University of San Francisco

Chemistry Department

Self Study

February 2005

TABLE OF CONTENTS

1. INTRODUCTION

1.1 History and Mission

The Department of Chemistry has been offering an ACS accredited degree in chemistry for over 40 years and an ACS accredited degree with an emphasis in biochemistry for over 15 years. In addition it offers minor programs in both chemistry and biochemistry. Although USF is primarily an undergraduate institution, it has had an active, laboratory based, Masters Degree program for the past 50 years. Along with serving students whose studies focus on chemistry, the department supplies numerous service courses for other majors, including biology, exercise and sports science, environmental science and, until recently, nursing (often considered the pre-professional science programs). In the past 10 years, the department has also delivered five different general education or "core" courses for the non science major that help students understand the nature of the physical world, the uses of the scientific method, and the implications of technology.

The primary mission of the Department of Chemistry at the University of San Francisco is to educate, train and advise students in the theory and practice of chemistry within the context of a Jesuit Liberal Arts University.

To accomplish this mission the Department:

- Provides an extensive and challenging laboratory-based program leading to Bachelor of Science degrees in chemistry or in chemistry with a biochemistry emphasis.
- Offers a flexible curriculum that enables some majors to be fully accredited by the American Chemical Society.
- Offers a minor in chemistry or biochemistry for students in other departments who are interested in secondary science education or wish to pursue a health science career.
- Encourages and supports student research in chemistry and biochemistry that involves extensive interaction with faculty mentors.
- Supports and encourages research students to attend and present the results of their research at conferences and meetings.
- Provides a laboratory-based masters degree program with a written thesis for students seeking further training in analytical, biochemical, inorganic, organic or physical chemistry.
- Provides training to teaching assistants and research students in chemical safety and peer communication.
- Maintains an informal atmosphere in which student and teacher interactions are encouraged through course work, research projects and advising.
- Provides counseling regarding opportunities for graduate study, industrial careers or other avenues open to chemistry graduates.

1.2 The Faculty

The Chemistry Department has seven full-time tenured faculty, one special full term faculty member, and one tenured faculty member who is half time in both Chemistry and Computer Science. Three faculty members (Castro, Gruhn, and Spector) have received the University of San Francisco's Distinguished Teaching Award, two faculty (Cobley, Curtis) have received the University of San Francisco's Distinguished Research Award, and one faculty member (Jones) has received the Arthur Furst Research Award.

The specialties and teaching roles of the faculty are as follows:

Professor	Specialty	General Teaching Duties
Claire Castro	Organic Chemistry	Organic Chemistry lecture/lab; Chemistry of Drugs
John Cobley	Biochemistry	Biochemistry lecture/lab; Advances in Biochemistry; Core science course
Jeff Curtis	Inorganic/ Physical Chemistry	Inorganic Chemistry lecture/lab General Chemistry lecture/lab Integrated lab Physical Chemistry
Theodore Jones	Biochemistry	Biochemistry lecture/lab; Fundamentals of Biochemistry; Advances in Biochemistry; Core science course
Tom Gruhn	Physical Chemistry	General Chemistry lecture/lab; Physical Chemistry; Polymer Chemistry
Larry Margerum	Inorganic/ Analytical Chemistry	General Chemistry lecture/lab; Analytical Chemistry Inorganic Chemistry lecture/lab; Integrated lab
Willie Melaugh (full time term)	Medicinal Chemistry	General Chemistry lecture/lab; Organic Chemistry lecture/lab; Fundamentals of Organic Chemistry
Tami Spector	Organic Chemistry	Organic Chemistry lecture/lab; Reaction Mechanisms
Kim Summerhays (1/2 Chemistry; 1/2 Computer Science)	Physical Chemistry	Physical Chemistry; Pre-Chemistry

1.3 Faculty Achievements

Since our last program review (Feb 1994, site visit), our Department has been productive in maintaining an active research and learning environment for faculty and for students. Achievements in *the last 10 years* are presented below under three headings: Grants, Publications and Presentations; Honors. Details can be found in the faculty CV's.

Grants

- Procured grant money from the Keck foundation to restructure the organic chemistry labs;
- Procured grant money from the Fletcher Jones Foundation to purchase a Brucker 400 MHz NMR,
- Procured grant money from the Oxford Molecular Group for CAChe software,
- 5 faculty received 10 external research grants (from NSF, Research Corporation, Petroleum Research Fund). Some of this money was used to purchase the following equipment:
    - Shimadzu atomic absorption spectrophotometer
    - Electrochemical workstation
    - Molecular Imager

In addition to the outside research grants listed above, the chemistry faculty has also enjoyed good success in competing for internal monies made available by USF. There have been several grants from the Lily Drake Cancer Research Fund, as well as grants obtained from the USF Faculty Development Fund and Dean's Office to support travel, to use as seed grants for research, and to implement curricular changes.

Publications and Meetings

- 38 publications in peer reviewed journals;
- 34 faculty research presentations at ACS-sponsored or at international meetings;
- 38 Masters Theses;
- Organized and hosted two ACS Undergraduate Research Symposia (1996 and 2003).

Honors

- Two faculty members received the Distinguished Teaching Award (1995, 2000), a university wide honor;
- Two faculty members received the Distinguished Research Award (1994, 1998), a university wide honor;

- One faculty member was NEH, Chair (1996-1997), a College of Arts and Sciences honor.

- One faculty was a visiting research faculty at California Institute of Technology (1996, 1998) and another faculty was a visiting professor at Ecole Normale Superieure (1994 & 1999).

1.4 The Staff

The department enjoys the support of one full time Program Assistant, Antoinette González, and a half-time stockroom manager (Charles George) who serves mainly the needs of the General Chemistry labs. In addition, we have a half-time instrument technician, Andy Huang. However, since Andy is Manager of Technical Operations for the entire College he is not a full-time staff member for the department. His assistant, Jeff Oda, helps with maintaining the instruments and is the technician for the non-science major core courses offered by the entire college. From 1998 to 2001 we had a Lab Manager who primarily helped manage the organic chemistry labs; however we lost that position in 2001. Once again we find ourselves under-supported.

2. SUMMARY OF PREVIOUS PROGRAM REVIEW AND OUTSIDE REVIEWER'S COMMENTS

2.1 Summary of the Department's 1993 Self-Study

Below is a list of strengths highlighted by the department for its last review: (These are not ranked in any particular order.)

A. The high level of research activity as noted by:

   - the high percentage of both faculty and undergraduates engaged in research;

   - recent papers published;

   - external funding sought for and acquired;

   - the existence of a small but important masters level graduate program;

B. The rigorous ACS-accredited curriculum;

C. The many activities promoted by the department to support informal and meaningful interactions between the students and the faculty.

The areas of deficiencies highlighted by the department for the last review are summarized below:

A. The difficulty in recruiting high-quality and domestic students into the graduate program;

B. The lack of advanced courses for the graduate students;

C. Insufficient financial support for graduate students;

D. Insufficient faculty to deliver the curriculum;

E. Insufficient lab and instrumentation support;

F. Lack of a capital budget;

G. Aged and sharing of facilities

H. Aged and inadequate equipment, e.g. NMR, AA.

2.2. Summary of the External Reviewers' Comments and the Changes the Department Implemented

In general the external reviewers agreed that the Chemistry Department was populated with "skilled and energetic teachers and researchers" and that with a little help the department would be able to convert "an already fine program into an outstanding one." Below we summarize their suggestions in five different categories: Budget and Financial Resources, the Graduate Program, Workload, Facilities, and the Curriculum. The Department's responses to these suggestions are in italics.

A. Budget and Financial Resources

The reviewers felt the department was "severely limited by the present level of financial support." The reviewers hoped to see a substantial increase in our operating budget and strongly recommended that we be given a separate capital budget (with rollover provision so as to allow building towards major purchases) to meet the demands imposed by delivering a "hands-on" curriculum.

There was little immediate change in the operating budget of the Department after an initial allotment of $45,000 to upgrade equipment and an increase of $5000 to the operating budget.

B. Graduate (M. S.) Program in Chemistry

The reviewers were convinced that the program "contributes positively to the undergraduate program" and they were "satisfied with the quality" of the program. However, they did believe that the program was inadequately funded and expressed their desire to see full tuition remission for the graduate students. They also felt however, that the department could do more to encourage undergraduates to engage in research.

Incoming graduate students now receive full tuition remission and a 2 year guaranteed TA stipend (conditional on spoken-English ability and demonstrated competence in the teaching labs) of about $7200.00/year. The department has also institutionalized undergraduate research

in the form of a new course, Chemistry 397. This course is offered every semester and since it was introduced (Fall 1998), its average enrollment has been about 6-7 students. While not every student who does research enrolls in this course, Chem 397 has been instrumental in creating a department atmosphere that encourages, expects, and supports undergraduate research. More details on this course can be found under the section "State of the Department–Curriculum".

A similar course (Chem 698) is offered twice per year for the graduate students and provides workload credit once per year to one of the faculty members active in grad-level research. Formally, it entails meetings between each of the grad students in the department and the faculty person in charge for technical discussions/presentations of project concept and progress. The overall amount of work to the faculty member is considerably less than one full course; thus faculty who regularly take on graduate students receive effective workload release ca. every 4-5 years.

C. Workload

The reviewers felt that some faculty members experienced an overload primarily due to lack of support staff. They specifically recommended that the department have (1) a full-time (vs. half-time) stockroom manager, and (2) *an additional* full time laboratory technician. The large number of laboratory sections in the lower-level courses also seemed to contribute to faculty overload and the reviewers recommended that the department scale back the lab contact hours for the general chemistry and organic chemistry courses. To further alleviate the burden of faculty involved in the lower-level courses, the reviewers suggested the department consider ways in which the biochemistry faculty could contribute to these courses. (The reviewers noted that the current 450/451 upper division courses were essentially grad-level courses and because they are offered every year, it limits the ability of the biochemistry faculty somewhat in terms of their being available to teach the lower-level courses). Workload for the chair was also addressed. The reviewers suggested the chair receive institutional research support.

In Fall 1998 a full time lab manager was hired to help primarily in the organic teaching laboratories. The presence of this manager greatly reduced the workload of the organic chemistry faculty (Castro, Spector) and to a lesser extent the other faculty involved in delivering lab based courses. The lab manager was involved in all aspects of delivering safe, pedagogically sound, organic chemistry experiments. He helped students with check in, he ordered chemicals and supplies and maintained an accurate, updated inventory, he helped with setting up proper equipment for experiments and he along with the faculty lab supervisor was available to troubleshoot as an experiment progressed. When time permitted, he helped out in the other labs, most notably in "prepping" for the analytical chemistry lab. Unfortunately, we lost this position in 2001and faculty is once again doing much work that should really be done by support staff. We are, however, fortunate that Jeff Oda, assistant to the Manager of Technical Operations, has helped us prepare for these courses in recent years, although we should stress that this is not part of Mr. Oda's job description; he manages to do so as a courtesy to the Department. The College of Arts and Sciences is currently conducting a search for a Chemical Hygiene Technician (CHT). The job description focuses largely on safety issues attendant with science programs in general, and chemistry in particular. At this point we are unclear how this hire will

help out the Department with the grunt work of running numerous lab-based courses each semester and hope that the administration will approve the hire of a fulltime lab coordinator/stockroom manager.

Also since the last review we have reduced the number of contact hours/week in both the General Chemistry and Organic Chemistry courses. In addition, we had developed ways for the biochemistry and organic faculty to be involved in the general chemistry program, although these changes are no longer in effect. Details of these curricular changes can be found under "State of the Department–Curriculum."

Finally, we would like to note that two faculty will be retiring within the next two years. We thus anticipate hiring two new tenure-track faculty (vide infra).

D. Facilities

The reviewers were particularly concerned with the dismal condition of the organic teaching laboratories. In other courses, they largely felt the faculty was comfortable with the facilities. However, they strongly urged members of the department to engage in long term planning regarding facilities and visit other institutions.

The Department received funds from the Keck foundation to renovate the organic chemistry laboratories. In addition, the department created a computer room across the hall from these labs. One faculty member (Margerum) has looked at other institutions and is currently on the Space and Planning Committee for the renovation of our science building, Harney Science.

E. Curriculum

The chemistry curriculum was found to be "sound." Specific changes the reviewers sought included combining the Chemical Literature course with the seminar course, the introduction of a senior exercise, the introduction of computer use early in the curriculum, the reduction of lab hours for both the organic and general chemistry curricula, and the elimination of duplication of subject matter between the biochemistry courses and molecular biology courses (biology department). They supported the idea of having one additional graduate/undergraduate elective each year and they recommended the hire of an analytical chemist to help in the delivery of the curriculum. Their other comments focused mainly on organization and presentation of the curriculum (e.g., offering analytical chemistry in fall vs. spring semester, listing advanced courses as undergraduate/graduate courses instead of separating them into two categories). Finally, they wished to see all faculty members involved in both upper- and lower-level courses.

To avoid redundancy in this report and to contextualize our current curriculum we provide a detailed response to the reviewers' comments under the heading "State of the Department–Curriculum."

3. STATE OF THE DEPARTMENT

3.1 Undergraduate Curriculum

The department offers bachelors in science in chemistry and biochemistry, both of which can be ACS accredited degrees, if the student chooses to adopt the more rigorous curriculum. In addition, we offer a minor program in biochemistry and a more recently (1997) introduced minor program in chemistry. Table I summarizes our current degree options and their attendant unit requirements.

TABLE 1

USF Chemistry Courses	Student units	ACS B.S.	non-ACS B.S.	ACS-Biochem	non-ACS Biochem	Chem Minor	Biochem Minor
111 (General- Lecture+Lab)	5	x	x	x	x	x	x
113 (General- Lecture+Lab)	5	x	x	x	x	x	x
230 (Organic- Lecture)	4	x	x	x	x	x	x[a]
232 (Organic Lab I)	1	x	x	x	x	x	
231 (Organic-Lecture)	4	x	x	x	x	x	x
233 (Organic Lab)	2	x	x	☐	☐	☐	☐
260 (Analytical- Lecture+Lab)	4	x	x	x	x	e	x
330 (Chem of Drugs-Lecture)	4	e	e	e	e	e	☐
340 (Physical-Lecture)	4	x	x	x	x	e	☐
341 (Physical-Lecture)	4	x	x	x	☐	e	☐
350 (Biochemistry-Lecture)	3	☐	☐	x	x	☐	x
351 (Biochemistry-Lecture)	3	☐	☐	x	x	☐	x
352 (Biochemistry-Lab)	2	☐	☐	x	x	☐	☐
353 (Biochemistry-Lab)	2	☐	☐	x	x	☐	☐
356 (Fund. Biochem-Lecture)	4	x	x	☐	☐	e	☐
397 (Research Method/Practice)	1	x	e	e	e	e	☐
410 (Integrated- Lecture+Lab)	4	x	e☐	x	☐	☐	☐
420 (Inorganic- Lecture+Lab)	4	x	x	x	x	☐	☐
450 (Advances Biochem-Lecture)	2	☐	☐	x	x	☐	☐
451 (Advances Biochem-Lecture)	2	☐	☐	x	x	☐	☐
600 level	3	e	e	e	e	☐	☐
total units in Chemistry	☐	46	41	53	45	22[b]	24-28[a]

Notes: a–students can substitute the 4-unit one semester Fundamentals of Organic Chemistry (Chem 236) in lieu of the year long organic chemistry sequence; b–students must take one 4 unit course elective or take 3 units of undergraduate research; e–elective.

In addition to the major courses listed above, chemistry students are required to take 16 additional units of supporting courses from math and physics (8 units of Calculus and Analytic Geometry and 8 units of calculus-based General Physics); Biochemistry Emphasis students take an additional 24 units (8 units of general Biology on top of the identical math and physics requirement for the chemistry major).

Upon completion of the major requirements, the students should have met the following program learning outcomes:

1. Understand a broad range of chemical principles and knowledge in analytical, biochemical, inorganic, organic and physical chemistry;
2. Apply their chemical knowledge and critical thinking skills to the solution of theoretical and practical problems in chemistry;
3. Demonstrate laboratory skills appropriate to the study of chemistry, such as the ability to (i) acquire, interpret and analyze data using manual and instrumental methods, (ii) carry out basic synthetic reactions, (iii) maintain a laboratory notebook, (iv) work confidently and safely in a laboratory;
4. Present scientific information, both orally and in writing, using computer technology (word processing, spreadsheets, chemical structure drawing programs and chemical information retrieval services);
5. Understand the importance of chemistry in an industrial, economic, environmental and social context;
6. Be prepared to pursue advanced studies in chemistry or chemistry-related area, or in gaining employment in the chemical industry.

In 2002 most of the departments in the College of Arts and Science converted to a 4-unit norm for courses as opposed to a 3-unit one. The rationale for adopting a 4-unit model was that it would lead to a simpler workload for students (4 courses per semester rather than 5 or 6, and an improved workload for faculty (the standard teaching load would go from 3 courses each semester to 2-2-2-3 courses over a 4-semester rotation. [Note: our contract requires a 36 unit load in a two year cycle]). In addition, the 4-unit model was supposed to provide an opportunity for departments to develop a more intensive, integrated curriculum. Applying this switch to an ACS curriculum has not been easy. In general, the chemistry faculty did not support this curricular change, and many of us worked unsuccessfully to impede its implementation. Nonetheless, the 4-unit model was adopted for most of our classes and the department worked with faculty in mathematics, physics and biology to ensure that the overall student unit requirement for the chemistry and biochemistry programs did not escalate to prohibitive numbers. Thus, the 66 unit ACS-Chemistry program in 2000 was reduced to a 62-unit requirement (2004); on the other hand, the ACS Biochemistry emphasis program (73 units, 2000) increased by 3 units (77 units, 2004). The non-ACS programs are 57 (Chemistry) and 69 units (Biochemistry).

Because USF has a sizeable Core Curriculum requirement along with a language requirement for the College of Arts and Sciences, (a chemistry student can take up to an additional 48 units in required courses), our majors, especially those following a "pre-med" curriculum, have demanding course schedules that offer limited flexibility in deviating from taking required courses. For this reason, many of our majors opt to follow a non-ACS track.

In the following paragraphs we present the different courses offered by the department and highlight how we have revamped these courses to address the new 4-unit curriculum, the external reviewer comments, ACS demands, and our own beliefs on how best to serve our students.

3.2 Major Courses Offered

General Chemistry

The general chemistry program made several major curriculum changes since the last review. We added a new faculty member (Margerum) and started a weekly 50-minute discussion section replacing some of the lab time in the fall of 1995. The next year, we adopted a new textbook (Kotz & Treichel) and transformed the discussion sections into computer-based workshops using the Interactive CD-ROM for General Chemistry (by Vining & Kotz). Most faculty members in the department rotated through these workshops with varying degrees of success and satisfaction using this non-traditional approach. Student groups visualized chemistry concepts and used data tables, animations and graphing programs to answer workbook questions for credit. Student surveys found general satisfaction with the workshops and the majority of students reporting that it helped their learning. Some problems with the workshops were that the room was crowded (up to 40 students sharing 20 computers), computers did not always work and a few students did not take them seriously (late arrivals, no CD-ROM, disruptive behavior).

Further changes took place in the general chemistry program with the move to 4-unit lecture courses. First, we dropped the discussion section and replaced it with extra lecture time (to be used for problem solving, not for more material). Second, we cut lab time to one four-hour meeting per week from the previous twice a week meetings (student credit hours for the course remain at 5 units). Third, the Dean's office agreed with our proposal to limit lecture sections to 45 students (previously 90-100) and lab sections to 18 students (previously 20) in order to help personalize instruction for first year college students. We now run four lecture and ten lab sections in fall, and three lecture and eight lab sections in spring. Four faculty are now involved in the lecture/lab components of the course whereas prior to the previous review one faculty person usually managed the entire course. Fourth, we moved acid-base chemistry and equilibrium topics from first semester to second semester in response to changes in the General Biology sequence. Finally, we adopted the on-line homework /tutor system called OWL (Online Web-based Learning) in fall 2002 to better support student learning.

Organic Chemistry (230-231, 232, 233, 234, 236)

The following courses are offered in organic chemistry:

1. Organic Chemistry I, II (Chem 230/231, Fall/Spring 8 units total)
2. Organic Chemistry Lab I (Chem 232, Fall 1 unit)
3. Organic Chemistry Lab II (Chem 233 and 234, Spring 2 and 1 unit respectively)
4. Fundamentals of Organic Chemistry (Chem 236, Fall 4 units)

Since the last program review (1993) the organic chemistry curriculum has undergone a number of changes. In 1994, Claire Castro was hired into a tenure track position, doubling the number of organic faculty to two. As a result of her hire, and based on the recommendations of the 1993 program review, a new organic laboratory curriculum (Chem. 232 and Chem. 233) was developed during academic year 1994-1995 and implemented in academic year 1995. The most significant changes were: (1) a reduction in number of laboratory hours from 7 contact hours to 5 contact hours; (2) a modification of the second semester lab course (chem. 233) into a course for "regular" chemistry majors that includes more advanced experimental techniques (e.g., inert

atmosphere techniques) and a computational component as an integral adjunct to most of the wet labs. In Spring 2004 we also added a second section of organic lab (Chem. 234) specifically designed for the numerous pre-pharmacy students, and other pre-health professional students who need Organic Lab II for application to post-BS programs.

During this same timeframe (1994-2001) the lecture portion of organic chemistry (Chem. 230 and Chem. 231) did not change significantly. These courses met 3 hours/week and we use L. G. Wade's Organic Chemistry as the text since it most closely reflects our approach to the subject. Traditionally in our Organic Chemistry II (Chem. 231) course students give a presentation on a current topic in the organic chemistry literature in lieu of a fourth hour exam. The format of these presentations has varied over the years and includes: a formal group lecture, a poster session with a brief formal presentation with intensive Q&A, and a current literature review with a very brief formal presentation and Q&A.

In 2002 the college curriculum changed from a 3-unit based model to a 4-unit based model. In order to accommodate this change and not increase the number of units students would take in organic chemistry we initially modified the Organic Lecture I and Laboratory I into one course for 5 units and eliminated the extra hour we use to allot to lab lecture. However, for a variety of reasons this structure was found to be unsuitable for the faculty and students. As a result, the course was changed into separate lecture (4 units) and lab (1 unit) courses.

In Spring 2005 the second semester of Organic Chemistry (Chem 231) will also be expanded to a 4 unit course to bring it in line with the default lecture time that was attendant with the adoption of the 4-unit norm. The corresponding second semester lab courses will remain at 2 units for the major course (Chem 233) and 1 unit for the non-majors course (Chem 234). The difference in units between these two courses is reflected in that the majors have sizeable computational components to many labs (these are often done on their own time) and must learn to write ACS-style lab reports.

Finally, the department offers a one-semester Fundamentals of Organic Chemistry course (Chem. 236) each fall that is intended to serve Exercise and Sports Science, Environmental Science, and Biology majors who do not want to take the traditional year-long sequence. Typically these students are less inclined towards chemistry as indicated by their performance in general chemistry. For many years this course had significant enrollment (54 students in Fall 1999), but more recently the enrollments have dropped (12 students in Fall 2003) due to changes in the requirements and advising in these majors. The course is now principally made up of pre-physical therapy majors (a track within the Exercise and Sports Science major) and the weaker biology majors. To accommodate the 4-unit curriculum, this course became a 4-unit lecture/lab course (3 hours lecture + 4 hours lab). However, it proved difficult to teach the lab within this structure. Beginning Fall 2005, Chem 236 will be a 4-unit lecture only course and students needing a laboratory component will need to take Chem 232; thus all our fall organic chemistry students will take the same lab.

Analytical Chemistry (Chem 260)

The curriculum change in 2002 did not affect the sophomore Analytical course since it was already a 4-unit course (2x50 minute lectures, 2x3 hours labs per week). The last review suggested we move this course to the fall, but the department did not like this idea. Almost all of

these students are taking Organic chemistry with lab and another 6 hours of lab for them will not work. The course is full each spring with 20-22 students in two lab sections (using TAs) with 30-50% biology majors who are required to take the course for a minor in Chemistry with Biochemistry emphasis.

Professors Margerum and Karney alternated each year in this course until Karney's appointment to the Environmental Science department. Over the last few years, we have had trouble staffing the course with full-time faculty. There were Part-time instructors (recent PhD's) doing the course in 2002 and 2004 with uneven results.

On the other hand, the content and lab work for the Analytical course has completely changed since 1995. First, a new, less dense textbook was introduced that focused on environmental and biochemical applications of analytical chemistry (Exploring Chemical Analysis by D. Harris). Second, Professors Margerum and Karney began replacing wet chemical experiments (titrations, gravimetric analysis) with modern instrumental methods (ion selective electrodes, GC, HPLC and AAS). Third, we expanded the use of spreadsheets (least squares analysis) and data acquisition experiments (hardware/software control by *Labworks*).

Finally, one faculty member (Margerum) replaced lectures with cooperative learning groups in which students take on the role of manager, presenter, calculator, and recorder in order to work on instructor prepared activities. To prepare students for group work there are required pre-meeting assignments or in-class reading quizzes. In addition, there are combined individual/group exams, where the total grade is a weighted average of scores (usually 70/30).

<u>Physical Chemistry</u>

Physical Chemistry I (Chem 340) and Physical Chemistry II (Chem 341) have undergone significant changes since 1993 in terms of course units, of material covered, and of clientele. Prior to 2002, each course was a three-unit one, and both courses were required of our majors, regardless of their track through our program. With the advent of the four-unit course as the university's norm, the year-long Physical Chemistry course sequence rose from a total of 6 units to 8 units. Regrettably these additional units, when considered in light of the additional units added in other areas of our program, were sufficient to preclude the maintenance of the two-course Physical Chemistry requirement for our majors in the Biochemistry Emphasis track. In order to minimize the impact on students' preparation in their major field of study, it became necessary therefore to rearrange the sequence of material treated in Chem 340 and Chem 341. Topics deemed of lesser import for biochemistry were moved to Chem 341, which Biochemistry Emphasis majors would no longer be required to take. Topics considered more critical to the training of biochemists were then concentrated into Chem 340, which all our majors are still required to complete.

Formerly the first course (Chem 340) was devoted to Chemical Thermodynamics, both classical and statistical. The second course (Chem 341) treated Quantum Theory, Spectroscopy and Kinetics. In the new configuration, classical Chemical Thermodynamics is followed by a treatment of Kinetics in the first course, while the second course takes up statistical Chemical Thermodynamics following the treatment of Quantum Theory and Spectroscopy.

While it remains arguable that our Biochemistry Emphasis students are left without exposure to a number of topics which will likely loom larger in the future of biochemistry than perhaps they do today, it can be said that for those enrolling in the year-long course sequence, the revised order of topics provides a more satisfying arrangement. This is so because the statistical Chemical Thermodynamics follows the development of key relationships in Quantum Theory that serve as a starting point for the statistical treatment. (Previously these were simply presented as "givens" at the outset of the statistical development.) Returning at the end of the year-long course to see the molecular basis for relationships seen previously in classical Chemical Thermodynamics brings a genuine sense of closure for students. On the one hand, they appreciate the elegance of the classical approach, with its intrinsic simplicity and cohesiveness. On the other hand, seeing how these relationships follow naturally from quantized systems involving huge numbers of chemical species is a rewarding experience for all who see molecules as the focus of their lives' work.

Finally it should be said that the additional lecture time afforded by four-unit courses over their three-unit predecessors has provided a variety of opportunities. For students in need of some remediation, time has been available for some quick topical reviews in mathematics and physics. For the more advanced student, the opportunity to occasionally explore some cutting edge application of a concept just studied has likewise been an important benefit of the additional minutes in class. For all, some extra time to work through and discuss problems has resulted in a better learning experience.

Inorganic Chemistry (Chem 420)
Inorganic chemistry is a fall semester, advanced course required of all chemistry majors in their final year. The course textbook is "Inorganic Chemistry" by Shriver and Atkins. The major topics covered are similar to other advanced inorganic courses. There are core chapters on atomic/molecular structure, MO theory, symmetry, acids/based, redox chemistry, and d-metal chemistry. This is followed by special topics that depend on the professor in charge (Professors Curtis and Margerum share this course), although electronic spectra, reaction mechanisms and organometallic chemistry are always covered.

The biggest change to Inorganic Chemistry occurred in the fall 2002 when we moved from a 3-unit lecture to a 4-unit lecture and lab. We maintained the 3x50-minute lecture format, but added 2.5 hour lab meetings twice a week. Our students now do many more advanced inorganic experiments than previously available in the Integrated Lab course. Dr. Curtis started the Lab course, doing such diverse experiments as the spectroscopy of Ti^{3+} species, magnetic susceptibility of transition metal complexes, and synthesis/characterization of ruthenium pentammine complexes. Dr. Margerum adapted some of the most successful experiments over the last two years and introduced new experiments in molecular modeling, synthesis of silica sol-gels and synthesis of ruthenium organometallic complexes characterized by 31P NMR and electrochemistry.

In the last three years, we had 13, 9 and 14 students taking inorganic lab. This number of students in lab leads to some compromises in order to use some of our research instruments (i.e. groups of 3-4 students instead of pairs, rotation of experiments, extended lab periods). However, we now clearly meet ACS certification guidelines for experimental work in inorganic chemistry.

Integrated Laboratory Course (Chem 410)
The department created the Integrated Lab course for several reasons. First, there were not enough chemistry majors to justify separate Physical, Instrumental and Inorganic Labs. Second, students wishing to obtain ACS certified degrees needed exposure to these topics in order to round out their degrees. From 1995 through 2000 Integrated Lab incorporated aspects of Instrumental Analysis, Physical Chemistry Lab and Inorganic Lab. This spring semester course was six units for students (3 hours lecture, 6 hours lab). The course alternated or was shared between professors Curtis and Margerum.

It became apparent that the number of credit hours for students and workload for faculty was overwhelming, so the department agreed to split the course into a 3-unit fall and 3-unit spring course for 2001-2002. This experiment lasted one year until the University changed to the 4-unit system.

The change to the new system has improved our advanced lab course offerings for ACS certified majors. We moved some experiments out of Integrated and into the new Inorganic course. The Integrated course was collapsed to 4-units each spring (2x50 minute lecture and 2x3 hour lab). As a result, we currently offer 8 units of lecture/lab between the Integrated and Inorganic course versus 9 units before the curriculum change. This should give our biochemistry-emphasis majors a better opportunity to obtain ACS certification by taking an advanced lab that includes experiments in electronic circuits, UV-vis, FTIR, NMR, AAS, GC-MS, and electrochemistry.

Biochemistry
The biochemistry courses remain essentially the same as in 1993:

1. Biochemistry I, II (Chem 350/351, Fall/Spring, 6 units total)
2. Biochemistry Lab. (Chem 352/353, Fall/Spring, 4 units total)
3. Recent Advances in Biochem (Chem 450/451, Fall/Spring, 4 units total)
4. Fundamentals of Biochemistry (Chem 356, Spring, 4 units)

Students majoring in **Chemistry with a Biochemistry Emphasis** complete 1, 2 and 3. We believe that, with the sustained and wide-ranging development of Biochemistry, a Chemistry degree that claims to have a Biochemistry Emphasis must provide the student with more than just the fundamentals covered in 350/351 and the Recent Advances series (450/451) is intended to help the student to move beyond that introductory level.

Students majoring in **Chemistry** are now required to complete 4 to satisfy the biochemistry requirement introduced recently by the ACS Committee on Professional Training.

Students from **Biology** or other disciplines often take either 1 or 4, especially if they plan to apply to medical, dental or pharmacy programs. Reviewers in 1994 suggested that the one semester Organic and the one semester Biochemistry courses (236 and 356) could be merged. This would be a problem for those Biology students who are aiming for medical or dental school. The students most commonly accepted into medical school are those who have taken 2 semesters of Organic Chemistry and one semester of Biochemistry. Students with one semester of Organic and one semester of Biochemistry are rarely accepted and a single course combining Organic and Biochemistry would be of no value to them.

The only **changes from the 1993 curriculum** are:

a. We divided the Biochemistry lab course into 2 two unit courses: protein based experiments are done in a lab course which is scheduled for the second half of the fall semester (Chem 352) and DNA experiments are done throughout the spring semester (Chem 353). This change allows the lab experiments to be correlated better with these topics as they are covered in the lecture courses (Chem 350/351).
b. Chem 356 has been changed to a 4 unit course in accordance with the change of most USF courses from 3 to 4 units.

The Integration of Biochemistry Related Material with Biology Courses

Reviewers in February 1994 suggested that some of the Biology and Biochemistry courses which overlap could be integrated. In May 1994, a committee composed of Profs. Jones (as Chair) and Cobley, both from the Chemistry Department, and Profs. Chien, Chihara, and Schultz, all from the Biology Department met about 5 times and hammered out a proposal for a Biochemistry/Molecular Biology Degree Program. This proposal identified courses from the 2 departments which would be integrated, the topics that would be covered in each and which faculty would be responsible for each. Complete agreement was achieved on the entire program, a significant accomplishment considering the potential turf concerns.

This proposal was presented to Dean Stanley Nel who passed it to the Chair of the Chemistry Department with an inquiry about how "such a major program might affect Chemistry enrollments." Jones later asked Dean Nel and Associate Dean for Science, Bill Jordan, repeatedly for a response to the proposal but none has ever been given. Since there still continues to be much overlap of course material taught in the Biology and Biochemistry areas it still would be worthwhile re-examining the possibility of integration.

3.3 Recently Developed Advanced Courses

Research Methods and Practice (Chem 397)

This course formalizes and makes more visible research with undergraduate students. While much of the research work with undergraduate students takes place over the summer and during intersession, this course helps to organize that portion of the training which takes place during the school year in such a way as to lend greater group cohesion, motivation, and accountability. As such, Chem 397 has both research and seminar components. In general, students received 1 unit of credit for 4-6 hrs of lab work/week. In addition, students attend 2-hr seminars every other week. The seminar time provides students with (1) a forum to share their research findings through short presentations; (2) the opportunity to learn more about searching the literature; (3) the background necessary to write an ACS-style research progress report, or full report (e.g., Senior Thesis); (4) the training to present their work at either a poster or oral session at the regional, annual ACS undergraduate research symposium. This course is required for those chemistry majors seeking ACS certification.

The Chemistry of Drugs (Chem 330)

This course focuses on the isolation, synthesis, and pharmacology of the most common drugs that act on the central nervous system (CNS). Our text is the ACS published *Chemistry of Mind Altering Drugs*, by Dan Perrine. The pre-requisite is two years of chemistry (general and

organic). Chem 330 was developed in 1998 to address the fact that (1) we had no undergraduate chemistry electives and (2) the needs of those students wishing to receive minors. Average enrollment is about 14 students. About one third are chemistry majors and about two thirds are minors. Finally, this course is a McCarthy Public Service certificate course and will incorporate a service learning component beginning Fall 2005.

Polymer Chemistry (Chem 670)
This course is available to graduate students and undergraduates who have completed the year course in organic chemistry and at least the first semester of physical chemistry (thermodynamics and kinetics). Strategies for polymer synthesis (condensation, addition, ring opening) are surveyed. The kinetics and the thermodynamic aspects of the major types of polymerization are treated in detail. Methods for the determination of molecular weights and distributions (light scattering, GPC, solution viscosity, etc.) are presented as is coverage of solution thermodynamics. Finally the course focuses on polymer morphology and the relationship between macromolecular structure and properties. Throughout the course examples are drawn from important industrial polymers, consumer products, and specialty polymers used in medicine, electronics, and various other areas of materials science.

Advanced Mechanisms (Chem 631)
As suggested in the 1993 program review we have added the advanced course Reaction Mechanisms (Chem. 631) into the courses that are taught consistently in the department. Since that time it has been taught 5 times (~ offered every other year). This graduate course serves both masters students and upper division undergraduates as an elective. Building on what students learn in undergraduate organic, inorganic and physical chemistry this course examines the intricacies of bond making and breaking in numerous chemical reactions and processes. To do this it focuses on the mechanics of writing mechanisms *and* elucidates the assumptions underlying these mechanics. Important aspects of this course include the relationship of experiment to mechanism (i. e., kinetics, the Hammett equation, transition state theory, etc.) and specific organic and organometallic reaction mechanisms. In addition, it develops a deeper understanding of molecular orbital theory and reactive intermediates. The course methodology emphasizes case studies of exemplary reactions, collaborative problem solving, and engagement with the current chemical literature. This course is currently 3-units but will be submitted for conversion to 4-units (65min 3x's/week) in the near future.

3.4 Service Courses That Satisfy the Core

Topics in Health and Illness (Chem 216)
Since the School of Nursing was started at USF in 1954 their program has always had a requirement for Chemistry. Until 1970, a two semester 6-unit course sequence was required and then this was changed to a one 4-unit course, Chemistry 116. In 2002 the School of Nursing cancelled this Chemistry requirement entirely and the course has not been offered by the department since then. To replace the student credit hours lost and to provide an introductory course in Chemistry for non-science majors a new course, Topics in Health and Illness (Chemistry 216) will be offered for the first time in Fall 2004.

Getting a Grip on Science: From Mass and Motion to Molecules (Chem 100)

This course is required for students in USF's Dual Degree Program (http://www.usfca.edu/dualdegree/). Students in this five year Dual Degree Program: 1) receive a Bachelor's Degree; 2) receive a Master of Arts in Teaching; and 3) fulfill the requirements for a California Multisubject Teaching Credential (K-8) issued by the State of California. The syllabus of this course has been developed to comply with the content specifications mandated by the California Commission on Teacher Credentialing (http://www.ctc.ca.gov/). A student in the Dual Degree Program will have explored all of the topics in all three domains of the Content Specifications in Science after having taken three four-unit courses as follows: Chemistry 100 - Getting a Grip on Science: From Mass and Motion to Molecules; Biology 100 - The Science of Life; Environmental Sci 110 - Understanding Our Environment.

Toxic World? (Chem 220)
Toxic World? is a course for those non-science majors who are interested in studying chemistry topics with an environmental perspective. The course has a weekly two-hour lab and uses the ACS text, *Chemistry in Context*. This course is also a McCarthy Public Service Certificate Course.

3.5 **Student Credit Hours** (SCHs)

Several events colluded in that past several years to lead to a modest decline in the Chemistry Department's SCHs (Table 2). Most notable were the cancellations of a chemistry requirement for nursing majors in 2002, the cancellation of Natural Science 214 (2003) and Natural Science 215 (2003). NS 214 and NS 215 were former General Education Curriculum requirement courses that served the majority of non-science majors. We are trying to recoup some of these lost SCHs by having introduced two new Core courses, Topics in Health and Disease and Getting a Grip on Science. Since these have only been recently introduced it is difficult to determine what long-term impact they will have on SCHs.

TABLE 2: Representative SCHs

Academic Year	Student Credit Hrs
1999-2000	2987
2002-2003	2717
2003-2004	2875

To give these numbers some perspective, for the most recent data available (2003-2004), in total number of SCHs, the chemistry department ranks third behind biology (5813) and math (4535), but is ahead of the other science programs (e.g., 2033 for Computer Science, 1830 for Physics). The majority (ca. 80%) of our SCHs come from the lower division chemistry courses, primarily from General Chemistry and Organic Chemistry. For example representative typical enrollments of lower and upper division courses are shown below (numbers are averaged over a 2-year period):

Gen Chem I	174 (4 sections)
O. Chem I	82 (2 sections)

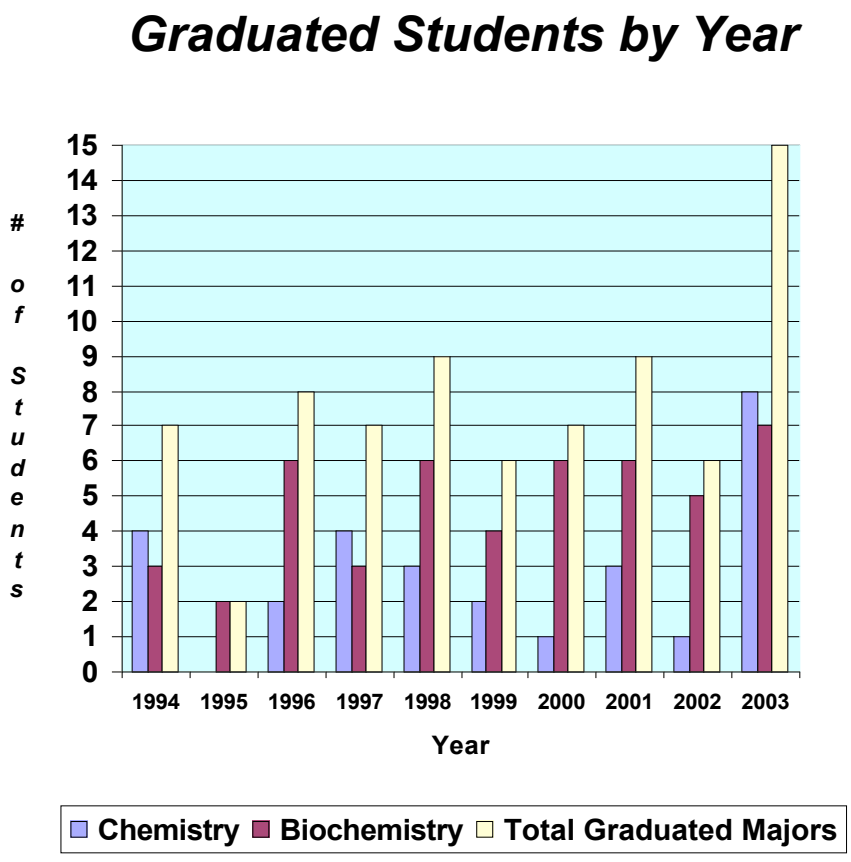
Inorganic Chem	15 (1 section)
Biochem I	18 (1 section)

3.6 The Undergraduate Student

Between Fall 1994 and Spring 2003, 76 chemistry and biochemistry majors graduated from USF. Graph A shows how many of these students graduated with a chemistry or biochemistry degree. In addition, it is helpful to know the number of those degrees that were ACS-certified. This information is presented below:

26% ACS B.S. Chemistry	20
11% nonACS B.S. Chemistry	8
14% ACS B.S. Biochemistry	11
49% nonACS B.S. Biochemistry	37

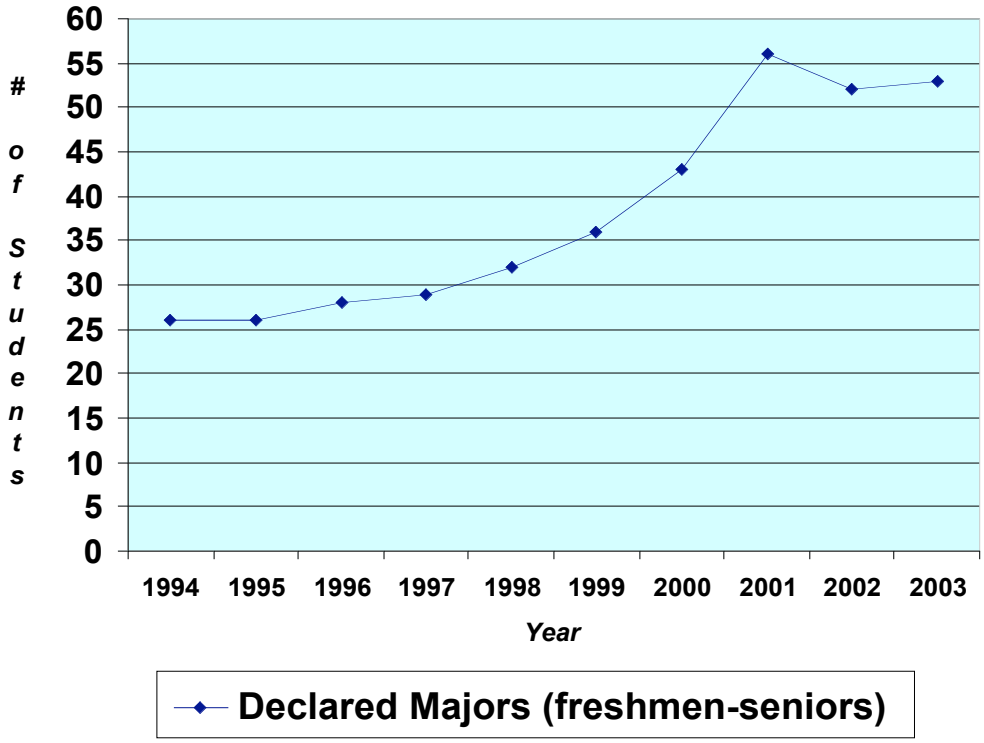
GRAPH A



Graph B presents the number of declared chemistry/biochemistry majors in a given year (i.e., freshmen through seniors) for the last 10 years. From these two graphs it is evident that (1) the number of majors has generally risen steadily since the last program review and (2) the majority of those students who graduate follow the Biochemistry emphasis track. This is in part reflected in students' perception that a major in biochemistry will help their chances in getting into a

health- professional program. Many of the biochemistry students apply to medical, dental, pharmacy or graduate programs; while many of the chemistry majors apply more exclusively to graduate programs in chemistry.

GRAPH B



The academic quality of our majors has been uneven. Some just barely pass through the program; others show a remarkable aptitude for the course material. Clearly one of the problems the Department faces is recruiting more chemistry majors with the skills and motivation to succeed in our programs. USF is not one of the most selective liberal arts schools. While a few students come to USF as declared chemistry/biochemistry majors, many of our majors are recruited through the General Chemistry and Organic Chemistry courses. We would like for the University, in conjunction with the Department, to actively recruit high school seniors with strong science interests. Creating a chemistry undergraduate scholarship fund or more aggressively advertising the department in local media would be helpful.

The quality of our top end students however is excellent. This is indicated by the following list of student achievements: (See Appendix I, for information on where our students go after graduation)

- 14 Students received competitive scholarships (e.g. ARCS, CUR, Clare Booth Luce, etc.)
- 3 Students accepted for internships (e.g. REU)
- Over 40 of student research presentations at ACS or □□□ regional

meetings;

- 9 papers with undergraduate student co-authors;
- Acceptance of students into excellent graduate schools, medical schools or pharmacy schools (UC Berkeley, UCSF, University of Washington, Yale, Harvard, etc).
- Ability of our students to find employment.

In addition, a 1997 USF graduate is now beginning her first year in a faculty tenure track appointment at Scranton University.

The Department carefully tracks the performance of its students. Those who do not meet the 2.0 GPA major requirements are notified, both orally and in writing, that the Department is concerned about their ability to graduate in chemistry. Students who do not seem to have the academic strength to complete the program successfully are encouraged to find a different major program. Faculty members also personally encourage students to engage in research through our advising process, through SAACS, and through contact with students in the lower level courses.

Both of our minor programs have been successful. The minor in Chemistry was introduced in Fall 1997. Table 3 provides data from the last five years. In general, over 25 students follow one of the minor tracks, with the Chemistry minor being more popular than the Biochemistry minor. Students obtaining either minor are typically biology majors following pre-professional health path.

TABLE 3: Minors in Chemistry/Biochemistry

	Chemistry	Biochemistry	Total
1999	30	6	36
2000	20	4	24
2001	23	2	25
2002	17	12	29
2003	25	12	27

Finally, we should note that the vast majority of our students are women. For example in 2003-2004, the total enrollment in all Biochemistry courses was 80 students, 19 male and 61 female.

3.7 The Role of Student Affiliates of the American Chemical Society (SAACS)

The Department of Chemistry has been fortunate to have an on-going active chapter of the Student Affiliates of the American Chemical Society. Each spring, from 1998 to 2002, SAACS received an ACS award in recognition of "commendable achievements." In addition, the Department has awarded the SAACS Achievement Award annually since 1977. While one of the primary purposes to SAACS is to develop a sense of camaraderie among the students and the faculty by hosting on-going faculty/student lunches, SAACS is also very much involved in activities that enhance the department's welfare. For example, SAACS sells the goggles to students taking chemistry labs; SAACS played a vital role in hosting the15th Annual American

Chemical Society Undergraduate Research Symposium held at USF in May 2003; SAACS hosted numerous chemistry seminars with outside speakers.

In recent years, SAACS has also been involved in outreach programs such as providing chemistry demonstrations in the public schools and in organizing donations for San Francisco's homeless population.

4. THE GRADUATE PROGRAM

4.1 The Curriculum of the M.S. Program

For admission into the graduate program applicants must have a chemistry background equivalent to that of a student graduating from USF with a B.S. in Chemistry. Should an applicant be short one or two courses this does not preclude admission; minor deficiencies can be made up by taking appropriate USF undergraduate courses. Applicants whose first language is not English must have taken the Test of English as a Foreign Language (TOEFEL) and scored either greater than 560 in the paper test or greater than 220 in the on-line test version. Applicants indicate their research interests by ranking the various sub-disciplines within chemistry (analytical, biochemistry, inorganic, organic, physical and polymer chemistry). An applicant's file is given first to those professors engaged in research within the sub-discipline ranked first by the applicant. Acceptance into the masters program only occurs if at least one faculty member is willing and committed to take the applicant into her/his lab. If this does not happen for any reason even a well-qualified applicant is denied admission. Students may enter the program at the start of either the Fall or the Spring semester.

In the first week of their first semester each new graduate student takes two placement examinations. The students are forewarned of these exams in their letter of acceptance which also contains some sample questions and a list of recommended textbooks and web sites for use in preparation. Students choose their two exams from the following: analytical, biochemistry, inorganic, organic, physical and polymer chemistry. The exams are the standard ACS multiple-choice exams which provide a reliable benchmark for student performance. To gain full admission into the program, newly admitted students are required to score in the 60^{th} percentile in both of their tests. A student must retake any failed test at the latest by the first week of the following semester. Alternatively, they may take in their first semester a USF undergraduate course in the area of their weakness, and receive a grade of B or better. If no such course is available in their first semester, a student with a weakness has no choice but to retake the placement exam in a timely manner. Through this process of graduate student placement any student who is academically unsuited to the program can be identified in a timely manner and asked to withdraw.

A part of the teaching philosophy of the M.S. program could be summarized as "learning on a need-to-know basis" (as opposed to learning through a formal lecture or laboratory course). This type of learning occurs when the grad student (and perhaps the professor) lacks necessary knowledge. Under these circumstances the professor helps the student discover the various ways that the missing knowledge can be acquired, and thus "teaches" the student how to be an

autodidact. Such skills are a major asset to those working in areas of science that are rapidly changing.

M.S theses completed in the last ten years will be available for examination by the Review Committee (see Appendix II: Graduate Theses of the Last Decade from the M.S. Program).

4.2 The Graduate Student

The graduate program in chemistry serves our graduate students in different ways. For those students (mainly U.S. citizens) who wish to pursue some career path in chemistry but who are not sufficiently prepared or experienced to enroll in a Ph.D. program, our M.S. program provides an opportunity to test out the world of academic research. Many of these students gain in expertise, confidence and maturity, and go on to Ph.D. programs (see Appendix III: Information on Career Paths of Graduates from the M.S. Program). Others decide to go directly into the workforce. The Bay Area is home to many biotech and biopharmaceutical companies that offer career opportunities for those graduating with M.S. degrees. For students educated outside the USA ("international students") our M.S. program offers them the chance to adjust to the mores of American academia, and to American scientific education. Many of these students, too, go on to Ph.D. programs.

However, the graduate program more than simply provides for the needs of the graduate students. The large majority of our grad students serve as TAs either for General Chemistry or Organic Chemistry. They also staff our Help Room where undergraduates can get assistance each afternoon. Many of these TAs are required to attend the relevant undergrad lectures, and all TAs attend pre-semester and in-semester TA meetings with faculty members in charge of the lab course. To insure that language barriers do not exist between TAs and those they serve, international students do not become TAs in their first semester unless they have been interviewed by a chemistry faculty member, on the telephone prior to their arrival on campus. The TAs enliven the physical space of the chemistry department, they are present and active in the department doing their research and they reveal to undergrads that ours is a department where real scientific research is conducted.

In its self-study of 1993 the Chemistry Department took a statement from the ACS Committee on Professional Training to help determine the academic strength of our program:

> *The single most reliable indicator of overall excellence in a given program has turned out to be the level of joint participation between faculty and undergraduates in research.*

This statement is still a touchstone by which to assay our department. The graduate program strengthens the department because it offers each faculty member the chance to create a research group with critical mass, and a sufficient energy to be productive and sustainable. Such research groups attract motivated undergraduates who are excited to be working alongside a graduate student. A research group such as this forms a social base for all students involved. In such a group undergrads learn scientific values, are absorbed in laboratory culture, and obtain experimental assistance. Camaraderie and science prevail.

4.3 Support for the Graduate Program

After the departmental self-study of 1993, the External Review Committee made several recommendations regarding the M.S. program in chemistry. They recommended that the program be continued, and that a way be found to waive all tuition and fees for master's degree students in chemistry. Much to the credit of the University, this recommendation was implemented. At present we are allowed, at any one time, a maximum of twenty students in the program on full tuition remission. At this moment in time there are 15 students enrolled for the M.S. degree. Over the last ten years we have graduated approximately four students per year. We expect this number to increase modestly over the next few years since we anticipate the appointment of two new chemistry faculty. These anticipated two new hires will be replacements for Profs. Jones and Gruhn who will shortly retire (and who are presently without graduate students). It is unlikely that the Chemistry Department will, in the foreseeable future, ever have twenty graduate students in the program at any one time since not all chemistry faculty are willing to take on graduate students.

The dollar value of TAships provided to chemistry graduate students at USF is well below the average provided at comparable universities. At present at USF, a chemistry graduate student serving as a TA for General Chemistry (a one year course) receives $7,200, and for this money serves in both semesters. This level of support we regard as the minimum acceptable. We are, however, very concerned about what level of support will be offered in the future. To understand the reason for our concern, it is necessary to look briefly at the history of the dollar value of TAships at USF. From 1980 –87 the dollar value of Chemistry TAships was almost constant. In 1987 the Chemistry Department sent a strong letter to the Dean requesting increases, and, in response, the value of TAships was doubled over a two year period to about $6,000 for a full General Chemistry TAship. Shortly after this increase a new Dean was appointed. Then again, from 1989-2000, the dollar value of Chemistry TAships did not increase (even for inflation). Yet again the Chemistry Department sent a strong letter to the Dean (letter available to the Review Committee). Only with another change in Dean was an increase forthcoming. Grad students make up a transient, poorly represented and vulnerable group on campus. We fear that without a change of policy, the value of graduate TAships will yet again erode, and chemistry graduate students will once again be short changed. **We propose that the dollar value of TAships be increased annually by the same percent as that set for faculty and staff salaries.**

In the past many of the students who enrolled in our M.S. program were from overseas. Since 9/11 the chance of obtaining an F1 entry visa with an I-20 form issued by USF has decreased. This has lowered our pool of applicants. However there seems to be a small increase in the number of applications from students already present in the USA.

4.4 Weaknesses in the Graduate Program

The External Review Committee in its report (1994) made other recommendations regarding the M.S. program in chemistry that are numbered below as in the 1994 report:

- that the department offer an additional undergrad/grad course per year (11)
- that chemistry faculty be more aggressive about inviting undergrads to conduct research and work with graduate students (15)

- that the chemistry department seek outside funding for a summer undergraduate research program as a way of attracting domestic graduate students (16)

The first of these recommendations (11) has proved difficult to implement because of the diversity of our students. Those grad students in the more traditional areas of chemistry have different needs from those with a biochemistry emphasis, and over the last decade our graduate students have been equally divided between these two chemical orientations. In spite of this, in the last decade Reaction Mechanisms (0202-631) has been taught five times, Polymer Chemistry (0202-670) five times, Spectroscopy (0202-630) twice, and Chemistry of Drugs (0202-330) three times. We believe that we have addressed this issue as best we can, given our circumstances.

Research grants to faculty members are currently providing funds to support researchers, both during and between semesters (recommendations 15 and 16). We have not perused any department-wide summer research grants as most faculty are comfortable with their current research group size.

5. DEPARTMENT FACILITIES

5.1 Space

The fourth floor of Harney is primarily devoted to the Chemistry Department, with the exception of room 402 (office space for a program assistant for graduate programs abroad), room 427 (office space for a professor in environmental science), and room 417 (janitor's closet). While the fourth floor houses all of the teaching/research laboratories, faculty and staff office space, chemistry stockroom, instrumentation shop, student meeting room (SAACS room), it does not house classrooms. Lectures are typically held on other floors of Harney or in other buildings. The lack of flexible, multiuse space is obvious, but also understandable given the age of the building.

Since the last program review, we have made some changes in the facilities. Most notably, in 1996, we received $300,000 to renovate the two organic teaching laboratories. We upgraded the lab benches, added new snorkel hoods, conventional hoods, chemical storage cabinets, student storage shelves and new chemical resistant flooring. In addition, we created an organic chemistry lab "prep" area in a small room sandwiched between the teaching labs. Finally, in 1996 the Dean's Office supported the complete renovation of a research lab (room 436) to accommodate the needs of a recent hire (Margerum). This lab was fitted with new cabinets, lab benches, desks and a fume hood.

Another significant change was converting the analytical balance room (room 417) into a computer room (six networked Macintosh G-4 PowerBooks). This room currently functions as a computer lab for small upper division lab courses, the chemistry help room (staffed by TA's) and a TA meeting room.

Current areas where we would like to see immediate improvement include the general chemistry labs (rooms 403 and 411) and the analytical chemistry lab (room 413). These labs have poor sight lines (i.e., difficult to see the board), inadequate hoods and are not well suited for group

work using computer data collection. In spring 2004, a faculty member (Margerum) wrote a grant application, supported by the Dean's Office and the USF Development Office, to the Stauffer Foundation to transform the analytical chemistry lab into a flexible lab/lecture multi-media room. Unfortunately, this grant was not funded.

The University is beginning a capital fundraising effort that includes plans to expand Harney Science Center (4 to 5 years away) in one phase and to renovate the existing space in a second phase. One chemistry faculty member (Margerum) is on the committee to develop plans for this addition. Thus, we are in line to address the chemistry department's long-term needs for adequate research/teaching space.

5.2 Equipment

One recommendation from the last review was to find ways to add more instrumentation. The department has been successful in this area. The Fletcher Jones Foundation and USF funded a $380,000 proposal to acquire a new Brucker 400 MHz NMR in 1997, the Hewlett Packard Foundation funded a request for a new GC/MS in 1998, and the university funded the acquisition of a Cary 5G UV-vis-NIR in 1998. Recently, research grants to individual PI's from NSF, funded a Shimadzu 6500 Flame AAS, a PAR 283/1025 electrochemical workstation and a BioRad FX Molecular Imager. Finally, donated equipment that has been put into working order by the technical staff include an HP 5890 GC, two HPLC systems (Hitachi 655 and Shimadzu SCL-6B) and a home-made magnetic susceptibility set-up.

In 1998, a faculty member (Margerum) obtained an internal curriculum grant to purchase six Labworks analog-to-digital interface boxes for analytical chemistry using surplus computers (upgraded to Dell Laptop PCs in 2001). We are currently using department funds to obtain new Vernier – brand data acquisition boxes (Labworks went out of business). In addition, we are slowly turning in old Spec 20's for credit towards purchase of Ocean Optics PC powered fiber optic based spectrophotometer (we now have three). We use these in Integrated, Inorganic and Analytical labs.

Finally, our computational facilities are greatly improved. We now have an SGI Octane workstation, a Sun Blade 2000 workstation, and access to the Keck cluster (a group of 64 dual-processor PC's housed in the Computer Science Department) for research calculations. Computational needs for undergraduate lab courses are addressed using the computer room (Harney 417). The recent upgrade to more flexible and faster notebook computers enables students to use MacSpartan with fewer problems in organic and inorganic chemistry courses.

Unfortunately, because of departmental structures at the university we have no departmental capital budget or maintenance budget. Although the Dean's Office has been able to help us at times with capital expenditures, we are unable to budget for anticipated equipment replacements, upgrades or repairs. There are several upcoming needs in the department. First, our current HP Diode Array Spectrophotometer is nearing the end of useful life and our modular HPLC's are more than 15 years old with no modern software control. The department anticipates the need to acquire a fluorescence spectrophotometer, an ion chromatography system and replacement rotors for existing centrifuges.

For a more detailed list of our important equipment, see Appendix IV.

6. DEPARTMENTAL GOVERNANCE

The Department is governed in the traditional manner for USF. We have one Department Chair who is responsible for all aspects of the program except for the graduate program, which is handled by the Graduate Advisor.

6.1 Chair

The Department Chair attends to the state of the Department budget, supervision of staff, teaching assistant assignments, part-time faculty selection, workload distribution, course-scheduling problems, outside accreditation (ACS) issues, etc. Typically the Chair holds department meetings every 3-4 weeks during the academic year to handle agenda items submitted by either the Chair or by other faculty members in the Department. In addition to these traditional department meetings, the Chair oversees virtual meetings via email throughout the year and in the summer, if necessary. The Chair also attends bimonthly meeting of College Council (comparable to Academic Senate) and bimonthly meeting of COSEC (The College of Science Executive Council). Finally, the Chair is a member of the Core-B committee that evaluates science courses for their ability to satisfy the "core" science requirement and makes the appropriate recommendation to the Provost. In general, the Chair is elected for a 3-year term and receives 5 units/semester of course release time for this post.

Because we are a unionized faculty, it should be noted that the Chair does not have the power typical of a college administrator. While the Chair can make recommendations for part-time hires or for workload assignments, the ultimate decision rests with the Associate Dean of Sciences. This lack of authority occasionally results in awkward modes of governance. This is particularly apparent with regard to supervision of support staff. For example, while the Chair is in direct contact with the Program Assistant, oversees her responsibilities, and conducts her job performance review, the Chair has no authority to ensure that she meets the expectations of her job duties. This authority lies with one of the Assistant Deans, who is simply too far removed from the daily interactions with the Program Assistant to be effective.

In contrast, this lack of authority forces a more consensus-based approach when dealing with issues that directly impact all faculty, e.g., space and course workload.

6.2 Graduate Advisor

One faculty member serves as a graduate advisor. This is a nominally rotating position (can be from 3 – 12 years). The graduate advisor supervises the operations of the graduate program, from recruitment to graduation. There is no course release associated with this position.

6.3 Course Workload

We have attached a typical workload spreadsheet that we use as the basis for making course workload decisions in Appendix V. Because we have no lab manager, the faculty members who teach lab-based courses expend a substantial amount of time doing staff-type work. This is reflected in the increased number of workload units faculty receive for teaching these courses

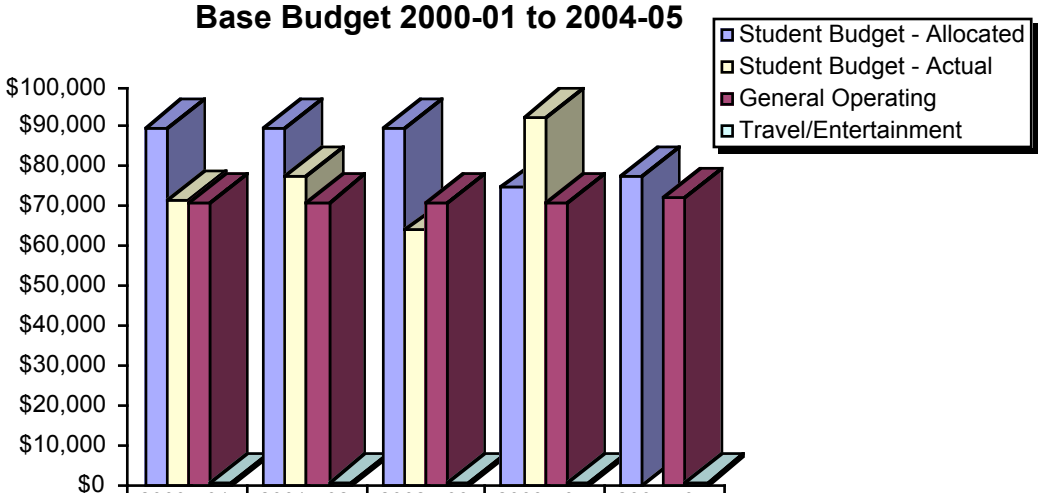
versus lecture-only courses. Also in Appendix V you will find a letter to the Dean (2000) requesting redress in the lack of adequate staff support for our department. With only a half-time stockroom position at our disposal and the ad hoc use of Jeff Oda, we are simply under supported. We are in a similar position as when we underwent our last program review. However, as mentioned earlier, the College is currently hiring a Chemical Hygiene Technician (CHT). While this in no way replaces our need for a lab manager, the CHT should relieve the work associated with constantly making sure our research and teaching labs are in compliance with OSHA regulations.

Also noteworthy is that two years ago, the Department lost a full time term position. William Karney had been carrying an annual 24-unit teaching load in the Chemistry Department (mainly teaching organic chemistry, analytical chemistry and core science courses) for five years. In 2002 he was appointed to the Environmental Science Department. The Department was not allowed to hire a full-time replacement for him. This loss, coupled with the loss of Bill Michaely, the lab manager for a few years, has resulted in insufficient full-time faculty to deliver the curriculum. We are feeling particular stress in general chemistry, organic chemistry and analytical chemistry: This year (2004-2005) we will hire part time faculty to cover four sections of general chemistry; the enrollments in the two first-semester organic chemistry sections have expanded beyond the 40 student cap (47 and 48, respectively); one faculty (Melaugh) is on teaching overload; we have a waiting list for the second semester organic chemistry lab for non-majors due to insufficient faculty to open new sections; we have had to rely on part-time faculty to deliver the analytical chemistry course twice in the last four years. Next year, we will need to hire part-time faculty to help us deliver the biochemistry curriculum.

7. THE DEPARTMENT BUDGET

The department budget can be separated into three general categories: (1) Student Employment, (2) General Operating, and (3) Entertainment. Graph C shows the budget in each of these categories for the past 5 years.

Graph C



	2000 - 01	2001 - 02	2002 - 03	2003 - 04	2004 - 05
Student Budget - Allocated	$89,868	$89,868	$89,868	$74,868	$77,863
Student Budget - Actual	$71,874	$77,714	$63,928	$92,315	$100158*
General Operating	$71,059	$71,059	$71,059	$71,059	$72,480
Travel/Entertainment	$687	$687	$687	$687	$701

* Student Budget – Actual: For 2004-05, the amount is projected.

7.1 Student Employment

The monies allotted for student employment is currently $77,863. This represents a 4% increase from last year. While the majority of this money goes to support teaching assistant stipends for our graduate students, a smaller part goes to support undergraduate students who work as readers or help in the chemical stockroom. In 2003-2004 the student budget was reduced by $15,000. The Dean at the time, Stanley Nel, removed money from the student employment budgets across all of the science departments at this time in order to create the salary for a Science System Administrator. While we applaud the hire of the Science System Administrator, we now find ourselves unable to stay within the budget. For example, this year we anticipate spending over $100,000 on student employment. More details on the reasonableness of this budget as it relates to TA support can be found in the section, *The Graduate Program.*

7.2 General Operating

Our budget for General Operating Expenses for the current fiscal year (June 1, 2004 –May 31, 2005) is $72,480. From this budget we pay for capital equipment, repair and maintenance costs for equipment, office supplies, chemicals and glassware to support the teaching labs, all duplicating expenses, and freight and postage. More minor expenditures (i.e., annual costs under $500) that are taken out of this budget include, telephone charges, interlibrary loan charges, honoraria and awards. Our biggest concern regarding the budget is that we have no allocation for a capital budget. Moreover, the lack of even a "roll over" provision from the General Operating category makes it very difficult to plan rationally for the purchase and maintenance of equipment. We realize that the College of Arts and Sciences, as a whole, is "capital poor" and that the implementation of a capital budget for science departments needs to come from administration at the university-wide level. We hope that the new administration in the College

of Arts and Sciences will be able to effectively communicate this issue to upper administration so it can finally be resolved.

7.3 Entertainment

We receive ca. $700 for this category, which is clearly inadequate to support even the most modest entertainment for our students. Two examples of how this money is used are (1) periodic luncheons hosted by SAACS to bring together chemistry faculty and students; (2) the end of the year Chemistry Banquet in which we honor our graduating seniors and masters students. These events alone cost much more than the allotted $700. Last year we spent $2024.

8. SUMMARY AND FUTURE OUTLOOK

8.1 Summary of Current Strengths

- Research activity of faculty and students
- Thesis-based masters program
- Flexible major
- Strong lab-based curriculum
- Excellent teachers
- Healthy number of biochemistry majors
- (Mostly) State of the art equipment
- Success of students after graduation

8.2 Summary of Current Inadequacies

- Lack of full-time stockroom/lab manager
- Lack of capital budget
- Insufficient number of chemistry majors
- Non-competitive TA stipend
- Inadequate multipurpose facilities

8.3 Future Outlook

We feel the Chemistry Department offers excellent programs for those students with a range of interests, something that was lacking at the time of our last program review. Our programs can be extremely rigorous (ACS-certified) or slightly more flexible, enabling the student to make the best fit with his or her long-range goals, whether it be pursuing a PhD, M.D, PharmD, or working directly after college. In addition, the masters program continues to successfully prepare our students for job or PhD program placement. We have undergone numerous curricular changes over the last 10 years and now hope that instead of expending energy and resources on such changes, we can focus our attention on recruiting more prepared students into our programs and spend more time on research with students. To accomplish this successfully and not feel the endless stress associated with delivering an intense laboratory-based program, we hope that we will have increased support staff, particularly in the form of a lab manager.

Nonetheless, the department realizes that it will likely need to change in fundamental ways in order to accommodate changing perceptions of chemistry. For example, in a recent C&E News[1] editorial, Rudy Baum, comments on the uncertainty of chemistry being able to retain its image as the central science. He questions whether chemistry departments have taken "seriously enough

the challenges for chemistry that are being posed by the increasingly multidisciplinary nature of science." He further notes that departments that traditionally supported chemistry "are going their own way and developing chemistry curricula and research programs better suited for their students and faculty."

While much of Baum's concerns can be interpreted to apply primarily to graduate programs, it may not be long before some of these same issues appear at the undergraduate level. Our own department has not been immune to the trend of other majors removing their chemistry requirement: nursing majors no longer need to take *any* chemistry course; physics majors no longer are required to take general chemistry; environmental science majors no longer take a semester survey course of organic chemistry. Traditionally, we have perceived this trend as one that reflects the "dumbing down" of other majors, since their students did so poorly in their chemistry courses. However, it may be time to revisit this issue and reflect how a small, ACS-accredited department is to remain viable with the current trend toward interdisciplinary science. Our response to this trend will partly be shaped by how ACS responds to the concept of becoming less rigid in its requirements, partly in having a science building that encourages interactions between colleagues, partly in the administration encouraging and rewarding collaboration across departments (e.g. team teaching, cross-department hires, etc.), and partly in the chemistry faculty's ability and desire to become more flexible and more creative in delivering a chemistry curriculum that seems relevant to other scientific disciplines.

Over the next decade the department will see numerous retirements; one will likely occur at the end of this year, another the following year. Thus, we are now at a point where discussions are occurring regarding the future makeup of our faculty. One possible scenario is that the department chooses a specific focus (e.g., nanotechnology, computational chemistry, biochemistry, chemical education) and this focus guides the hiring of new faculty. Another scenario is that the department simply hires faculty that have been trained in an interdisciplinary field, e.g., biophysical chemistry, bio-inorganic chemistry. We will clearly need to explore chemistry programs at other institutions to gain a better understanding of what is possible to implement here at USF.

Finally, we should note that the Chemistry Department would like to see the administration support a science seminar series in the future. Currently the Physics Department seems to be one of the few science departments to continuously host colloquia. The Chemistry Department has sporadically attempted to do this over the years with varying degrees of success. The most problematic issues are (1) low attendance and (2) the amount of time required by the faculty member who is in charge of organizing the seminars. Instead of having separate, department specific colloquia, we propose that the College of A &S support *one* science seminar series, scheduled at a time that all science students could attend. The faculty organizer for this event would have to ensure s/he get speakers from many disciplines and would likely receive some sort of workload compensation. In addition, the faculty organizer would clearly rotate among all participating science departments. We feel this is an excellent way to pool our resources and to promote interdisciplinary ideas amongst both faculty and students.

[1] Chem and Engineering News, Oct. 11, 20

APPENDICES