for two straight years to cut down on the preparation time. We try to balance a large lecture course assignment with a smaller lab or course in the same semester. The tables below summarize these assignments for the last two full academic years, F19-S20 and F20-S21, along with columns for Student Credit Hours (SCH) and Faculty Workload Units. The far right column summarizes how many times the faculty member taught the course, including multiple sections in the same semester. Please note in the table below that we hired adjunct faculty or had faculty overload to deliver some basic core courses. Some courses were also covered by a term faculty no longer at USF. To ease the transition, we worked with our adjuncts, term faculty, and junior faculty on an informal mentoring basis to share philosophy of teaching and TA training, syllabi and lab experiments and grading practice the first time through a course. Once established, our new junior faculty implemented new lab experiments or approaches that have enriched our students. At this point, most of the faculty believe we are offering all required courses very well, but in the past two years we have offered only one optional chemistry course. The tables below also show that in fall 2019 we offered a graduate course (for the first time in numerous years).

Courses in Chemistry	Fall ’19 & ‘20	SCH	Workload units	Last two years (# times)
Gen Chem I lecture	CHEM 111 (5 sections)	3	4	West (3), Meloni (2), Yang (1), Melaugh (1), Stevenson(1),Anguiano(1)
Gen Chem I lab oversight w/TAs	CHEM 112 (14 sections)	1	4	Margerum (1), Yang (1)
Org Chem I	CHEM 230 (4 sections)	3	4	Spector (2), Hendrix (2), Nikolayevskiy (2), Karney (1), Melaugh (1)
Org Chem I Lab	CHEM 232 (9 sections)	1	8	Spector (1), Nikolayevskiy (1)
Kitchen Science	CHEM 310	4	4	Spector (1)
Inorganic Chem I (lect + 2 lab sections)	CHEM 320 & 320L	4	8	Evbuomwan (2)
Medicinal Chem	CHEM 332	4	4	Nikolayevskiy (1)
P-Chem I	CHEM 340	4	4	West (1), Meloni (1)
Biochem I	CHEM 350	4	4	Yang (1), Stevenson (1), adjunct (1)
Fundamentals of Biochem	CHEM 356	4	4	Yang (1), Melaugh (1)
Research Methods and Practice	CHEM 397	1	4	Yang (1)
Graduate Special Topics	CHEM 686	3-4	3-4	Margerum (1)
Graduate Research Methods	CHEM 698	2 to 6	0	West (no credit)
	Sabbatical Leave		16	Meloni

Courses in Chemistry	Spring '20 & '21	SCH	Workload units	Last two years (# times)
Gen Chem I lecture	CHEM 111 (1 section)	3	4	Anguiano (1), adjunct (1)
Gen Chem I lab	CHEM 112 (2 sections)	1	2	Melaugh (1), Yang (1)
Gen Chem II lecture	CHEM 113 (3-4 sections)	4	4	Evbuomwan (2), West (1), Margerum (1), Stevenson (1), Anguiano (1), adjunct
Gen Chem II lab with TA oversight	CHEM 114 (11 sections)	1	4	Evbuomwan, Meloni
Org Chem II	CHEM 231 (3 sections)	4	4	Nikolayevskiy (2), Hendrix (2), Spector (1), Karney (1)
Org Chem II Lab	CHEM 234 (6 sections)	1	4	Spector (1), Anguiano (1)
Fund. of Org Chem	CHEM 236	4	4	Melaugh (1), adjunct (1)
A-Chem lecture	CHEM 260	4	3	Margerum (1), West (1)
A-Chem lab with TA oversight	CHEM 260 L (2 sections)	2	3	Margerum (1), West (1)
Advanced Organic Lab	CHEM 333	3	4	Spector (1)
P-Chem II	CHEM 341	4	4	West (1), Meloni (1)
Biochem II	CHEM 351	4	4	Yang (1), Stevenson (1)
Experimental Biochem	CHEM 352	4	4	Yang (1)
Fundamentals of Biochem	CHEM 356	4	4	Yang (1)
Sp. Top: Chem. of Biomedical Imaging	CHEM 386	4	4	Evbuomwan (1)
Research Methods and Practice	CHEM 397	1	4	Spector (1), West (1)
Integrated Lab	CHEM 410	4	8	--
Graduate Special Topics	CHEM 686	3-4	3-4	--
Graduate Research Methods	CHEM 698	2 to 6	4	Evbuomwan, Nikolayevskiy
	Sabbatical Leave		16	Meloni

C. Research

We have six faculty members doing on-campus research and publishing with student authors in bioinorganic (Stevenson), biochemistry (Yang), organic/medicinal (Nikolayevskiy), physical chemistry (Meloni), computational organic (Karney), and inorganic (Evbuomwan). One faculty member publishes work at the intersection of science, art, philosophy, and aesthetics (Spector), organizes both local and international conferences in that field, and is internationally recognized. We have one emerita faculty member who is still research active in computational organic chemistry with undergraduate students (Castro). Our term and adjunct faculty are not research active. The majority of publications since the last review have come from the senior faculty, because the junior faculty are still gaining momentum. This reflects the fact that our full professors are still actively engaged in publishing. Please refer to the full CVs in the Appendix for lists of key or recent publications.

The research in the department is funded by a combination of external and internal grants. Below is a list of research grants and external grant proposals since 2012 (not including USF Faculty Development Fund grants).

Meloni

ACS Petroleum Research Fund $70,000 2016-2020
i-PEPICO Investigations of High-Energy Density Fuels

Advanced Light Source (ALS), Lawrence Berkeley National Lab Beamtime Allocations
- *High-Energy Density Fuels Reactions: Characterization via SPIMS* 2017 – present
- *Multiplexed SPIMS Studies of the Oxidation Reactions of High-Energy Density Fuels* 2016-2017
- *Synchrotron Photoionization of Furanic Fuels* 2014-2015

Swiss Light Source (SLS), Paul Scherrer Institute Beamtime Allocations
- *Photoionization Characterization and Pyrolysis Study of Selected Biofuel Molecules: Methyl Butyrate, Ethyl Butyrate, and 2,5-Dimethylfuran* 2013
- *Photoionization Characterization of Selected Biofuel Molecules, Mesitylene and Gamma-Valerolactone* 2012

Karney

National Science Foundation $202,564 2021-2024
RUI: Heavy-Atom Tunneling in Annulenes and Helical Polycyclic Conjugated Hydrocarbons

Karney and Castro

National Science Foundation $204,902 2016-2020
RUI: Computational Studies on Hydrocarbon Rearrangements: From Reactions of Polycyclic Aromatic Hydrocarbons to Tunneling in Annulenes

National Science Foundation $197,748 2012-2016
RUI: Rearrangements in Dehydroannulenes and Polycyclic Aromatic Hydrocarbons

Evbuomwan

Lily Drake Cancer Research Fund	$16,640	2019-2021
Development of [5-^{13}C]-glutamine dipeptides for non-invasive assessment of glutamine metabolism by Magnetic Resonance Spectroscopy (MRS)		
Mindlin Foundation Undergraduate Research Program	$5000	2018, not funded
An Investigation of the Impact of Amide Proton Exchange on the PARACEST MRI Efficiency of Lanthanide-bound Water Molecules		
Research Corporation, Cottrell Scholar Award	$100,000	2018, not funded
An Investigation of the Paramagnetic Chemical Exchange Saturation Transfer (PARACEST) and Luminescence Properties of Lanthanide Complexes lacking a Bound-Water Molecule		

Yang

Lily Drake Cancer Research Fund	$17,423	2021-2024
Mechanisms of Substrate Selectivity and Transport by an ABC Importer		
National Institutes of Health	$419,312	2021-2125
Mechanisms of Substrate Selectivity and Transport by a Bacterial Methionine ABC importer		

Nikolayevskiy

Lily Drake Cancer Research Fund	$16,475	2021-2023
Development of Self-Immolative Chemotherapeutics with a Highly Tunable Off-Switch		

The vibrant research activity in the department is reflected in the many presentations delivered by faculty and their undergraduate and graduate research students in the past several years. Below is a list of conferences or venues where faculty and students have presented research results since 2012.

- <u>Numerous Presentations</u> (faculty and sponsored students): ACS National Meetings, Gordon Research Conferences, Northern California ACS Undergraduate Research Symposia, American Society of Molecular Biology and Biochemistry, International Symposium on Reactive Intermediates and Unusual Molecules, AnalytiX 2017, Photon Tools for Physical Chemistry 2014, Leonardo Arts-Science Rendezvous (LASER), Dynamics of Molecular Collisions, Pacific Conference on Spectroscopy and Dynamics, International Society for Philosophy of Chemistry, Djerassi Resident Artists Program, ACS Regional Meetings, Western Spectroscopy Association Conference, Electrochemical Society National Meeting

- <u>Invited Talks</u>: Santa Clara University, Rutgers University, University of the Pacific, University of Texas Arlington, Gordon Research Conference on Physical Organic Chemistry, Dominican University, University of Sassari, ISRIUM, University of l'Aquila, World Congress on Mass Spectrometry, Taiwan Light Source, National Sun Yat-sen University, Universitá degli Studi di Perugia (Italy), Slovak Technical University, University of Rome, San Francisco State University, TechSoup Octribe Meetup, 52nd Heyrovsky Discussion (Czech Republic), Justus-Liebig Universität Giessen (Germany), Ruhr-Universität Bochum (Germany)

D. Service

Some highlights were listed in an earlier section and will not be repeated here. A theme for our faculty with on-campus service is a focus on student development (Mentor program, Dean's Medal, curriculum and academic excellence committees, Research celebration, CSI planning) and faculty development (Tenure & Promotion Committee, Faculty Development Fund, academic computing).

Other ways that the faculty are involved in the profession and community can be found in the CVs, and include editorship of journals, peer-reviewing of journal manuscripts and grant proposals, hosting conferences (International Philosophy of Chemistry, OWL National Faculty Workshop), serving as session chairs or discussion leaders at conferences, taking students to regional and national meetings, MS program directors, consultants (Cengage Learning-OWL lead teacher, NovaBay Pharmaceuticals) and outreach via the SF Exploratorium or local schools.

E. Relationship with Other Departments and Programs

One member of the Chemistry faculty has a joint appointment in the Environmental Science Department and until 2016 taught primarily in that department; he now teaches primarily in Chemistry. One Chemistry faculty member is collaborating with a member of Environmental Science on a research project. There is coordination among Chemistry, Engineering, and Environmental Science on curriculum for the General Chemistry for Engineers and Scientists lecture/lab sequence. Other interactions center on discussions of curriculum and scheduling. All Chemistry majors take a year of Calculus and a year of Physics, so coordination with the Mathematics and Physics Departments is essential to avoid schedule conflicts. Our department also coordinates to some extent with Biology because some Chemistry majors have to take the upper-division Genetics course, as well as General Biology, and Biology majors take General Chemistry and Organic Chemistry lectures and labs.

The University began a new program in Engineering in fall 2020, and all students in that program are required to take one or two newly designed chemistry courses, depending on their emphasis. One member of the Chemistry faculty (Evbuomwan) has worked with faculty in other departments and the director of the Engineering Program to design the "General Chemistry for Engineers" courses.

F. Interdisciplinary Programs

The Chemistry Department does not currently participate in any degree-granting interdisciplinary programs.

G. Recruitment and Development

As a result of recent retirements/departures we have just hired a one-year term faculty member and a three-year term faculty member. We have also requested an additional tenure-track faculty member to start in 2022. Teaching areas where we need coverage include analytical chemistry, and physical chemistry. Finally, an additional tenure-track faculty member will help accommodate more students seeking research experiences.

The Department anticipates one or two retirements in the next 5-10 years. As those occur, new hires will be needed.

There are no formal development programs for faculty within the Department. The College and University sponsor various events and workshops for faculty development. We do have a strong mentoring program for junior faculty. In their first year, faculty members have regular (e.g. weekly or biweekly) meetings with their assigned faculty mentor. Guidance covers all aspects of the job, including teaching, scholarship, applying for grants, publication, running a research group, dealing with student issues, and service opportunities. The mentoring activities continue up until the faculty member earns tenure, and usually beyond.

V. Departmental Governance

The Department by-laws can be found in the **Appendix** and include a set of objectives that guide our decisions and interactions. The 3-year position as chair is rotated among the tenured faculty by mutual consent. There are monthly meetings with an agenda set by the chair with input from all faculty. Most important decisions on curriculum, student progress and department direction are finalized at these meetings. The chair does the vast majority of administration, from daily guidance for the program assistant to stockroom and lab coordinator oversight and review. The department budget is always a source of frustration as the union contract does not allow any input, thus we are given a budget that is always too low on student help (TAs, readers, stockroom help) and has no provision for capital or maintenance. The previously agreed-upon 5 workload units of release time for the chair was reduced this past year by the administration to 4 units, which the department feels is insufficient.

VI. Students

Below is a summary of two key questions from our 2017-2019 BS Alumni Survey (all BS graduates since 2012: see **Appendix** for full results). The total response rate was 42% (50 answers versus 118 requests).

Are we doing a good job of preparing our students? Here is what our graduates self-reported (n = 50):

Q3. I feel my technical training and education at USF were at least equal to that of my peers who graduated from other institutions.		
Answer Options:	Response Count	Percentage
Strongly agree	29	58.0%
Somewhat agree	17	34.0%
Neutral	2	4.0%
Somewhat disagree	1	2.0%
Strongly disagree	1	2.0%
answered question	50	100%
skipped question	0	—

Q11. Overall, I feel very positive about my experience in the Chemistry program at USF.		
Answer Options:	Response Count	Percentage
Strongly agree	28	59.6%
Somewhat agree	15	31.9%
Neutral	3	6.4%
Somewhat disagree	0	—
Strongly disagree	1	2.1%
answered question	47	100%
skipped question	3	—

The survey had a 42% response rate (slightly lower than the 48% response rate for the previous survey in 2011). Because of the good response rate, the results give us confidence in the strength of our program. About 92% of the respondents (sum of “strongly agree” and “somewhat agree”) felt they had a technical training and education at USF at least equal to their peers from our institutions, and over 90% felt positive about their experience at USF.

We made changes to our courses and to our major/minor requirements to attract the best current students and to increase the rigor of the undergraduate experience (*Committee on Professional Training, CPT-ACS newsletter, Winter 2011, Vol. 9, No. 1*). Besides personal recruitment from our courses, we reworked General Chemistry labs to incorporate more group work, more inquiry-based experiments, computer-based data collection (LabQuest) and lab practicals, all published methods that encourage a diversity of student success and rigor. We raised the SAT/ACT cut off in General Chemistry to ensure students are prepared for the course. We raised all prerequisites course grades to C or higher, as C- students were not making it. Through our assessment program, we identified a major issue: students do not bring a good working knowledge of prerequisite course material into new courses. We are testing various methods to make students more responsible as the new courses start. We are informing students through syllabi, advising and our web pages. Historically, this issue is most severe in the Physical Chemistry course, which has calculus-based physics and second semester calculus as prerequisites. Specifically, we seek any advice on how best to address this issue as we debate the merits of adding a separate Physical Chemistry course for Biochemistry concentration majors.

Our department prides itself on our faculty/staff/student interactions and we foster this in many ways. Our SAACS (Student Affiliates to ACS) group is quite active hosting 'meet the faculty' events, hosting a faculty research talk night, and participating in student orientations. One faculty member satisfies their service as the advisor. We average 10-15 research students each semester in CHEM 397 and in summer. This serves as a way for us to mentor our research students in an informal setting. As a result of their participation in research, our undergraduates have given approximately 55 poster presentations and 8 oral presentations at conferences (details in Appendix). In addition, our MS students have presented approximately 35 posters since 2012.

VII. Staff

Total full-time-employees = 3.0 (currently 2.0, as 3rd position is unfilled as of Sept. 27, 2021)

- **Deidre Shymanski: Program Assistant,** started 2008.

  Main duties: Office support of faculty, chair and MS program director, coordinate advising/student questions, maintain department web pages, oversee student workers and timecards.
- **Angela Yishun Qin: Stockroom Manager and Chemistry Laboratories Manager ,** started 2009.

  Main duties: Ordering, cataloging, delivering lab and research chemicals; preparation for General, Analytical, and Experimental Biochemistry labs; centralized waste collection; day to day stockroom management with student workers.
- **[Organic Chemistry Laboratory Specialist],** currently vacant, search in progress.

  Main duties: Organic lab preparation (lower and upper division) including instrument setup/training, TAs (assignments, scheduling, safety training), coordinating enrollments for lower-division organic lab courses, NMR maintenance/repair, quality control, and training.

Shared positions among all science departments:

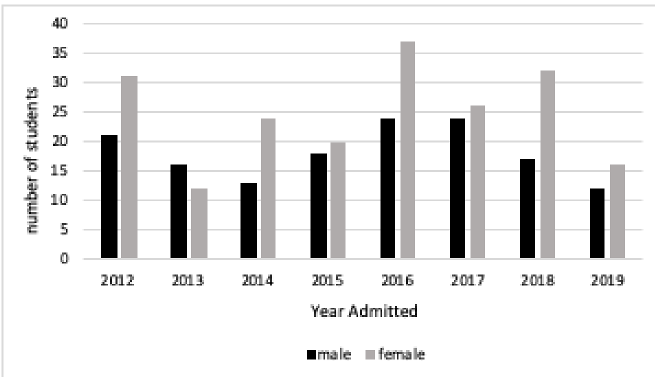
- **Matt Helm: Director of Technical Staff and Instrumentation Specialist**

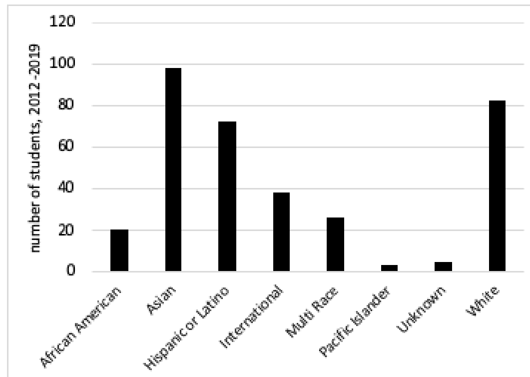
  Duties for Chemistry: mechanical repairs, NMR cryogen fills, gas cylinders, maintenance contracts, hardware upgrades
- **Jeff Oda: Instrument Specialist**
- **Craig Conforti: Lab Safety Manager**

Our three full-time chemistry staff positions officially report to the Associate Dean of Sciences, Osasere Evbuomwan, due to the faculty-union contract. In practice, the department chair has day-to-day oversight and direction, including annual written staff reviews. A major challenge in fall 2021 is the lack of an Organic Chemistry Lab Specialist.

VIII. Diversity and Internationalization

We consistently have a higher number of female students than male students in our major. Our female students are supported through numerous USF groups, including the Association of Women in Science, Women in Chemistry, and the Clare Boothe Luce Foundation, which has recently awarded two, one-year full tuition scholarships to Chemistry majors. The ethnic background of our students is also extremely diverse. We encourage our underrepresented minority students to apply for the ACS Scholars Program. The data shown below is for our undergraduate majors.





IX. Technology/ITS Support/Library

We have a good and improving support structure on campus from ITS/Technology. Our NMR hardware/software is complex and problematic without a full-time instrument manager, so ITS has helped support this LINEX system. Other maintenance/upgrades to computer-based lab equipment does not really happen until something breaks down. John Hendrix has been crucial for the NMR maintenance in the last four years. With no capital or maintenance budget, the department must go directly to technical operations (Matt Helm) or to the College administration for upgrades. While both have been supportive in the past, this is not the optimal way of doing business. We do not see this changing.

Our Center for Instructional Technology (CIT) on campus has been very helpful for us as we implement new technology (iClickers with Canvas linked grading, new technology in the classroom and training courses for new or adjunct faculty). The library now provides full-text access to all ACS, RSC, and Elsevier journals in place of bound copies on site. We share a SciFinder license with Santa Clara University, and the library staff provide training on searching with this interface.

X. Facilities

As outlined above, the new Lo Schiavo Center for Science and Innovation houses undergraduate teaching labs for Organic, Analytical, and Inorganic Chemistry, as well as Biochemistry. It does not include any faculty office or research space. Harney Science Center was built in 1965 and is near the end of its useful life. We currently have two research instrument rooms, besides the dedicated NMR room, that serve undergraduate courses and research groups. They are small and crowded, with all bench space taken. One particular challenge facing the Department is that our 500 MHz Agilent NMR is old, new parts cannot be obtained for it, and we currently have nobody to maintain it. We will attempt to acquire a new instrument within the next year. Development of a funding proposal is in progress.

We strongly support efforts by the University to renovate Harney Science Center. In late fall 2011, two rooms on the chemistry floor in Harney were reconfigured into three offices and meeting/research space in response to losing one faculty office to CSI construction. We are also in planning mode with faculty and staff on improvements to the chemistry stockroom and organization of undergraduate labs. A thorough renovation of Harney is planned for sometime in the next several years.

XI. Conclusions to the Self Study Report

Strengths and improvements since last review

- Improved teaching lab facilities in the new science center, along with implementation of lab fees in fall 2015 ($25/semester) to supplement the department budget
- New Medicinal/Synthetic Chemistry track and new Inorganic sequence (under development)
- Improved group supplemental instruction with the introduction of PLTL workshops (joint project with USF Learning Center)
- Faculty willingness to try new approaches to teaching and assessment. For example, we changed our curriculum to be more flexible for students, including course prerequisites and providing more lab courses in the junior year. We instituted a diagnostic test for general chemistry taken by all students.
- New junior faculty contributing immediately to curriculum revisions and research with students
- Increased number of research grant applications, funding, and publications
- Increased staff support (although still need staff for upper division labs); some instrumentation expansion and upgrade
- BS and MS students succeeding in job or graduate school placement
- Small, personalized lab experience using research quality instruments for all majors and MS students
- Improved mentoring of new faculty

Challenges Identified

General

- Faculty replacement needed to help deliver general, analytical, and physical chemistry courses and establish active research groups.
- Difficulty planning course offerings—both undergraduate and graduate—in conjunction with the administration’s new Under-enrolled Course Policy.
- Need to replace our NMR spectrometer within the next year.

- Need for a capital budget and administrative plan for replacement of instrumentation.

Undergraduate

- Desire to increase the number of majors in all tracks.
- Difficulty scheduling and staffing enough lab sections for numerous courses—especially General and Organic, but also at times Analytical and Inorganic.
- Lack of a support staff member for organic chemistry labs and for NMR maintenance.
- Need for additional support staff to assist in the delivery of expanded lower division Analytical and upper division Inorganic, Biochemistry and in-depth Inorganic/Integrated labs.
- Given the Biology Department's desire to no longer have underprepared Biology majors take Foundations of Chemistry prior to Gen Chem I, the Department is currently discussing ways to support underprepared students entering General Chemistry I, beyond doing OWL Quick Prep over summer.
- Difficulty accommodating more undergraduate researchers given our desire for an increase in the number of majors.

Graduate

- Methods to increase the MS financial package to become more competitive with peer programs and to fairly compensate MS students working as TAs and research assistants.
- Increase the number of graduate merit scholarships to accommodate anticipated increase in graduate students (based on the number of hires in the last five years with active research groups and a desire to maintain a vibrant research environment).
- Need to offer a graduate course on a regular basis.

XII. Plan for the Future

As the Chemistry Department looks to the next several years, we plan to continue strengthening several aspects of our programs. In our MS program, we intend to implement a one-course requirement in order to reliably give all master's students the opportunity to take a high-level course. This course will appeal to a broad range of subdisciplines and prove useful to the students in their work at USF as well as in their future endeavors. We also hope to increase the number of students in our MS program to both bolster faculty research and to assist in teaching lab sections. In our BS program we hope to maintain healthy numbers of majors in all three degree tracks by timely recruiting and outreach. We will aim for stability and regularity in our upper-division course offerings in the face of the Under-enrolled Course Policy—both for our required courses and for upper-division electives of broad interest. To maintain effective delivery of our expanding lab courses, such as Analytical Chemistry, Inorganic Chemistry, Experimental Biochemistry, and Integrated Lab, we will seek additional support staff. We will seek funding for a new NMR spectrometer—an instrument that is heavily used in our teaching and research. The Department also plans to continue striving for rigor and excellence in faculty research programs. This effort will include components such as encouraging and supporting more applications from faculty for external funding (which could enable us to hire more undergraduate research students), maintaining robust and up-to-date facilities, and providing support for students to present their work at conferences. External to our Department's degree programs and research, our faculty will regularly teach one or more chemistry courses in the Engineering program.

Concluding Remarks

The Chemistry Department maintains a thriving program with three rigorous degree tracks, ACS-certified options for students, extremely dedicated faculty, and an active research program involving both undergraduate and master's students. Graduates from our programs go on to excellent graduate programs and/or good jobs in biotech, government labs, and the chemical or pharmaceutical industry. The recent increase in the number of undergraduate majors is welcome but also presents challenges to the department, in terms of delivering enough lecture and lab sections. We have identified areas that are candidates for improvement, and we hope to work as a department and with the administration to address those areas so that the Department can continue helping students meet their academic and career goals.

Appendix A. Undergraduate Program: Course descriptions

The course sequence for Chemistry/Traditional track, followed by required courses for Biochemistry track and Medicinal/Synthetic track, is presented below. Summaries include updates to curriculum and labs since the last review, such as class/lab size, writing assignments, policies and practices. We accept AP credit for General Chemistry with a 4 or 5 score and routinely accept community college transfer credit for most courses in the first two years.

General Chemistry I (CHEM 111, 3x65 min, 5 x 50 students in fall and 1 x 40 in spring; 3 units), Prereq: diagnostic chemistry test minimum score of 15/42 correct on high school math and chemistry.

Rotations: Stevenson, Meloni, Yang, Stamenov, Ganguly, adjuncts

The learning outcomes are based upon the first nine chapters of "Chemistry..." by Kotz, et.al., [stoichiometry, heat, atomic/molecular structure, gas law and solution properties] with exams, and common homework schedule (OWL v2 online: tutorials, simulations, and mastery homework, end-of-chapter quizzes, and Adaptive Study Plans) coordinated among instructors and published as a spreadsheet for the semester. Most instructors allocate 10-15% to OWL with the remainder on Exams and group work. Lecture styles depend upon the individual instructor, but have included use of iClicker, group work/POGIL, and traditional lecture.

General Chemistry I Lab (CHEM 112, 1x4 hr, 14 sections x 18 students fall; 2x18 sections in spring, 1 unit), Prereq: concurrent CHEM 111.

Rotation: Yang, Ganguly

Labs meet weekly with MS students and adjunct teaching instructors. The professor in-charge works with the stockroom/laboratory prep, holds weekly TA meetings for training and experiment run-through, and is in charge of setting up Canvas for grading/policies. Margerum (2014 and 2017-2019) rewrote all experiments to use guided inquiry and The Science Writing Heuristic (SWH). UC-Berkeley 1A/1B Lab coordinator shared their curriculum and we adapted other experiments [polymers, biofuels/calorimetry, VSEPR, creating glow sticks, extraction of turmeric spice]. LabQuest computers/sensors are in use for many labs, student groups post in-lab results for whole-class graphing, and carbon copy notebooks are in use for the first time. TA meetings are used to review experiments, create grading rubrics and to discuss teaching goals and assessment.

Our new TA training includes a full day of instruction on group dynamics and learning styles, and how to deal with student issues, in addition to SWH training.

General Chemistry II (CHEM 113, 3x65 min lectures, 4 sections x 50 students, spring, 3 units), pre-req: C or higher in CHEM 111 and 112L.

Rotations: Stevenson, Meloni, Yang, Stamenov, Ganguly, adjuncts

The format and coordination with OWLv2 is similar to Chem 111 and covers intermolecular forces, kinetics, equilibria, acid-base, thermodynamics, redox and coordination chemistry.

General Chemistry II Lab (CHEM 114, 1x4 hr, 11 sections x 18 students, spring, 1 unit), Prereq: concurrent CHEM 113 and C or higher in 111/112L.

Rotations: Meloni, Ganguly

The format of Chem 114L is similar to Chem 112L with a mix of in-house and adapted guided inquiry labs with a Green Chemistry focus from UC-Berkeley [acids in the environment, salt water electrolysis, kinetics, freezing point depression, inorganic synthesis/characterization of colors]. Margerum (2017-2019) rewrote all experiments to use SWH, including a new 3-week project his research team created on the use of dried avocado peels to absorb dyes as a model for cleaning up dirty drinking water in remote villages (NSF-Analytical Active Learning workshop).

Organic Chemistry I (CHEM 230, 3 x 65 min lecture, fall 3 units), Prereq: CHEM 113 and 114 with a minimum grade of C

Rotations: Spector, Karney, Nikolayevskiy

This course is the first half of a yearlong sequence in organic chemistry. In recent years, section sizes have ranged from 35-45. The course covers the fundamental principles underlying the structure and reactivity of carbon compounds. Mechanisms and multi-step syntheses are emphasized. The course also introduces important spectroscopic tools that are used to determine the structures of compounds. Major topics include alkanes, alkenes, alkynes, alcohols, stereochemistry, conformational analysis, acid-base chemistry, substitution and elimination reactions, radical reactions, IR spectroscopy, NMR spectroscopy. Course content is organized to appropriately coincide with Organic Chemistry I laboratory (CHEM 232) experiments. All faculty who teach organic chemistry use the same text and coordinate with one another regarding the ordering of the syllabi topics and the number/dates of exams. The faculty also coordinate summative assessment by embedding the same questions in all sections of the final exam. The focus of this coordinated assessment is student comprehension and application of structure, mechanism, synthesis, acid/base theory, and spectroscopy.

Organic Chemistry I Lab (CHEM 232, 1 x 4 hr, fall, 9 sections, 16 students/section, 1 unit), pre-req: concurrent CHEM 230 or CHEM 236, or CHEM 230 or CHEM 236 with a minimum grade of C

Rotations: Spector, Karney, Nikolayevskiy

This course provides an introduction to many of the common techniques used to synthesize, isolate, purify, characterize, and analyze organic compounds. While the theory behind each experiment reinforces concepts from CHEM 230, this course stands on its own with an emphasis on best practices, safety, notebook protocols preparation and record keeping, and management of chemical waste. Students prepare question-based pre-labs, participate in laboratory exercises, maintain a detailed laboratory notebook, analyze/interpret data, and complete a question-based post-lab. Students in all organic labs cannot bring the lab manual and must write a pre-lab in their lab notebook prior (approved by the laboratory instructor). In Organic Chemistry I Lecture/Lab students are introduced to IR and ^{1}H NMR spectroscopy relatively early in the semester. They do a ^{1}H NMR "dry lab" in the 7th or 8th week and are required to interpret their spectra for all subsequent labs.

Organic Chemistry II (CHEM 231, 3 x 65 min lecture, fall 4 units), Prereq: CHEM 230 with a minimum grade of C

Rotations: Spector, Karney, Nikolayevskiy

This course is the second half of a yearlong sequence in organic chemistry. Using fundamental principles covered in the first half, this course continues the study of chemical reactivity. The course covers the structure, properties, and chemical behavior of numerous classes of organic compounds, including ethers, conjugated systems, aromatic compounds, carbonyl compounds, amines, important classes of biomolecules, and synthetic polymers. Emphasis is placed on mechanisms, multi-step synthesis, molecular orbital theory, and spectroscopy. As for Organic Chemistry I, all sections use the same text and coordinate syllabi, number of exams, grading, and assessment.

Organic Chemistry II Lab (CHEM 234, 1 X 4 hr, spring 6 sections, 16-18 students/section, 1 unit), pre-req: CHEM 232 with a minimum grade of C; Pre- or Co-req: CHEM 231

Rotations: Spector, Karney, Nikolayevskiy

This course provides additional experience with the common techniques used to synthesize, isolate, purify, characterize, and analyze organic compounds. The theory behind each experiment reinforces concepts from CHEM 231 and Organic Chemistry I lab. In addition, they engage in computational modeling and more complex spectral analysis. The format for Organic Laboratory II is similar to Lab I. In addition, students write experimental conclusions and participate in a lab practicum at the end of the semester. Previously, we had a separate organic lab course for chemistry majors while this lab served primarily non-chemistry majors (primarily biology majors). Beginning in Spring 2017 we changed the requirements and now all chemistry majors (all tracks) take this course.

Fundamentals of Organic Chemistry (CHEM 236, 3 x 65 min lecture, spring 4 units), pre-req: CHEM 113 and 114 with a minimum grade of C-

Rotations: adjuncts

This course (1 section, 20-40 students) is a survey of organic chemistry for non-chemistry majors. It covers the basics of organic structure, properties, nomenclature, reactions, mechanisms and spectroscopy. It is primarily taken by non-pre-health-oriented biology majors and those who have not acquired the grade prerequisite of a C in Organic Chemistry I to enroll in Organic Chemistry II. It, along with Organic Chemistry I lab, fulfills the Biology department organic chemistry requirement, although most biology majors choose to take the full year organic sequence. We typically offer it in the Spring semester so biology majors who have not achieved a C grade in Organic Chemistry I, as is required for their major and for enrollment in Organic Chemistry II, can stay on track in their major.

Analytical Chemistry (CHEM 260/260L, 2 x 65 min lecture, 1x4 hr lab, spring 4 units), pre-req: CHEM 113 and 114 with a minimum grade of C

Rotations: Ganguly

An introduction to the principles and practices of analytical chemistry with an emphasis on quantitative methods in a lecture + lab course. In addition to traditional lecture, both instructors use various active learning methods such as POGIL, group problem solving, or group exams during class meetings. Learning outcomes cover a broad range of topics, including error analysis, statistical methods, calibrations, least squares analysis, chemical equilibrium, acid-base chemistry, ionic strength, classical methods such as titrimetric and volumetric analyses, plus instrumental methods involving spectroscopy, electrochemistry, chromatography, and mass spectrometry. Applications of these techniques are performed using in-house experiments and adapted published experiments presented mainly as Problem-Based Learning projects [Vitamin C in fruit via titration, electrochemistry on acetaminophen, Beer's Law analysis, ethanol in beer via GC internal standards, and HPLC on headache tablets]. The labs emphasize problem solving, group collaboration, sample preparation, proper waste disposal, lab safety, and maintenance of a lab notebook. Students use Excel for calculations, data analysis and making high quality scientific figures. Post-laboratory full or partial reports, in the ACS style, are prepared using Word.

Physical Chemistry I (CHEM 340, 3 x 65 min lecture, fall 4 units), pre-req: CHEM 113/114, PHYS 210 or PHYS 101, MATH 110 with a minimum grade of C

Physical Chemistry II (CHEM 341, 3 x 65 min lecture, spring 4 units), pre-req: CHEM 340 with a minimum grade of C

Rotations: Meloni

Up until Fall 2018, the two-semester physical chemistry sequence was based on the classical approach of presenting thermodynamics, electrochemistry, and kinetics in the fall semester and quantum chemistry, spectroscopy, and statistical thermodynamics in the spring semester. Starting in Fall 2018, the content was redistributed into ACS style foundational and in-depth semesters: CHEM 340 introduces thermodynamics, kinetics, quantum chemistry, and spectroscopy, while CHEM 341 revisit these topics in more depth (and using a higher level of math) and introduces statistical thermodynamics. Typical class size is 16-24 (100% increase from our previous review). Meloni has written his own textbook for CHEM 340 students that can be supplemented with any other physical chemistry textbook. This textbook is based on his lecture material and provides end-of-chapter questions that students should answer to make sure that they master the material covered. West utilizes POGIL and home-made group work activities to supplement lectures on Thermodynamics and quantum mechanics. Meloni uses an oral exam as part of the physical chemistry curriculum to promote studying and thinking. Students need to understand the concepts and be able to explain them to an interlocutor.

Many of our majors do not have a firm foundation in partial differentiation or multivariable functions (very little in CHEM 340, but more in CHEM 341). In addition, students seem not to retain much material from Math 110 (Calculus 2) and PHYS 210 (Physics 2), which are prerequisite courses. To help with this a "calculus refresher" is presented to revive important mathematical concepts, ranging from limits and derivation to multiple integrals.

Inorganic Chemistry I (CHEM 320/320L, 2x75 min lecture, 1x4 hr lab, 2 lab sections of 10-12, fall 4 units), pre-req: CHEM 260with a minimum grade of C

Rotations: Stevenson

The Department decided to restructure this course to a foundational junior level course that does not require P-Chem and reduces lab time to 4 hr/week from 6 hr/week (CHEM 320/320L from CHEM 420/420L) starting in Fall 2017 (transition year). All chemistry tracks take this foundational inorganic course. A second in-depth inorganic/physical/analytical course (M-cubed: Metals, Macromolecules and Materials) will be created and required for the standard/traditional track at 6 lab hrs/week. This 2-semester sequence fills a large hole in our curriculum. The old version of this course covered much of the Shriver textbook, plus additional advanced topics in lecture and lab. Dr. Curtis ran the course (except 2011-Margerum and adjunct faculty for two years due to faculty shortage). Course populations now exceed 16-18 students so two lab sections are necessary.

The new foundation lecture (Fall 2018) focuses on atomic structure, periodic trends, acid/base, and redox properties, simple molecular orbital theory, symmetry/group theory, the solid state (metallic and ionic compounds) and coordination complexes. A number of active-learning methods are employed in the classroom (POGIL activities, in-class worksheets, and board work). Class size increased in Fall 2018 and Fall 2019 to 27 and 22 students, respectively.

The new foundational lab focuses on the synthesis, characterization, and analysis of inorganic compounds and materials. Students use Schlenk lines and a range of analytical techniques to characterize their synthesized compounds. Labs are typically multi-week projects aimed at helping students establish relationships between the structures and properties of their synthesized compound/material library. Significant emphasis is placed on analysis of pooled class data. Additionally, students complete a computational lab with Spartan software to visualize molecular orbitals. Students write three project reports and give two presentations: one on an analytical technique they have "mastered", and the other on their final lab project.

The second in-depth inorganic/analytical course is currently in development and will be offered as a four-unit lecture and lab course. The content covered in this course will include organometallic compounds, bioinorganic chemistry, and macromolecular, supramolecular, and nanoscale materials. Real world applications of inorganic chemistry will also be covered. Our initial thoughts are to require this course of all students in the standard track but to make it accessible to students from the other tracks who are interested in the selection of topics covered, or who desire an ACS-certified degree. We are currently using the following publication as a guide in the design of this course: "Great Expectations: Using an Analysis of Current Practices To Propose a Framework for the Undergraduate Inorganic Curriculum, by Reisner, et. al, *Inorg. Chem.* **2015**, *54*, 8859−8868."

Integrated Laboratory (CHEM 410/410L, 3 x 50 min lecture, 2 x 3.5 hr/wk lab, spring 4 units), pre-req: CHEM 340 with a minimum grade of C

Rotations: Meloni

This is a capstone four-unit lecture course with a lab component that is required for all Standard Track students (approved starting Fall 2019) and students in other tracks pursuing ACS certified degrees. The course is offered every other year (not offered in Spring 2021), with class sizes ranging from 4 - 10 students. The student population is typically a mixture of juniors and seniors, with a few graduate students occasionally. The course "integrates" both traditional physical chemistry and instrumental analysis lecture and lab material with open-ended and exploratory projects. Students actively engage with the scientific literature in addition to designing and executing experiments in small groups of 2 - 3. They are also expected to independently operate several spectroscopy and chromatography instruments (NMR, GC-MS, HPLC, FT-IR, FT-Raman, UV-Vis, and Fluorescence) and analyze data collected using these techniques. Students maintain professional-level lab notebooks, write brief project proposals, produce high-quality lab reports written in the format of an ACS manuscript, and give oral and poster presentations detailing the results of their respective projects. In the past, our small class size has enabled class visits to nearby national laboratories and made it a bit easier for students to participate as a cohort in local, regional, and national meetings in the San Francisco Bay area.

Curriculum: Biochemistry Track

Biochemistry I (CHEM 350, 3 x 65 min lecture, fall 4 units), Prereq CHEM 231/236 with C or higher and BIOL 105 (Note: the BIOL 105 Prereq is waived for non-Biochem Track Chemistry majors.)
Rotation: Yang, Stevenson, Stamenov

The department has offered one section of this course every fall, but as a result of increased student demand, this semester we scheduled two sections (20-25 students each). In this course, the first of the two-course biochemistry lecture sequence, students learn how the basic principles of chemistry are used to describe life at the molecular level. The class focuses on the chemical structures and biological roles of the four major classes of biomolecules: proteins, nucleic acids, carbohydrates, and lipids. Emphasis is placed on the connection between the three-dimensional structure of proteins and their function in the cell. Students learn to relate chemical bonding and reactivity, thermodynamics, and kinetics to enzyme mechanisms. Several biochemical techniques are introduced, including x-ray crystallography, protein and DNA sequencing, and protein purification.

Biochemistry II (CHEM 351, 3 x 65 min lecture, spring 4 units), Prereq CHEM 350 with C or higher.
Rotation: Yang, Stevenson

This course (one section, ~15 students) is the second half of our yearlong sequence for biochemistry-track majors. Students explore the integration and regulation of the enzyme-catalyzed biochemical reactions that make up complex metabolic processes. This comprehensive study details the biosynthesis and catabolism of diverse small molecules including amino acids, carbohydrates, lipids, coenzymes, and nucleotides. The class begins with a review of the basic framework of the cell's energy requirements with emphasis on the concept of Gibbs free energy and the coupling of exergonic and endergonic reactions. Students use their knowledge of reduction and oxidation to dissect the reactions necessary for energy generation and storage in the cell. Regulation of both near- and far-equilibrium reactions are studied in the context of an organism's changing metabolic needs.

Neither of the two biochemistry lecture courses includes a concurrent laboratory.

Experimental Biochemistry (CHEM 352L, 2 hr lecture, 6 hr lab/wk, every other year, spring 4 units)
Prereq CHEM 260 with C or higher, CHEM 350 with C or higher.
Rotations: Yang, Stevenson

This capstone laboratory course (one section, ~12 students) provides Biochemistry Track students with intensive practical experience in the fundamental techniques behind protein purification and analysis. Students start by practicing essential basic skills, such as accurate pipetting and buffer preparation, and then move on to more complex experiments, including spectrophotometric binding assays and enzyme activity assays. In parallel, students learn to utilize basic computational tools to visualize the proteins used in these experiments. The course includes a lab practical in which each student determines the kinetic parameters of a coupled enzyme system using nonlinear regression analysis. Students then examine the enzyme kinetics in the presence of an inhibitor and determine the mechanism of inhibition. In a multi-week project, students express, purify, and characterize enhanced green fluorescent protein (eGFP).

Throughout the course, students are required to maintain a detailed laboratory notebook, for which carbon copies are graded during each lab session. Students generate numerous lab reports that conform to ACS style. In the beginning of the semester, students produce multiple short lab reports, and each report focuses on a particular section of a lab report (i.e., Introduction, Methods, etc). The two formal lab reports are longer, in-depth assignments, for which students submit drafts and revisions. Lastly, students are required to give a 15-minute PowerPoint presentation on a research article from the ACS journal *Biochemistry.*

Historically, this course has been offered every other year, but starting this year the department is attempting to offer it every year, given the increase in number of Biochemistry Track students.

Fundamentals of Biochemistry (CHEM 356, 3 x 65 min lecture, fall 4 units). Prereq CHEM 231/236 with C or higher.
Rotations: Yang, Stamenov, Stevenson

This course is a one-semester survey of biochemistry for non-chemistry majors or chemistry majors in the standard track. This class of ~40 students is mainly comprised of pre-health-oriented biology majors. The first two-thirds of the lectures cover the basics behind the function of macromolecules including proteins, nucleic acids, lipids, and carbohydrates. The last one-third highlights the chemical reactions involved in metabolic pathways.

Curriculum: Medicinal/Synthetic Track

Medicinal Chemistry (CHEM 332, 3 x 65 min, 3 units, spring). Prereq CHEM 231 with C or higher.
Rotations: Nikolayevskiy

This course presents an overview of the principles underlying the discovery, design, and development of modern medicines, and places a special emphasis on the public policy issues and social attitudes relevant to certain drugs. Medicinal concepts are presented from an organic chemistry perspective, with an emphasis on modern synthetic reactions and strategies central to drug development. Widely used pharmaceuticals are used as case-studies to introduce topics such as pharmacology, structure-activity relationships, and the biochemical roles of common macromolecular drug targets. These concepts are reinforced through group discussions, a thorough analysis of the primary literature, and a summative group presentation. This class can serve as an elective for all chemistry tracks.

Advanced Organic Chemistry Lab (CHEM 333, 6 hr/wk, 3 units, spring) Prereq CHEM 231 and Chem 234 with C or higher.
Rotation: Spector, Karney, Nikolayevskiy **(note this course replaces Chem 233 – Organic Chem Lab II for majors)**

This course, which is required for the Medicinal/Synthetic track, was taught for the first time in spring 2018. It builds on the principles and techniques learned in the yearlong organic chemistry laboratory for the synthesis, purification, and characterization of organic compounds. In addition to providing additional experience with basic lab techniques such as thin-layer chromatography, extraction, and distillation, it introduces more advanced techniques such as inert-atmosphere manipulations (e.g., syringe, vacuum manifold) and flash column chromatography and emphasizes spectroscopic methods (NMR, IR, MS) for the characterization of products, and more sophisticated principles of spectral interpretation (use of ^{1}H NMR coupling constants, 2D NMR). Students also run enantioselective reactions and enzymatic kinetic resolution. Computational chemistry (molecular modeling) with *Spartan* software is employed throughout the course as an aid to understanding experimental results. The students learn to use SciFinder, keep a detailed lab notebook, write formal reports in the style of an American Chemical Society (ACS) manuscript and serve as a peer reviewer for one another's reports. This class can serve as an elective for all chemistry tracks.

Advanced Organic Synthesis (CHEM 334, 4 units, fall) Prereq CHEM 231 with C or higher.
Rotation: Spector, Nikolayevskiy, Karney

This is an upper division lecture class for students who have completed CHEM 231 and would like to learn intermediate and advanced topics in organic chemistry. The course was taught for the first time in fall 2017. The emphasis is on synthesis, with mechanisms employed to enhance understanding of the reactions. In addition to expanding the students' repertoire of functional group transformations, protecting groups, and current methods for carbon-carbon bond formation, this class emphasizes stereochemistry, molecular orbital theory and significant engagement with the current organic literature as a means to teach students strategies for multi-step syntheses and retrosynthesis. A number of the reactions taught in this course are aligned with those the students perform in the Advanced Organic Laboratory course (CHEM 333). This class can serve as an elective for all chemistry tracks.

All tracks:

Undergraduate Research Methods and Practice (CHEM 397, offered every semester, faculty led research, 1 unit, can be repeated up to 4 units), pre-req; permission of the research director
Rotations: Karney, Meloni, Nikolayevskiy, Spector, Stevenson, Yang

The primary purpose of the course is to provide students with a research experience as part of a faculty-led research program. Students must first be accepted into a research group before enrolling in the course. Alternatively, students may participate in an approved off-campus summer research project, such as in the SF Medical Examiner's Office, Gilead, UCSF, or other labs. In the fall, the instructor assists students in writing a required research progress report from work completed in fall or the preceding summer. Additionally, students give an informal presentation and develop a professional portfolio including a resume and cover letter. In the spring, the faculty in charge of the course assists students in preparing a professional oral or poster presentation of research for a campus, local and/or national conference. For students who are completing the ACS-certified degree, a full written report is required in their final semester. We encourage most chemistry majors to take the course before they graduate, especially if they are considering graduate school. Students often complete two or three consecutive semesters of CHEM 397, and enrollments vary between 6-15 students per semester.

The delivery of Chem 397 each semester reflects a strength in our department. Many of our faculty work in the summer to ensure our majors enjoy a research experience. While there are some summers in which we cannot accommodate all of our majors, most of the time interested students find a research group. In addition, the Department has been somewhat successful in placing students in REU programs.

Other Chemistry Electives

Kitchen Science (Chem 310, 3 x 65 min, 4 units, Spector) Prereq CHEM 231 with C or higher.

Kitchen Science fulfills the chemistry major and minor elective option/requirement and assumes knowledge of General Chemistry I and II and Organic Chemistry I and II. It focuses on the physical and chemical properties of actual food and drink, including pickles, tea and ice cream, and the transformative nature of cooking. It probes and reviews scientific concepts, molecular structures, metabolic processes and reactions learned in General and Organic Chemistry. Students hand in weekly problem sets, reflection papers and give presentations, and read about and discuss issues associated with the cultures of food in the U.S. In addition, a majority of course meetings involve making, eating, and analyzing food and drink associated with the weekly lecture topics.

Environmental Chemistry (CHEM 311, 3 x 65 min, 4 units, Karney) Prereq CHEM 113 with C or higher, and one of the following: CHEM 230, CHEM 236, ENVS 212.

This lecture course is intended for chemistry majors and minors as well as students majoring in Environmental Science. It satisfies the requirement for an elective course for Chem majors and minors. The course serves as an introduction to major topics in the chemistry of the environment, including the chemistry of tropospheric air pollution, aquatic chemistry, water pollution and water treatment, microbiological processes, soil chemistry, and synthetic organic chemicals. The course covers important conceptual aspects of each subject, as well as approaches to quantitative problem solving in each area. Across the different topics, the application of fundamental chemical concepts is emphasized. These include molecular structure, intermolecular interactions, reaction mechanisms, kinetics, equilibrium, solubility, acid-base chemistry, and oxidation-reduction reactions. In addition to doing practice problems in class, students do additional readings (including research articles from the primary literature), and apply what they have learned to numerous problem sets. The course is cross-listed in the Environmental Science Department.

Special Topics: The Chemistry of Biomedical Imaging (CHEM 386, 3 x 65 min, 4 units, Evbuomwan, Spring 2021)
Biomedical Imaging is defined as the visualization of anatomic, physiologic, metabolic, and molecular changes that differentiate diseased from normal tissue in living organisms. Although several biomedical imaging modalities exist, their selection for specific clinical applications is dependent on a number of factors that include resolution, depth penetration, disease target, and safety. Regardless of the modality used, the images produced facilitate a better understanding of various disease mechanisms. In this course, students will learn about the fundamental principles behind current biomedical imaging techniques and the molecular basis of the signal generated in an image. They will also be introduced to the process of biomedical imaging agent development from target identification through imaging probe design, synthesis, evaluation, and regulatory approval. This course will rely heavily on the scientific literature and will culminate in a final project in which students will apply knowledge from organic chemistry, inorganic chemistry, analytical chemistry, and biochemistry coursework towards designing their own biomedical imaging agent for a specific disease.

Miscellaneous courses

Foundations of Chemistry (CHEM 001, 3 X 65 minutes, fall 4 units), not currently offered
This course is designed for students who did not place into Chem 111 (General Chemistry I) and is a 4-unit lecture course that reviews high school chemistry and problem-solving techniques, with emphasis on weekly problem sets and in-class problem solving. A change in Biology Department advising guidelines caused enrollment in this course to plummet, so this course has not been offered since fall 2018, despite the fact that numerous students would benefit from it.

Molecular Gastronomy: The Science of the Food We Eat (CHEM 110, Spector, 3x65 min, 2 hr lab)
This course has not been taught since 2012. It fulfills the Core B2 Science requirement and is intended for non-science majors. It is taught by Spector without TAs, and it enrolls 16-18 students. The intention of this course is to employ the students' natural interest in food to engage them in science (primarily chemistry) and contemporary issues related to food consumption and policy in the U.S. The course is

structured so that each week students learn about a particular aspect of food science in lecture, do a lab related to the week's scientific topic, and discuss assigned readings from Michael Pollan's Omnivore's Dilemma.

Appendix B. Student Research Presentations

PRESENTATIONS BY MASTERS STUDENTS

STUDENT	FACULTY	TYPE	MEETING, DATE	PRESENTATION TITLE
[redacted]	Nikolayevskiy	poster	11th Annual Creative Activity and Research Day, University of San Francisco, May 2021	Covalent Inhibition Against Sortase A Activity in Staphylococcus aureus Bacteria
[redacted]	Nikolayevskiy	poster	261st ACS National Virtual Meeting, March, 2021.	Modulating the Cytotoxicity of DNA Alkylators through Intramolecular Deactivation.
[redacted]	Nikolayevskiy	poster	11th Annual Creative Activity and Research Day, University of San Francisco, May 2021	Modulating the Cytotoxicity of DNA Alkylators through Intramolecular Deactivation.
[redacted]	Nikolayevskiy	poster	260th ACS National Virtual Meeting, August, 2020.	Modulating cytotoxicity by tuning the instability of substituted azabicyclo[3.1.0]hexanes.
[redacted]	Nikolayevskiy	poster	10th Annual Creative Activity and Research Day, University of San Francisco, May 2020	Modulating cytotoxicity by tuning the instability of substituted azabicyclo[3.1.0]hexanes.
[redacted]	Stevenson	poster	11th Annual Creative Activity and Research Day, University of San Francisco, May 2021	Elucidating Calcitermin and Metal Interactions
[redacted]	Yang	poster	American Society of Biochemistry & Molecular Biology Meeting, San Diego, 2018	Nanodiscs, A Novel Approach to Study the Methionine ABC Transporter System
[redacted]	Yang	poster	American Society of Biochemistry & Molecular Biology Meeting, Orlando, CA, 2019	NaAtm1: Studying a Heavy-Metal ABC Transporter System
[redacted]	Evbuomwan	poster	258th ACS National Meeting, San Diego, August 2019	Effect of a coordinating pyridine moiety on the SAP
[redacted]	Evbuomwan	poster	9th Annual Creative Activity and Research Day, University of San Francisco, April 2019	Effect of a coordinating pyridine moiety on the SAP and TSAP isomer populations of bimodal Lanthanide (III) complexes
[redacted]	Meloni	poster	260th ACS National Virtual Meeting, San Francisco, CA, August, 2020.	Characterization of the DMM oxidation reaction via synchrotron radiation photoionization mass spectrometry
[redacted]	Meloni	poster	260th ACS National Virtual Meeting, San Francisco, CA, August, 2020.	Synchrotron Photoionization Study of the $O(^3P)$ + Alpha-Angelica Lactone (AAL) Reaction at 298, 550, and 700K
[redacted]	Meloni	poster	260th ACS National Virtual Meeting, San Francisco, CA, August, 2020.	Oxidation of Alpha-Pinene Initiated by $O(^3P)$ and Analyzed via Synchrotron photoionization
[redacted]	Meloni	poster	257th ACS National Meeting, Orlando, Florida, March 2019	Investigation of 2,5-Dimethylfuran Oxidation Reaction Initiated by $O(^3P)$ atoms via Synchrotron Photoionization
[redacted]	Meloni	poster	255th ACS National Meeting, New Orleans, March 2018	Synchrotron Photoionization Study of Furan and 2-Methylfuran Reactions with Methylidyne Radical (CH) at 298 K

[redacted]	Meloni	poster	255th ACS National Meeting, New Orleans, March 2018	Reduction of CO_2 and N_2 using the Li_3F_2 superalkali
[redacted]	Meloni	poster	253rd ACS National Meeting, San Francisco, April 2017	Photoionization Cross Sections of Three Propargylic Fuels
[redacted]	Meloni	poster	253rd ACS National Meeting, San Francisco, April 2017	Synchrotron Multiplexed Photoionization Mass Spectrometry of Cl-Initiated Oxidation of Tetrahydropyrane (THP) at 298, 550, and 650 K
[redacted]	Meloni	poster	253rd ACS National Meeting, San Francisco, April 2017	Cl-Initiated Oxidation of Propargylamine via Synchrotron Multiplexed Photoionization Mass Spectrometry
[redacted]	Meloni	poster	253rd ACS National Meeting, San Francisco, April 2017	Photoionization and Photodissociation of Xylyl (Methylbenzyl) Bromide Radicals using VUV Synchrotron Radiation
[redacted]	Meloni	poster	Pacific Conference on Spectroscopy and Dynamics, Asilomar, CA, Jan. 2017	Synchrotron Photoionization Study of 2-Methy-3-Buten-2-O (MBO) Oxidation Initiated by $O(^3P)$ Atoms
[redacted]	Meloni	poster	Pacific Conference on Spectroscopy and Dynamics, Asilomar, CA, Jan. 2017	Absolute Photoionization Cross Sections of Two Cyclic Ketones: Cyclopentanone and Cyclohexanone
[redacted]	Meloni	poster	251st ACS National Meeting, San Diego, March 2016	Furfural: Unimolecular photodissociation reaction of the simplest furanic aldehyde
[redacted]	Meloni	poster	Dynamics of Molecular Collisions XXV," Asilomar, Pacific Grove, California, July 12 – 17, 2015	Dissociative Photoionization of Ethylenediamine
[redacted]	Meloni	poster	249th ACS National Meeting," Denver, Colorado, March 22 – 26, 2015	The Study of Low Temperature Oxidation Reactions of 2-Methylfuran using Photoionization Mass Spectrometry
[redacted]	Meloni	poster	248th ACS National Meeting, San Francisco, August 2014	Low temperature oxidation of isooctane using synchrotron photoionization mass spectroscopy
[redacted]	Meloni	poster	248th ACS National Meeting, San Francisco, August 2014	FTIR analysis of biofuel and aerosol interactions
[redacted]	Meloni	poster	247th ACS National Meeting," Dallas, Texas, March 2014	Investigation of Oxidation Reaction Products of 2-Phenylethanol using Synchrotron Photoionization
[redacted]	Meloni	poster	44th Western ACS Regional Meeting, Santa Clara, CA, October 2013	Oxidation reactions of methyl and ethyl formate with chlorine radicals using photoionization mass spectrometry
[redacted]	Meloni	poster	44th Western ACS Regional Meeting, Santa Clara, CA, October 2013	Combustion Products of Ethyl Tert-Butyl Ether using Synchrotron Photoionization
[redacted]	Meloni	poster	245th ACS National Meeting, New Orleans, April 2013	Experimental study on the reactions of three furans with the methylidyne (CH) radical utilizing

				synchrotron photoionization mass spectrometry
[redacted]	Meloni	poster	60th Annual Western Spectroscopy Association Conference, Asilomar Conference Center, Pacific Grove, CA, Jan. 2013	CH (X^2P) + Furans (F, MF, DMF) Characterization via Synchrotron Photoionization Mass Spectrometry

PRESENTATIONS BY UNDERGRADUATE RESEARCH STUDENTS

STUDENT	FACULTY	TYPE	MEETING, DATE	PRESENTATION TITLE
[redacted]	Nikolayevskiy	poster	260th ACS National Virtual Meeting, San Francisco, CA, August, 2020.	Synthesis of sultams from vinyl aziridines and 1,4-diazabicyclo[2.2.2]octane bis(sulfur dioxide).
[redacted]	Nikolayevskiy	poster	10th Annual Creative Activity and Research Day, University of San Francisco, May 2020	Synthesis of sultams from vinyl aziridines and 1,4-diazabicyclo[2.2.2]octane bis(sulfur dioxide).
[redacted]	Nikolayevskiy	poster	10th Annual Creative Activity and Research Day, University of San Francisco, May 2020	Optimizing the Synthesis of a Theranostic Rhodamine
[redacted]	Nikolayevskiy	poster	10th Annual Creative Activity and Research Day, University of San Francisco, May 2020	Synthesis of Self-Immolative Rhodamine Based Theranostic Agent
[redacted]	Yang	poster	American Society of Biochemistry & Molecular Biology Meeting, Orlando, CA, 2019	Examining the Bacterial Methionine Transporter Utilizing Soluble Lipid Bilayer Systems
[redacted]	Yang	poster	American Society of Biochemistry & Molecular Biology Meeting, Orlando, CA, 2019	Heavy Metal Transport by the ABC transporter Atm1
[redacted]	Yang	poster	30th Annual ACS Northern California Undergrad Research Symposium, Mills College, April 2018	Examining the Bacterial Methionine Transporter Utilizing Soluble Lipid Bilayer Systems
[redacted]	Yang	poster	30th Annual ACS Northern California Undergrad Research Symposium, Mills College, April 2018	Heavy Metal Transport by the ABC transporter Atm1
[redacted]	Evbuomwan	poster	31st Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 2019	Impact of Quinoline Amide Substituents on the Luminescence and PARACEST MRI properties of Bimodal Europium (III) Complexes
[redacted]	Evbuomwan	poster	31st Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 2019	Investigating the Impact of Bound-Water Exclusion on the PARACEST MRI and Optical Properties of Lanthanide (III) Complexes
[redacted]	Evbuomwan	poster	31st Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 2019	Synthesis of a Zn(II)-Responsive ParaCEST MRI Agent for Improved Diagnosis of Prostate Cancer
[redacted]	Evbuomwan	poster	9th Annual Creative Activity and Research Day, University of San Francisco, April 2019	Investigating the Impact of Bound-Water

				Exclusion on the PARACEST MRI and Optical Properties of Lanthanide (III) Complexes
[redacted]	Evbuomwan	poster	9th Annual Creative Activity and Research Day, University of San Francisco, April 2019	Impact of Quinoline Amide Substituents on the Luminescence and PARACEST MRI properties of Bimodal Europium (III) Complexes
[redacted]	Evbuomwan	poster	9th Annual Creative Activity and Research Day, University of San Francisco, April 2019	Synthesis of a Zn(II)-Responsive ParaCEST MRI Agent for Improved Diagnosis of Prostate Cancer
[redacted]	Meloni	poster	251st ACS National Meeting, San Diego, March 2016	Furfural: Unimolecular photodissociation reaction of the simplest furanic aldehyde
[redacted]	Meloni	poster	248th ACS National Meeting, San Francisco, August 2014	Room temperature Cl-initiated oxidation of furfural
[redacted]	Meloni	poster	247th ACS National Meeting," Dallas, Texas, March 2014	Dissociative Dynamics of Furfural
[redacted]	Meloni	poster	44th Western ACS Regional Meeting, Santa Clara, CA October 2013	Characterization of Isobutanol + OH Reaction at Room Temperature via Multiplexed Photoionization Mass Spectrometry
[redacted]	Meloni	poster	44th Western ACS Regional Meeting, Santa Clara, CA October 2013	Imaging Photoelectron Photoion Coincidence (i-PEPICO) Investigation of Furfural
[redacted]	Meloni	poster	44th Western ACS Regional Meeting, Santa Clara, CA October 2013	Hypervalence in Monoxides and Dioxides of Superalkali Clusters
[redacted]	Meloni	poster	25th Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 2013	Combustion of Methylidyne Radical CH (X^2P) with 2-Methylfuran
[redacted]	Meloni	poster	245th ACS National Meeting, New Orleans, April 2013	Investigation of low-temperature oxidation reactions of 2-phenylethanol using photoionization mass spectrometry
[redacted]	Karney	poster	11th Annual Creative Activity and Research Day, University of San Francisco, May 2021	Barrier Width and Tunneling Probability in Dynamic Processes of Fluorinated Cyclooctatetraenes
[redacted]	Karney	poster	11th Annual Creative Activity and Research Day, University of San Francisco, May 2021	Effect of Tunneling on 6-Electron Electrocyclic Ring Closures
[redacted]	Karney	poster	11th Annual Creative Activity and Research Day, University of San Francisco, May 2021	Computational Study of Tunneling in the Electrocyclic Reactions of Helical Systems
[redacted]	Karney	poster	11th Annual Creative Activity and Research Day, University of San Francisco, May 2021	Probability of Quantum Tunneling in Intramolecular Diels-Alder Reactions
[redacted]	Karney, Castro	talk	31st Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 2019	Tunneling By 16 Carbons: Planar Bond Shifting in [16]Annulene

[redacted]	Karney, Castro	poster	9th Annual Creative Activity and Research Day, University of San Francisco, April 2019	Heavy-Atom Tunneling in the Planar Bond Shifting of [16]Annulene
[redacted]	Karney, Castro	poster	257th ACS National Meeting, Orlando, FL, April 2019	Heavy-Atom Tunneling in the Planar Bond Shifting of [16]Annulene
[redacted]	Karney, Castro	poster	30th Annual ACS Northern California Undergrad Research Symposium, Mills College, April 2018	Heavy-Atom Tunneling in Conformational and Degenerate Bond Shift Reactions of [10]Annulene
[redacted]	Karney, Castro	poster	30th Annual ACS Northern California Undergrad Research Symposium, Mills College, April 2018	Computational Study of Heavy Atom Tunneling in the Möbius π-Bond Shifting in [16]Annulene
[redacted]	Karney, Castro	poster	30th Annual ACS Northern California Undergrad Research Symposium, Mills College, April 2018	Heavy Atom Tunneling in Hückel π-Bond Shifting in [14]Annulene
[redacted]	Karney, Castro	talk	30th Annual ACS Northern California Undergrad Research Symposium, Mills College, April 2018	Heavy Atom Tunneling in the Planar π-Bond Shifting in [16]Annulene
[redacted]	Karney, Castro	poster	8th Annual Creative Activity and Research Day, University of San Francisco, April 2018	Computational Study of Heavy Atom Tunneling in the Möbius π-Bond Shifting in [16]Annulene
[redacted]	Karney, Castro	poster	8th Annual Creative Activity and Research Day, University of San Francisco, April 2018	Heavy Atom Tunneling in Hückel π-Bond Shifting in [14]Annulene
[redacted]	Karney, Castro	poster	255th ACS National Meeting, New Orleans, March 2018	Computational Study of Heavy Atom Tunneling in the Möbius π-Bond Shifting in [12]- and [16]Annulene
[redacted]	Karney, Castro	poster	29th Annual ACS Northern California Undergrad Research Symposium, San Jose State University, May 2017	Computational Study of Heavy Atom Tunneling in the Möbius π-Bond Shifting in [12]- and [16]Annulene
[redacted]	Karney, Castro	poster	253rd ACS National Meeting, San Francisco, CA, April 2017	Computational Study of Heavy Atom Tunneling in the Möbius π-Bond Shifting in [12]- and [16]Annulene
[redacted]	Karney, Castro	talk	28th Annual ACS Northern California Undergrad Research Symposium, St. Mary's College of California, April 2016	Computational Study of Stone–Wales Rearrangements in Hydrocarbons with Pyracyclene Cores
[redacted]	Karney, Castro	talk	28th Annual ACS Northern California Undergrad Research Symposium, St. Mary's College of California, April 2016	Computational Analysis of Radical-Induced Hydrogen Shifts in Polycyclic Aromatic Hydrocarbons
[redacted]	Karney, Castro	talk	6th Annual Creative Activity and Research Day, University of San Francisco, April 2016	Computational Study of Stone–Wales Rearrangements in Hydrocarbons with Pyracyclene Cores
[redacted]	Karney, Castro	talk	6th Annual Creative Activity and Research Day, University of San Francisco, April 2016	Hydrogen Shifts of Aryl Radicals

[redacted]	Karney, Castro	poster	27th Annual ACS Northern California Undergrad Research Symposium, UC Santa Cruz, May 2015	Computational Analysis of Monomethylated and Dimethylated Hückel and Möbius [16]Annulenes
[redacted]	Karney, Castro	talk	27th Annual ACS Northern California Undergrad Research Symposium, UC Santa Cruz, May 2015	Computational Study on the High Temperature Isomerization of Phenanthrene
[redacted]	Karney, Castro	poster	5th Annual Creative Activity and Research Day, University of San Francisco, April 2015	Computational Analysis of Monomethylated and Dimethylated Hückel and Möbius [16]Annulenes
[redacted]	Karney, Castro	poster	5th Annual Creative Activity and Research Day, University of San Francisco, April 2015	Computational Study on the High Temperature Isomerization of Phenanthrene
[redacted]	Karney, Castro	poster	249th ACS National Meeting, Denver, March 2015	Computational Analysis of Monomethylated and Dimethylated Hückel and Möbius [16]Annulenes
[redacted]	Karney, Castro	poster	249th American Chemical Society National Meeting, Denver, March 2015	Computational Study on the High Temperature Isomerization of Phenanthrene
[redacted]	Karney, Castro	poster	26th Annual ACS Northern California Undergrad Research Symposium, University of San Francisco, May 2014	Computational Study on the Effect of Methyl Substitution on Planar vs. Möbius Conformational Preferences in Annulenes
[redacted]	Karney, Castro	poster	44th American Chemical Society Western Regional Meeting, Santa Clara, CA, Oct. 2013	Computational Investigation of Stone–Wales Isomerization in Polycyclic Aromatic Hydrocarbons
[redacted]	Karney, Castro	poster	245th ACS National Meeting, New Orleans, April 2013	Circuital Patterns: Pi-Bond Shifting in Medium-Sized Dehydroannulenes via Möbius and Hückel Topologies
[redacted]	Karney, Castro	poster	25th Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 2013	Circuital Patterns: Pi-Bond Shifting in Medium-Sized Dehydroannulenes via Möbius and Hückel Topologies
[redacted]	Karney, Castro	poster	3rd Annual Creative Activity and Research Day, University of San Francisco, April 2013	Circuital Patterns: Pi-Bond Shifting in Medium-Sized Dehydroannulenes via Möbius and Hückel Topologies
[redacted]	Karney, Castro	poster	245th ACS National Meeting, New Orleans, April 2013	Computational Study of High-Temperature Rearrangements of Phenylenes
[redacted]	Karney, Castro	poster	25th Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 4, 2013	Computational Study of High-Temperature Rearrangements of Phenylenes
[redacted]	Karney, Castro	poster	3rd Annual Creative Activity and Research Day, University of San Francisco, April 2013	Computational Study of High-Temperature Rearrangements of Phenylenes
[redacted]	Karney, Castro	poster	245th ACS National Meeting, New Orleans, April 2013	Polycyclic Aromatic Hydrocarbon Rearrangements Under High Temperature and Flash Vacuum Pyrolysis

[redacted]	Karney, Castro	poster	25th Annual ACS Northern California Undergrad Research Symposium, Santa Clara University, May 2013	Polycyclic Aromatic Hydrocarbon Rearrangements Under High Temperature and Flash Vacuum Pyrolysis
[redacted]	Karney, Castro	poster	3rd Annual Creative Activity and Research Day, University of San Francisco, April 2013	Polycyclic Aromatic Hydrocarbon Rearrangements Under High Temperature and Flash Vacuum Pyrolysis
[redacted]	Karney, Castro	poster	24th Annual Northern California ACS Undergrad Research Symposium, Mills College, Oakland, CA, April 2012	Polycyclic Aromatic Hydrocarbon Rearrangements Under High Temperature and Flash Vacuum Pyrolysis
[redacted]	Karney, Castro	talk	24th Annual Northern California ACS Undergrad Research Symposium, Mills College, Oakland, CA, April 2012	Rearrangements in Biphenylene and [3]Phenylene via Diradical Mechanisms
[redacted]	Karney, Castro	poster	2nd Day of Celebration of Students' Research and Artistic Scholarly Creative Activity, University of San Francisco, April 2012	Polycyclic Aromatic Hydrocarbon Rearrangements Under High Temperature and Flash Vacuum Pyrolysis
[redacted]	Karney, Castro	poster	2nd Day of Celebration of Students' Research and Artistic Scholarly Creative Activity, University of San Francisco, April 2012	Rearrangements in Biphenylene and [3]Phenylene via Diradical Mechanisms

Appendix C. Faculty Bios

Osasere Evbuomwan, Associate Professor and Associate Dean for Sciences and Engineering, received her BS in Chemistry with a minor in Mathematics from Lewis-Clark State College in Lewiston, Idaho in May 2006. Later that year, she joined the chemistry program at the University of Texas at Dallas where she received her PhD in Chemistry under the supervision of A. Dean Sherry. Dr. Evbuomwan spent an additional year at UT Dallas as a postdoctoral research associate after which she was selected as one of ten Madrid-MIT M+Vision Postdoctoral Research Fellows at MIT. In 2015, she began a tenure-track faculty position at Gonzaga University where she taught a variety of upper and lower division courses in Chemistry and performed research with undergraduates in the field of Biomedical Imaging.

At USF, Dr. Evbuomwan's research endeavors are primarily focused on the development of Magnetic Resonance Imaging (MRI) and Optical Imaging agents for prostate cancer diagnosis, and image-guided tumor resection. All projects span inorganic chemistry, organic chemistry, analytical chemistry, and biomedical imaging, and introduce students to the interdisciplinary nature of research. In addition to synthesizing multi-dentate ligands and their corresponding lanthanide complexes, students will become familiar with common analytical techniques such as NMR, HPLC, MS, luminescence, and UV-Vis spectrophotometry.

Shreyashi Ganguly, Term Assistant Professor, received her Ph.D. in Inorganic Chemistry (Material Science) from Wayne State University, Detroit, Michigan. She then completed her postdoctoral studies from University of California, Davis and University of Minnesota, Minneapolis, in Material Chemistry. In 2016, she began her tenure track position of Chemistry at Northwestern State University, Natchitoches, Louisiana and in 2019, she joined Texas A & M University, Corpus Christi as a Professional Assistant Professor of Chemistry. At these universities, she taught various courses such as General Chemistry I and II, Descriptive Inorganic Chemistry and Advanced Inorganic Chemistry lecture and laboratories. She also had her own research group/laboratory where her research group focused on synthesizing novel nanomaterials for renewable energy applications.

Currently at USF, Dr. Ganguly is teaching General Chemistry I and II lecture and laboratories and in the following semesters, along with General Chemistry courses, she will be teaching Analytical Chemistry lecture and laboratory. Dr. Ganguly's research interests include synthesizing novel nanomaterials for renewable energy applications such as photovoltaics, electrocatalysis and thermoelectrics.

William Karney, Professor, received his B.A. in Chemistry from Haverford College and his PhD in Organic Chemistry from the University of California, Los Angeles. He did postdoctoral work at the University of Washington and the University of California, Berkeley. At USF, William teaches organic chemistry and environmental chemistry. His research, performed in collaboration with Prof. Claire Castro, involves the use of computational chemistry to understand the structures, energetics, and properties of organic compounds and the mechanisms of organic reactions. Recent projects include the elucidation of mechanisms for dynamic processes in annulenes and high-temperature rearrangements of polycyclic aromatic hydrocarbons (PAHs), and the contribution of heavy-atom tunneling to organic reactions.

Giovanni Meloni, Professor, received his Ph.D. from the Universita' di Roma, La Sapienza. Prior to joining the University of San Francisco, Dr. Meloni carried out postdoctoral research at the University of California, Berkeley and at Sandia National Laboratories. In his research, he employed state-of-the-art experimental and computational techniques, to study semiconductor clusters, van der Waals species, and hydrocarbon radicals. Dr. Meloni's interests range from high-temperature physical chemistry to spectroscopic characterization of reaction intermediates. More recently, his research group performs experiments at the Advanced Light Source of Lawrence Berkeley National Laboratory using a multiplex photoionization mass spectrometer to investigate biofuel molecules combustion and atmospheric reactions.

Herman Nikolayevskiy, Assistant Professor, received his BE in Chemical Engineering from Cooper Union, a primarily-undergraduate institution in the heart of NYC. After a transformative undergraduate research experience, Herman was inspired to pursue a PhD in Organic Chemistry at Yale University, where he focused on the total synthesis and computational analysis of bioactive natural products under Professor Seth B. Herzon. After leaving New Haven, Herman did his postdoctoral work at the National Institutes of Health (NIH) with Dr. Daniel H. Appella, where he employed NMR spectroscopy to study the mechanism of action of thioester-based HIV inhibitors.

At USF, the Nikolayevskiy group leverages its expertise in synthetic chemistry and mechanistic analysis to explore the therapeutic potential of molecular "off-switches" as a strategy for increasing the tolerability of anticancer chemotherapies. Students in the group will develop novel methodologies for the efficient synthesis of programmable, bioactive molecules and probe their kinetic and thermodynamic tunability using biophysical techniques. This work has the potential to expand the repertoire of clinically available cytotoxins, and may be useful in related areas of interest, including logic-gated polymers and molecular diagnostics.

Aleksandra Dimitrijevic Samenov, Term Assistant Professor, received her B.S. and Ph.D. in Biochemistry from the Faculty of Chemistry, University of Belgrade, Serbia. For her thesis work she investigated activity and stability of microbial enzymes and their application in non aqueous catalysis. After graduate school she first completed a short training in proteomics and MALDI imaging mass spectrometry at INRA-Angers-Nantes Centre, France and then joined the lab of Dr. Dana Aswad at UC Irvine, for her postdoctoral work, where she studied protein aging and repair in mouse brain. She served as a lecturer at UC Merced from 2017-2021 where she taught Biochemistry and Cell Biology.

At USF, Aleksandra teaches General Chemistry and Biochemistry. Her research interests include aging and repair of microbial proteins as well as chemistry and biochemistry education research.

Michael Stevenson, Assistant Professor, received his BS in Biochemistry from the University of Washington. After getting experience in teaching and research during his gap years, he attended Dartmouth College and received his Ph.D. in Chemistry. For his thesis work, he studied the thermodynamics of copper and other metal ions binding to the metallochaperone HAH1 and its homologues. After graduate school he first completed postdoctoral work at Ohio State University where he made a light-driven artificial hydrogenase mimic. Afterwards, he focused on understanding the role of metal ions in modulating peptide hormones in his second postdoctoral appointment at the University of California, Davis.

At USF, the Stevenson Group studies the interplay between antimicrobial peptides (AMPs) and metal ions. AMPs are part of the innate immune system and one of the oldest forms of protection against pathogens. Students in the group will learn peptide biochemistry, coordination chemistry, spectroscopy, and calorimetry to elucidate how metal ions may influence AMPs. This bioinorganic research will help provide the foundation for rational design of new, innovative therapeutics for treatment of bacterial infections as alternatives to traditional antibiotics.

Tami Spector, Professor, received her B.A. from Bard College, her Ph.D. from Dartmouth College, and was a postdoctoral researcher at the University of Minnesota. She teaches Organic Chemistry I and II, Organic Laboratory I and II, Advanced Organic Synthesis, Advanced Organic Lab, and Molecular Gastronomy: The Science of the Food We Eat. Trained as a physical organic chemist, her scientific work has focused on fluorocarbons, the transformations of strained ring organics, and the molecular dynamics and free energy calculations of biomolecular systems. She also has a strong interest in aesthetics and chemistry and has published and presented work on The Molecular Aesthetics of Disease, John Dalton and The Aesthetics of Molecular Representation, The Visual Image of Chemistry, and the Relationship between Chemistry and Contemporary Visual Art. She serves on the board of Leonardo/International Society for the Arts, Sciences and Technology and as the treasurer for the International Society for the Philosophy of Chemistry (ISPC). She is on of Leonardo/ISAST governing and editorial boards, co-hosts the San Francisco based Leonardo Arts Sciences Evening Rendezvous' (LASERs), and serves as the editor of the on-going special section "Art and Atoms" for Leonardo Journal.

Janet Yang, Assistant Professor, received her BS from Yale University and then promptly headed for the West Coast. She attended the University of California San Francisco for her PhD in Biochemistry, and then did her postdoctoral work at the California Institute of Technology. Prof. Yang has always been fascinated by molecular motor proteins that harness the energy from ATP binding and hydrolysis to perform work in the cell. Her research uses quantitative thermodynamic and kinetic measurements to understand how these motor proteins function and how they are regulated.

At USF, the Yang Group studies the mechanism of ATP Binding Cassette (ABC) transporters, specialized integral membrane proteins that regulate the movement of substrates across cellular membranes. These transporters must sequester and import essential nutrients with low availability, as well as identify and exclude toxic compounds. Using a variety of biochemical and biophysical techniques, studies focus on the coupling of ATP binding and hydrolysis to transport, the regulation of individual ABC transporters, and the interconnection between transporter systems within one cell.

Appendix F. Alumni Survey Results

Below are the results of a survey sent to our **BS graduates** since 2012. The survey was conducted between 2017 and 2019. Overall 50 students responded.

Q1. I completed (or will complete) my USF degree with a:		
Answer Options:	Response Count	Percentage
BS Chemistry	11	22.0%
BS Chemistry-ACS certified	13	26.0%
BS Chemistry with Biochemistry Concentration	17	34.0%
BS Chemistry with Biochemistry Concentration-ACS certified	3	6.0%
BS Chemistry with Medicinal/Synthetic Concentration	6	12.0%
BS Chemistry with Medicinal/Synthetic Concentration-ACS certified	0	—
answered question	50	100%
skipped question	0	—

Q2. What have you done since leaving USF? Check all items that apply to you:		
Answer Options:	Response Count	Percentage
Graduate School in Chemistry, Biochemistry or Science related field	17	26.2%
Medical School	2	3.1%
Pharmacy or other health related graduate school	11	16.9%
Position in a chemistry/biochemistry related industry	23	35.4%
Position in other industry	8	12.3%
K-12 Teaching	2	3.1%
Community College or University teaching	0	—
Work in non-profit company	2	3.1%
answered question	50	100%
skipped question	0	—

Q3. I feel my technical training and education at USF were at least equal to that of my peers who graduated from other institutions.		
Answer Options:	Response Count	Percentage
Strongly agree	29	58.0%
Slightly agree	17	34.0%
Neutral	2	4.0%
Slightly disagree	1	2.0%
Strongly disagree	1	2.0%
answered question	50	100%
skipped question	0	—

The American Chemical Society has identified a set of skills needed to become successful science professionals: These skills, which can also be termed process skills, soft skills, or employability skills, share the characteristics that they are generic and transferable, are marketable and lifelong, and have wide applications that go beyond course content alone (this and the skills cited below are from ACS publication CNBP_025490). Please read the descriptions and rank each skill with regard to your USF Chemistry experience from coursework, labs, research or informal interactions with the faculty and staff in the department (if you were a TA at USF, include this training/experience also).

Q4. Problem-Solving Skills **Students should be able to apply the scientific method: define a problem clearly, develop testable hypotheses, design and execute experiments, analyze data, and draw appropriate conclusions. Examinations should be constructed to encourage the synthesis of a variety of concepts in solving problems while discouraging rote memorization. Students should be able to integrate knowledge across chemical sub-disciplines and apply this knowledge to solve problems. In the laboratory, they should understand the use of statistical methods and the fundamental uncertainties in experimental measurements.**		
Answer Options:	Response Count	Percentage
Very high development	22	45.8%
Good development	23	47.9%
Adequate development	3	6.3%
Little or no development	0	—
answered question	48	100%
skipped question	2	—

Q5. Communication Skills **Students should have a variety of writing experiences, not limited to laboratory reports. They should be able to synthesize information from a variety of sources in a clear and organized manner using a scientifically appropriate style (written and oral). Students should be able to use technology, such as presentation software, word processing/graphics, spreadsheets, and chemical-structure drawing in written, oral or poster formats.**		
Answer Options:	Response Count	Percentage
Very high development	26	54.2%
Good development	18	37.5%
Adequate development	4	8.3%
Little or no development	0	—
answered question	48	100%
skipped question	2	—

Q6. Chemical Literature Skills **Students should be able to retrieve specific information from the chemical literature, evaluate technical articles critically and use the peer-reviewed scientific literature effectively. They should be comfortable in using SciFinder/Chemical Abstracts and other compilations.**		
Answer Options:	Response Count	Percentage
Very high development	21	43.8%
Good development	18	37.5%
Adequate development	9	18.8%
Little or no development	0	—
answered question	48	100%
skipped question	2	—

Q7. Laboratory Safety Skills **A high degree of safety awareness should begin with the first laboratory course and includes understanding safety and dress rules; knowing when to use fume hoods; the use of safety/emergency equipment; handling, storage, and disposal of chemical waste; understanding and use of material safety data sheets; awareness of OSHA requirements; and, in general, knowing how to handle laboratory emergencies effectively.**		
Answer Options:	Response Count	Percentage
Very high development	26	54.2%
Good development	21	43.8%
Adequate development	1	2.1%
Little or no development	0	—
answered question	48	100%
skipped question	2	—

Q8. Team Skills

Solving scientific problems often involves working in teams. Students should learn to work productively with a diverse group of peers; and should be able to lead portions of an activity or be effective followers, as dictated by the situation.		
Answer Options:	Response Count	Percentage
Very high development	30	62.5%
Good development	15	31.3%
Adequate development	3	6.3%
Little or no development	0	—
answered question	48	100%
skipped question	2	—

Q9. Ethics **Progress in chemistry, as in all sciences, relies on complete honesty, openness, and trustworthiness of chemists, and on reproducibility of experimental results. Students should display high personal standards and integrity, conduct themselves responsibly, and be aware of contemporary issues related to chemistry.**		
Answer Options:	Response Count	Percentage
Very high development	29	61.7%
Good development	15	31.9%
Adequate development	3	6.4%
Little or no development	0	—
answered question	47	100%
skipped question	3	—

Q10. Looking back on your USF experience, what additional emphasis or new electives do you think should be part of a Chemistry curriculum (choose three or fewer)?		
Answer Options:	Response Count	Percentage
Solar and alternative energies	14	10.9%
Medicinal or pharmaceutical chemistry	33	25.6%
Solid-state materials (semiconductors, crystal structures, etc.)	14	10.9%
Environmental chemistry	18	14.0%
Green chemistry	16	12.4%
Quality control/quality assurance	14	10.9%
Nano-chemistry	10	7.8%
Separations	5	3.9%
Bio-analytical	11	8.6%
answered question	48	100%
skipped question	2	—

Q11. Overall, I feel very positive about my experience in the Chemistry program at USF.		
Answer Options:	Response Count	Percentage

Strongly agree	28	59.6%
Slightly agree	15	31.9%
Neutral	3	6.4%
Slightly disagree	0	—
Strongly disagree	1	2.1%
answered question	47	100%
skipped question	3	—

Below are the results of a survey sent to our **MS graduates** since 2012. The survey (n=13) was conducted between 2017 and 2019.

Q1. What have you done since leaving USF? Check all items that apply to you:		
Answer Options:	Response Count	Percentage
Graduate School in Chemistry, Biochemistry or Science related field	4	25.0%
Medical School	0	—
Pharmacy or other health related graduate school	0	—
Position in a chemistry/biochemistry related industry	9	56.3%
Position in other industry	0	—
K-12 Teaching	0	—
Community College or University teaching	2	12.5%
Work in non-profit company	1	6.3%
answered question	13	100%
skipped question	0	—

Q2. I feel my technical training and education at USF were at least equal to that of my peers who graduated from other institutions.		
Answer Options:	Response Count	Percentage
Strongly agree	8	61.5%
Slightly agree	5	38.5%
Neutral	0	—
Slightly disagree	0	—
Strongly disagree	0	—
answered question	13	100%
skipped question	0	—

The American Chemical Society has identified a set of skills needed to become successful science professionals: These skills, which can also be termed process skills, soft skills, or employability skills, share the characteristics that they are generic and transferable, are marketable and lifelong, and have wide applications that go beyond course content alone (this and the skills cited below are from ACS publication CNBP_025490). Please read the descriptions and rank each skill with regard to your USF Chemistry experience from coursework, labs, research or informal interactions with the faculty and staff in the department (if you were a TA at USF, include this training/experience also).

Q3. Problem-Solving Skills Students should be able to apply the scientific method: define a problem clearly, develop testable hypotheses, design and execute experiments, analyze data, and draw appropriate conclusions. Examinations should be constructed to encourage the synthesis of a variety of concepts in solving problems while discouraging rote memorization. Students should be able to integrate knowledge across chemical sub-disciplines and apply this knowledge to solve problems. In the laboratory, they should understand the use of statistical methods and the fundamental uncertainties in experimental measurements.		
Answer Options:	Response Count	Percentage
Very high development	5	38.5%
Good development	7	53.8%
Adequate development	1	7.7%
Little or no development	0	—
answered question	13	100%
skipped question	0	—

Q4. Communication Skills Students should have a variety of writing experiences, not limited to laboratory reports. They should be able to synthesize information from a variety of sources in a clear and organized manner using a scientifically appropriate style (written and oral). Students should be able to use technology such as presentation software, word processing/graphics, spreadsheets, and chemical-structure drawing in written, oral or poster formats.		
Answer Options:	Response Count	Percentage
Very high development	4	30.8%
Good development	8	61.5%
Adequate development	1	7.7%
Little or no development	0	—
answered question	13	100%
skipped question	0	—

Q5. Chemical Literature Skills

Students should be able to retrieve specific information from the chemical literature, evaluate technical articles critically and use the peer-reviewed scientific literature effectively. They should be comfortable in using SciFinder/Chemical Abstracts and other compilations.		
Answer Options:	Response Count	Percentage
Very high development	3	23.1%
Good development	8	61.5%
Adequate development	2	15.4%
Little or no development	0	—
answered question	13	100%
skipped question	0	—

Q6. Laboratory Safety Skills A high degree of safety awareness should begin with the first laboratory course and includes understanding safety and dress rules; knowing when to use fume hoods; the use of safety/emergency equipment; handling, storage, and disposal of chemical waste; understanding and use of material safety data sheets; awareness of OSHA requirements; and, in general, knowing how to handle laboratory emergencies effectively.		
Answer Options:	Response Count	Percentage
Very high development	5	38.5%
Good development	6	46.2%
Adequate development	2	15.4%
Little or no development	0	—
answered question	13	100%
skipped question	0	—

Q7. Team Skills Solving scientific problems often involves working in teams. Students should learn to work productively with a diverse group of peers; and should be able to lead portions of an activity or be effective followers, as dictated by the situation.		
Answer Options:	Response Count	Percentage
Very high development	8	61.5%
Good development	3	23.1%
Adequate development	2	15.4%
Little or no development	0	—
answered question	13	100%
skipped question	0	—

Q8. Ethics Progress in chemistry, as in all sciences, relies on complete honesty, openness, and trustworthiness of chemists, and on reproducibility of experimental results. Students should display high personal standards and integrity, conduct themselves responsibly, and be aware of contemporary issues related to chemistry.

Answer Options:	Response Count	Percentage
Very high development	9	69.2%
Good development	4	30.8%
Adequate development	0	—
Little or no development	0	—
answered question	13	100%
skipped question	0	—

Q9. Looking back on your USF experience, what additional emphasis or new electives do you think should be part of a Chemistry curriculum (choose three or fewer)?		
Answer Options:	Response Count	Percentage
Solar and alternative energies	7	18.9%
Medicinal or pharmaceutical chemistry	6	16.2%
Solid-state materials (semiconductors, crystal structures, etc.)	3	8.1%
Environmental chemistry	1	2.7%
Green chemistry	4	10.8%
Quality control/quality assurance	5	13.5%
Nano-chemistry	2	5.4%
Separations	3	8.1%
Bio-analytical	3	8.1%
Computational chemistry	2	5.4%
Spectroscopy	1	2.7%
answered question	13	100%
skipped question	0	—

Q10. Overall, I feel very positive about my experience in the Chemistry program at USF.		
Answer Options:	Response Count	Percentage
Strongly agree	9	69.2%
Slightly agree	3	23.1%
Neutral	1	7.7%
Slightly disagree	0	—
Strongly disagree	0	—
answered question	13	100%
skipped question	0	—

Q11. While pursuing my MS degree, concerns about finances interfered with my ability to concentrate on my studies/research.		
Answer Options:	Response Count	Percentage
Strongly agree	1	7.7%

Slightly agree	9	69.2%
Neutral	0	—
Slightly disagree	2	15.4%
Strongly disagree	1	7.7%
answered question	13	100%
skipped question	0	—

Q12. As an MS research student or TA, I made a positive impact in mentoring USF undergraduates in science research or courses.		
Answer Options:	Response Count	Percentage
Strongly agree	10	76.9%
Slightly agree	3	23.1%
Neutral	0	—
Slightly disagree	0	—
Strongly disagree	0	—
answered question	13	100%
skipped question	0	—

Q13. The MS degree was helpful in getting me a job or placement into graduate school.		
Answer Options:	Response Count	Percentage
Strongly agree	10	76.9%
Slightly agree	2	15.4%
Neutral	1	7.7%
Slightly disagree	0	—
Strongly disagree	0	—
answered question	13	100%
skipped question	0	—

Appendix G. Department Policies and By-Laws

Department Policy Regarding the Interaction of Faculty with Graduate and Undergraduate Research Students

The chemistry department at USF is a small community of scholars that encourages active collaborative undergraduate and graduate research with faculty members. We believe that part of a high quality research experience depends upon the professional and ethical conduct of the research faculty and students. Excellence in research is achieved when faculty and students are highly motivated by the work they are doing and respect one another's personal and professional goals. Chemistry faculty and research students must recognize that some types of behavior are offensive and harmful to others and that all of us have the right to expect high standards of behavior from one another. We should all strive to act responsibly and with sensitivity towards one another.

To this end, it is essential that research advisors:

- Conduct themselves in a mature, professional, and civil manner.
- Work respectfully with all faculty, students and staff regardless of race, gender, religion, sexual orientation, or national origin.
- Impartially evaluate student performance regardless of a student's race, gender, religion, sexual orientation, or national origin.
- Act in a manner that best serves the educational and professional needs of all of their research students.
- Attempt to maintain confidentiality in communication with research students regarding their research performance and interactions with other students.
- Prevent personal differences with students, other faculty or staff from interfering with their duties as a research advisor.
- Provide research students with a clear understanding of their research responsibilities, including weekly time commitments and timeline for completion of their research and thesis.
- Respect research students' need to allocate their time among competing demands.
- Refrain from asking students to attend to tasks not related to their academic or professional development.
- Make students aware that they can seek appropriate assistance for a grievance without threat of retaliation from themselves, another faculty member or administrator.

To this end, it is essential that students:

- Conduct themselves in a mature, professional, and civil manner.
- Work respectfully with all faculty, students and staff regardless of race, gender, religion, sexual orientation, or national origin.
- Take responsibility to inform themselves of the University regulations and policies governing their academic careers.
- Take responsibility for understanding laboratory protocols appropriate to their project and communicate with their research advisor before doing an experiment if they are unclear about a protocol.
- Come to an understanding with their research advisor regarding the time commitment associated with doing research.
- Recognize that their research advisor is responsible for monitoring the accuracy, validly, and integrity of their research.
- Understand that if they feel they are being mistreated, harassed, or discriminated against by

any member of the department, including their research advisor, that they have an obligation to report their misconduct. To do so the student must contact any other faculty member in the department about the situation with whom they feel comfortable speaking. He/she will then serve as an advocate for the student. If the student is willing, the faculty advocate will set up and mediate a meeting between the student and the faculty member that they feel behaved improperly. If the mediated meeting does not lead to a satisfactory solution for the student, or if the student is unwilling to meet with the faculty member they feel has mistreated, harassed or discriminated against them, they will instead be asked to speak with the department chair to determine an appropriate course of action. In all cases the faculty member who the student feels has behaved improperly and the chair of the department will be informed that the student has reported the misconduct, unless the student explicitly requests, in writing, that they not be informed.

USF Department of Chemistry By-Laws (Approved 04/04/08)

I. Objectives

The objectives of the Department of Chemistry shall be:

1. To plan, organize, and deliver a sound, up-to-date curriculum to students obtaining a Bachelor of Science degree in Chemistry or Chemistry with an emphasis in Biochemistry.
2. To prepare students obtaining a Bachelor of Science in Chemistry, Chemistry with an emphasis in Biochemistry, and Masters students in Chemistry and Biochemistry for a professional career in chemistry, or chemistry related field, upon graduation from USF.
3. To offer a curriculum that can fulfill the requirements for American Chemical Society certification of the
Bachelor's degree in Chemistry.
4. To offer courses in sufficient number and in a predictable rotation for students obtaining a Bachelor of Science Degree in Chemistry or Chemistry with an Emphasis in Biochemistry to be able to graduate within a four year (i.e., 8 semester) timeframe.
5. To offer a research based Masters program in chemistry and biochemistry.
6. To maintain a dynamic departmental environment where undergraduate and masters students can obtain experience working with faculty on substantial and meaningful research projects.
7. To maintain a collegial and safe environment for all members of the department, including faculty (full-time and part-time), staff and students.

II. Membership

All members of the USF Faculty Association in good standing who hold academic appointments in the Department of Chemistry and primarily teach courses for the Department of Chemistry are voting members of the department. Part-time faculty are welcome to attend Department meetings as visitors.

III. Chairperson

1. The chairperson shall serve a three-year term beginning July 1st unless negotiated otherwise by the incoming and outgoing chairperson.
2. The chair shall be elected by majority vote of the full-time faculty members in accordance with the USFFA Collective Bargaining Agreement [section 25.3]; voting shall be subject to a simple majority of the voting members. Absentee ballots will be allowed. Should no one candidate for chair receive a majority vote a run-off election shall be conducted between the two top candidates. Any member of the department can request that voting take place secretly and in writing.
3. The chairperson shall represent the majority view of the department in all dealings with the administration.
4. The department chairperson shall attempt to represent the majority view of the department at all COSEC and College Council meetings and report all pertinent information from these meetings to the department members. In cases when the department chair cannot be present at such meetings they will either ask another department member to attend in their stead and/or be responsible for gathering the minutes from the meeting for distribution to their department members.

5. The chairperson, in collaboration with the department members, shall prepare the schedule of classes for submission to the Dean. The chairperson will maintain a file of potential part-time faculty, interview part-time faculty for specific course openings and recommend such faculty to the Dean as the need arises.
6. The chairperson, in collaboration with the department members, shall prepare a yearly workload rotation that projects the workload for all members over a two-year timeframe.
7. The chairperson, in collaboration with the department members and departmental program assistant, shall be in charge of all departmental review documents, including the ACS annual program review, ACS 5-year program review, and external program reviews.
8. The chairperson, in collaboration with the Dean's office of Arts and Sciences shall be involved in interviewing all potential staff members for the department and recommend such staff to the Dean as the need arises.
9. The chairperson shall keep records of the departmental budget, keep the department informed of the available operating budget at each department meeting, and in consultation with appropriate faculty and staff, allocate funding for course related materials, departmental office supplies and, after discussion with the department, selected capital equipment.

IV. Department meetings

1. Department meetings shall be held once monthly during a semester, unless the chairperson determines that there are insufficient agenda items to warrant a meeting.
2. The chair shall solicit, in writing, agenda items from the department members. Agenda items shall be solicited sufficiently in advance of a scheduled department meeting.
3. Minutes shall be taken at all department meetings and distributed prior to the following department meeting.
4. Department policies shall be established at department meetings. For policies to be established a quorum must be present, where a quorum is a majority of the department. For items/policies where a vote of the membership is deemed necessary, as determined by any member of the faculty, members will vote verbally at a department meeting, unless any member of the department requests a secret, written ballot to be issued instead. All such items/policies will be established by simple majority vote.

V. Graduate Advisor

1. The graduate advisor shall be chosen by mutual agreement of the department and will serve a three-year term beginning July 1st, unless negotiated otherwise. Department members eligible to be graduate advisor shall be active participants in the graduate program.
2. The graduate advisor shall administer admissions to the graduate program including application file transfer from the admissions office to the department; routing applications to appropriate research directors; sending letters of acceptance and rejection to applicants; extending financial offers to accepted students; conducting phone interviews with accepted applicants to determine their ability to be a TA; overseeing the visa application processes.
3. The graduate advisor shall oversee the arrival of incoming graduate students including providing housing, registration, and financial information; providing an academic orientation session; administering and evaluating qualifying exams.

4. The graduate advisor shall monitor and mentor the students enrolled in the graduate program including
overseeing their timely progress through the program; serving as an advocate for them, individually and collectively; overseeing the disciplining and/or sanctioning of students who do not fulfill the academic requirements of the program or do not adhere to the policies regarding collegial conduct in the department; assisting students in seeking funds for professional development activities.

5. The graduate advisor shall maintain and enhance the graduate program by actively participating in recruitment efforts; administering maintenance of the University catalogue copy related to the program and the program website; seeking adequate funding for graduate students research and teaching assistantships.

VI. Amendments to By-Laws

The Department of Chemistry By-laws may be amended by a simple majority vote of the department.

VII. Subordination

No part of the Department of Chemistry By-laws or proceedings shall stand in contradiction to the constitution of the USFFA, the Collective Bargaining Agreement, the By-Laws of COSEC, or other published policies of the USFFA.