University of San Francisco

College of Arts and Sciences

Department of Chemistry

Self–Study

December 1993

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- Course Syllabi

1 Department Overview

The Chemistry Department at the University of San Francisco (USF) is a small, American Chemical Society-certified department with five and one-half full-time faculty members. We currently have 48 undergraduate majors and 12 students in our master's degree program.

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

Professor	Specialty	Current Teaching Duties
John Cobley	Biochemistry	Biochem. lecture, Biochem. lab, Biochemistry Advanced Topics, Freshman Seminar, Natural Sciences, Chemical Literature
Jeff Curtis	Inorganic Chemistry Physical Chemistry	Senior-Level Inorganic Chemistry, Physical Chemistry lecture, Instrumental Analysis, Analytical Chemistry lecture and laboratory
Theo Jones	Biochemistry	Biochem. lecture, Biochem. lab, Biochemistry Advanced Topics, Nursing Chemistry
Tom Gruhn	Physical Chemistry	General Chemistry, Physical Chemistry lecture and laboratory
Tami Spector	Organic Chemistry	Organic lecture and laboratory, Chemical Literature
Kim Summerhays (1/2 Chemistry; 1/2 Computer Science)	Analytical Chemistry Physical Chemistry	Nursing Chemistry, General Education Science Course

For related data on Chemistry faculty, see Appendices 1–4: A capsule summary of full-time faculty, *curricula vitae*, and publication lists are located in Appendix 1; faculty teaching evaluations, together with a sample evaluation form, are located in Appendix 2; faculty grade distributions for Spring 1993 (lower and upper divisions) are located in Appendix 3; and the enrollment history of the Department from 1985 to present is summarized in Appendix 4. (In addition, faculty publication reprints are available for review at USF.)

Of the five and one-half full-time faculty members, two and one-half currently have outside research grants. One of the current grants is from the National Science Foundation (Professor Curtis), one is from the Petroleum Research Fund of the American Chemical Society (Professor Spector), and one is from The Consortium for Advanced Manufacturing International (Professor Summerhays). One faculty member has recently applied for and only narrowly missed a large grant from the NIH, and one plans a submission to NSF in the mid-term future. There are small, competitive internal grants available at USF, and all of the faculty have turned to these at various times to bridge gaps between outside grants.

The Chemistry Department at USF stands out as one of the more intense and active academic units on campus. This statement is made on the basis of a number of straightforward indicators. Many of these will become obvious after a reading of this report. The major points in this regard are:

1) the percentage of faculty who work with undergraduates in scientific research activities (currently 4 of 5.5, 73%)

2) the percentage of upper-division Chemistry majors choosing to become involved in research (currently 6 out of 15, 40%)

3) the substantial array of departmental activities designed to promote student-professor contact and engender a sense of community (see Section 9)

4) the existence of our active chapter of Student Affiliates of the American Chemical Society (SAACS)

5) the percentage of faculty either with or seeking outside funding (4.5 of 5.5, 82%)

6) the percentage of faculty with a publication appearing in a refereed journal within the last two years (4 of 5.5, 73%)

7) the percentage of faculty and students who remain at USF over the summer and intersession (January) in order to work on their research and/or prepare for the coming semester's laboratory courses (most of the faculty and all of those undergraduates who are involved in research)

As noted in item (7) above, most of the Chemistry faculty are on campus, available to students and working all year long – in many cases in the evenings and on weekends. Very importantly, students in Chemistry have the opportunity to work closely with faculty and become involved as truly important players in ongoing, externally-funded research projects. They routinely appear as co-authors on the scientific publications of the USF Chemistry Department.

Our students have a very good track record for going on to higher degree programs or finding professional employment upon leaving us. Section 12 of this report, "Student Epilogue," summarizes the career paths of our recent graduates. We take great pride in the accomplishments of these students, and we make every effort to maintain contact with them after they leave us.

In addition to supporting the University's Statement of Mission to the extent possible within our curriculum, the primary charter of the Department is both to serve a core group of Chemistry majors with a well-constructed, American Chemical Society-approved degree program that will effectively prepare them for careers and/or advanced study in chemistry, and at the same time serve the University with lower-division Chemistry courses for students in other majors (chiefly Biology and Nursing). A secondary goal is to run a modest-sized master's degree program that will enliven the academic atmosphere of the Department, provide competent teaching assistants for the laboratory courses who will be readily accessible to the undergraduate students, and supply society at large with research-capable advanced-degree holders in chemistry. In addition to all of the above, we also seek to nurture the existence of small, active research groups composed of both graduate and undergraduate students (preferably in about equal proportions) where new insights into the nature of physical reality are gleaned and from which they are disseminated to the greater scientific community through publications and presentations.

The primary educational outcomes expected for students who go through our undergraduate program are:

- thorough grounding in both the practical and theoretical aspects of chemistry
- full understanding of the scientific method as it is applied to chemistry and the process of discovery in chemical research
- familiarity with the chemical literature and how to use the library and modern information retrieval techniques so as to research any topic in chemistry
- ability to compose and present professional-quality written reports on laboratory work, as well as the ability to present cogent, formal oral presentations, either on research work or literature topics
- familiarity with modern chemical instrumentation and instrumental methods

Educational outcomes expected for students in the graduate program are described in detail in Section 10 of this report.

Given its modest size and funding level, this Department is doing reasonably well in fulfilling its objectives. As general evidence in support of this assertion, we would point to the high activity levels discussed earlier in this section and, most importantly, to the placement history and track record of our alumni (see Section 12, "Student Epilogue"). We believe that this latter point stands as both the simplest and the strongest indicator as to the integrity of our program. We have recently come up with some ideas as to how to begin measuring our educational outcomes systematically using standardized tests. These are discussed in the Preliminary Development Plan that accompanies this Self-Study.

There are some areas within the Department, however, that are definitely in need of attention. In particular, the sections of this report entitled "Chemistry Curriculum" (Section 2), "Faculty Workload" (Section 3), "Department Governance" (Section 4), "Department Facilities" (Section 5), and "Graduate Program" (Section 10) will make the relevant issues clear, as will the information on enrollment statistics in Appendix 4.

2 Chemistry Curriculum

Our curriculum is described on pages 53-57 of the University Catalog for 1993-94 (located in Appendix 5). Individual course syllabi are available for review at USF. Most of this curriculum is of the same structure as that which is found at the majority of institutions around the country. It takes its form naturally on the basis of the lines of demarcation between subdisciplines within chemistry and the need to introduce basic concepts sequentially during the first two years of study and then build upon them in the second two years. The mixture of topics covered in each course is designed to be in keeping with the American Chemical Society guidelines in effect at the time. These vary slightly from year to year according to the ongoing debate in the literature (*Journal of Chemical Education*) and within the ACS itself. As an example of this process, we have recently implemented laboratory experiments in our Analytical (Chemistry 260), Organic (Chemistry 232,233), and Instrumental Analysis (Chemistry 460) laboratory courses in order to respond to ACS demands for a higher content of experiments geared toward inorganic chemistry (refer to course syllabi, available for review at USF).

The ACS guidelines for a certifiable degree program are:

- a minimum of 420 hours of classroom work, supervised reading courses, and active-participation seminar courses; and

- a minimum of 500 hours of laboratory work. Normally at least 400 of these hours will come from structured courses. It is admissible for 100 of these to come from student research projects, as long as a written report or senior thesis is forthcoming at the end of the process.

On the order of four-fifths of an approved program are to be covered in the core curriculum (*vide infra*) and spread approximately equally over the areas of analytical, inorganic, organic, and physical chemistry (as well as biochemistry for students pursuing that degree option). The remaining fifth is to be covered in a minimum of two regularly offered advanced courses other than research.

The courses taken by our **ACS-certified** students can be broken down as follows (calculated on the basis of a 15-week semester):

Course	Semester Credits	Lecture Hours	Lab Hours
General (Chem 111/113)	10	90	180
Organic (Chem 230/231/232/233)	10	90	180
Analytical (Chem 260)	4	30	90
Physical (Chem 340/341/342)	10	120	90
Inorganic (Chem 420)	3	45	0
Instrumental Analysis (Chem 460)	4	30	90
Chemical Literature (Chem 380)	2	20	20*
Undergraduate Seminar (Chem 385)	1	15**	0
TOTALS	44	440	650

* time spent in library doing literature and computer database searches
** mostly student presentations

Of the courses listed above, General, Organic, and Analytical (first set) are University-wide service courses. The second set are taken almost exclusively by Chemistry majors. Individual course descriptions are listed in the Catalog copy included in Appendix 5. The ACS-certified students also take the following Mathematics and Physics courses:

Course	Semester Credits	Lecture Hours	Lab Hours
Analytic Geometry and Calculus (Math 109/110/212)	9	270	0
Multivariable Calculus (Math 210)	3	90	0
General Physics (calculus based) (Physics 110/210/212)	12	270	45
TOTALS	24	630	45
OVERALL TOTALS	68	1,070	695

As the Chemistry-only section of the above breakdown shows, our students are just slightly over minimum compliance with the ACS guidelines for lecture hours, but well above the minimum for laboratory hours. Where we flirt with trouble is in the area of advanced courses (*vide infra*). Up until now the ACS has been willing to waive their guideline that *ca.* 20% of the curriculum be delivered in the form of two advanced courses. This has been done in consideration of the above-minimum laboratory hours that we require and the fact that two of our "core" courses, Inorganic (Chemistry 420) and Instrumental Analysis (Chemistry 460), both have Physical Chemistry as a prerequisite and both can be argued to contain at least some "advanced" material.

The courses taken by our **Biochemistry emphasis** majors are as follows:

Course	Semester Credits	Lecture Hours	Lab Hours
General (Chem 111/113)	10	90	180
Organic (Chem 230/231/232/233)	10	90	180
Analytical (Chem 260)	4	30	90
Biochemistry (Chem 350/351)	6	90	0
Biochemistry lab (Chem 352)	4	30	90
Adv. Biochemistry (Chem 450/451)	4	60	0
Physical (Chem 340/341)	6	90	0
Inorganic (Chem 420)	3	45	0
Chemical Literature (Chem 380)	2	20	20*
Undergraduate Seminar (Chem 385)	1	15**	0
TOTALS	50	560	560

* time spent in library doing literature and computer database searches
** mostly student presentations

These students also take the following Mathematics, Physics, and Biology courses:

Course	Semester Credits	Lecture Hours	Lab Hours
Analytic Geometry and Calculus (Math 109/110)	6	90	0
General Biology (Biol 105/106)	10	90	180
General Physics (calculus based) (Physics 110/210)	8	180	30
TOTALS	24	450	210
OVERALL TOTALS	74	1,010	770

In addition to the above, all of our students take the courses outlined in the **General Education Curriculum** (copy included in Appendix 5). The unit requirements in the GEC break down as follows:

Writing Courses	6
Public Speaking	3
Statistics	3
History and Social Science	6
Cultural Perspectives	6
Literature and the Arts	6
Philosophy and Theology	15
Language	8
TOTAL	53

Thus the total unit requirement for ACS Chemistry students is found to be 68 + 53 = 121, and that for the Biochemistry emphasis is 74 + 53 = 127.

These represent some of the highest overall loads in the University. The result is that Chemistry students are rather tightly scheduled, and they have only a minimum amount of room left for electives and/or research activities.

2.1 Lack of Advanced Courses

The primary and glaring problem with our curriculum is the lack of advanced courses for our upper-division ACS pure Chemistry majors and graduate students. The primary reason for this deficiency is that we simply have not had the staffing level necessary to both run advanced courses and our relatively laboratory-intensive upper-division curriculum. This situation undermines the integrity and credibility of our program at both the undergraduate and graduate levels, and it threatens to get us into trouble with the ACS.

It is our great hope that we will soon be in a position to remedy this problem. With the addition of a new faculty member to help handle our expanding enrollments in the lower-division courses (primarily GEC, freshman, and Organic), we anticipate being able to add one or two upper-division elective courses as well. These could be team-taught courses offered either once a year or once every other year.

A possible curricular change designed to help facilitate this goal involves a consolidation of the Physical Chemistry laboratory course (342) and Instrumental Analysis laboratory (460) into a single "Integrated Laboratory" course. This plan is discussed further in the Preliminary Development Plan that accompanies this Self-Study. The idea here would be to shrink our overage in the laboratory area by a modest amount (45 hours of laboratory and 15 hours of laboratory-oriented lecture) and open up space (45 hours of lecture) for an advanced lecture course.

Probably the most needed, general-interest electives we could offer would be the courses on Spectroscopy and Reaction Mechanisms already listed in the Catalog but no longer taught (Chemistry 630 and Chemistry 631, respectively – see Appendix 5). We might also run the Polymer Chemistry course (Chemistry 670), which tends to be popular among students due to its high degree of industrial relevance. These courses would be of sufficient interest to students in all subdisciplines that we could be confident of adequate enrollments. This would go a long way toward giving our upper-division majors and graduate students a more satisfying and intellectually well-rounded experience here.

2.2 Natural Science General Education Curriculum (GEC) Course

Starting in Fall 1994, the Chemistry Department will be taking part in the offering of the new GEC laboratory science course. The exact details of the implementation of this course are still being worked out, but some aspects are clear as of this writing. The Chemistry component will come as the second of a three-part sequence (Physics/Chemistry/Biology) taking a total of two semesters to present.

In both the Biology Department and in the Chemistry Department, there has been some degree of faculty reluctance to becoming involved in the development and implementation of this course. The understandable fear on the part of faculty members is that they may become permanently associated with the course and end up with it as a substantial part of their teaching load forever. We are committed to not doing this in Chemistry. This course will be taught in at least semi-regular rotation by *most if not all* of the members of the Department. Hopefully, we can find a way to assign workload credit for this course such that participation in it is not looked upon as a curse and a misfortune. If the faculty delivering this course have a positive attitude toward it, then it will have a much higher chance of being accepted positively by the students.

2.3 The Role of Undergraduate Research in the Major

We have a long-standing tradition of undergraduate involvement in research here at USF. Historically, approximately 50% of the upper-division majors will choose to be involved in research with one of the professors in the Department during any given year. As of this writing, we are somewhat below our usual level of participation; of our 15 upper-division students, only six are involved in research. If we consider only seniors, however, things look better; five of our eight current seniors are actively engaged in research. We wish the overall participation by our upper-division students could be higher, and we have recently instituted measures to try to raise it (in the form of an informational/promotional social event).

Importantly, students are seldom turned away by professors in the Chemistry Department if they wish to do undergraduate research. Indeed, Professor Jones of our Department is currently working with two undergraduate students from Biology who are interested in his area of biochemistry. Normally these slots would be occupied by Chemistry students, if the demand were higher. The number of Chemistry majors has tended to remain fairly constant over the years in spite of wide fluctuations in the total student credit hours (SCHs) taught in the Department (see the data presented in Appendix 4). We anticipate that we will continue to be able to offer research experience to virtually all of our upper-division majors who desire it (students who are not achieving an average of B in their science courses, however, are disallowed from research).

The role of research in the training of a laboratory scientist is of pivotal importance. It is here that the students come to grips with the struggle and exhilaration of actually *doing science* as opposed to just learning about it. There is an invaluable deepening in the student's appreciation of what science is and an important process of self-discovery with regard to whether the student enjoys it enough to want to make a career of it. The nature of the student-professor relationship takes on a new dimension, and in many cases the research director becomes a mentor and a friend for life. The detailed letters of recommendation from research directors about a given student's abilities carry much more weight with prospective employers and/or professional school admissions committees than do the standard kinds of letters most students are able to obtain.

The Department itself gains in several ways from the existence of a healthy undergraduate research program. The sense of belonging and enthusiasm that exudes from the students has a very positive effect on morale for all concerned. The undergraduate researchers contribute to a true sense of scientific community, and their confidence and positive feelings about USF radiate out with them as they enter jobs in the local community or go off to graduate school. The scholarly work that these students help to create serves to enliven the Department academically as the professors publish the findings (always a thrill for the undergraduates involved) and compete for external funding from a strengthened position.

We believe that the opportunity for interested undergraduates to participate in ongoing research programs is one of the single most important distinguishing characteristics of an education in Chemistry at the University of San Francisco.

In Appendix 6 we include a copy of a highly relevant address on the topic of undergraduate research by Dr. Fred Shair, Dean of Natural Sciences at California State University, Long Beach. Dr. Shair very correctly identifies the pivotal role of undergraduate research in building a sense of community within a department. We also include in Appendix 6 two excerpts from the ACS Committee on Professional Training (CPT) Newsletter. The first of these forcefully makes the point that, in the history of the Departmental studies conducted by the CPT, *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.* In the CPC's 50 years of experience, very few excellent bachelor's programs have weak research components, and no weak programs have strong research components.

2.4 Nursing Chemistry Course

A final curricular matter that bears some attention concerns the Nursing Chemistry course (Chemistry 116). This is a four-unit course with two 75-minute lectures per week and one three-hour laboratory per week. In this course the professor is expected to deliver a cogent introduction to General, Organic, and Biochemistry. The pace is simply too fast. One result of this is that only a relatively small amount of Biochemistry, the most relevant topic for the Nursing students, can be wedged in at the end of the semester. The whole experience from the student's perspective has been likened to "drinking from a fire hose."

In Appendix 7 we include a survey that was conducted in 1988 of a sampling of nursing programs around the country. It is clear that the majority of the other institutions surveyed devote *approximately twice* as much time to chemistry for their nursing students as we do. Our students are not any better prepared than those at these other institutions, and it is no great wonder that our Nursing Chemistry course is experienced by many as being either too shallow or too hurried, or both. Needless to say, many find it to be too stressful and difficult. Compounding the primary problem of the rapid pace is the fact that most of the Nursing students take the course in their freshman year before many of them have developed the levels of seriousness and good study habits that are demanded by conceptually rigorous material. Experience has very clearly shown that the older students tend to handle the course better than the entering freshmen do. Redesigning this course as perhaps a three-unit course in the fall semester on General and Organic and then a two-unit course in the spring semester on Biochemistry would go a long way toward making it into a more satisfying and useful experience for the students. Moving the course into the sophomore year would help a great deal with the maturity and study habit problems that plague many of the students now.

2.5 Chemistry Student Statistical Profiles

In Appendix 8 we include various data tables relating to the demographic makeup of our majors and their scholastic aptitudes. From these data we see that the student body in Chemistry is moderately diverse ethnically and towards the upper end of the range of students entering USF as regards scholastic aptitude.

3 Faculty Workload

The University policy on teaching load is that all faculty have 12-unit loads, along with a contractual obligation of three units of service to the University. At the discretion of the Dean, three units of release time for research may be granted. All of the professors in the Chemistry Department have sufficient levels of research in progress that we all receive the three-unit release. Workload distributions for the last two years are found in Appendix 9. As can be seen from the lists, the standard teaching load in the Department usually works out to be nine units with three units of credit being given for research. This translates into approximately three three-unit lecture courses, or one three-unit lecture and one six-unit upper-division laboratory course per semester.

Certain important qualitative aspects of workload are not evident in these numbers. These primarily consist of the especially demanding nature of running the General Chemistry Lecture/Laboratory course (111-113) and the Organic Chemistry Laboratory (232,233,234). These courses involve large numbers of students, preparatory workers, and teaching assistants, as well as logistically very complex laboratory components. The hassle factor to the professor considerably exceeds that which is currently credited for these courses by the Dean's Office. Importantly, these courses also require a large amount of preparatory work over the summer (in the hundreds of hours for student preparatory workers) and over intersession. Supervision of the preparatory students involved absolutely requires faculty time, energy, and presence. The above arguments also apply to some degree to the Nursing Chemistry (Chemistry 116) course. The

Dean's Office guidelines for assigning workload credit, as currently applied, are probably in need of some minor revision to reflect the above facts.

3.1 Graduate Advisor Position

The Department is currently not allowed to grant any workload credit to the faculty member who serves as Graduate Advisor. Administering the graduate program is a very substantial job. The time input and hassle factor exceed by a factor of at least three what is traditionally expected of Chemistry faculty in the way of service to the University. The Graduate Advisor must be available not only during the academic year to run the program, track students, organize and execute promotional efforts, solve problems, and lobby for money, but he or she must also be on campus and available over summer and intersession (January). Much of the job involves fire-fighting and dealing with people in states of high anxiety. Thus the Graduate Advisor is put in a reactive mode much of the time -- often a more tiring kind of duty than simple time considerations would indicate. More details as to the duties of the Graduate Advisor are included in Section 4 on "Department Governance."

3.2 NMR Expert/Contact Person

Each professor in the Department is currently responsible for keeping on top of maintenance problems and supply shortages for one or two departmental instruments (since our Instrument Technician is stretched too thin to do this). This is a fair and reasonable arrangement, except for the case of the Nuclear Magnetic Resonance Spectrometer (NMR). The NMR is somewhat *more* than one order of magnitude more complex to operate, organize, and maintain than any of the other instruments in the Department. The faculty member who ends up having to serve as troubleshooter, organizer, consultant, and contact person for the NMR ends up with a *huge*, 12-month per year hassle to deal with (Andy Huang, Instrument Technician, is able to do some of the routine maintenance, such as handling the cryogenics and keeping the compressor line going, but anything that requires an understanding of the instrument's operation is quite beyond him). The efficacy with which the NMR expert/contact person does this job directly impacts the functioning of Chemistry 460, 342, the Organic laboratories, and numerous students' research projects. In the recent past the Chair was allowed to recognize the magnitude of this burden by granting one unit per year of workload credit, but this consideration has been revoked by the University.

3.3 Research Groups

Recently, three units of research release have been granted by the Dean's Office to all Chemistry Department faculty who are engaged in significant original scientific work. This happens whether or not they choose to take on the task of running a research group – as is the case in most of the rest of the University where faculty typically pursue their research work on a solitary basis. The existence and importance of research groups is fairly unique to Chemistry, and it presents something of a dilemma for the University regarding workload policy.

Running a group is a central activity to the research chemist, yet it is not, in itself, research. It requires a considerable commitment of time and energy in the form of teaching, coaching, cheer leading, counseling, logistical support, laboratory management, waste management, inventory control, instrument tinkering/repair, and simply "being around." The tasks involved in running a group are outlined in detail later in this section.

It would be *possible* for professors within the Department to gather very limited amounts of new data and occasionally publish without the existence of research groups, but the activity level within the Department would drop dramatically. Undergraduate researchers in the Department would be deprived of the valuable opportunity to work as members of a real scientific team, and the graduate program would cease to exist. If we are to maintain our identity as a Department where significant, externally-funded research is a viable option and where undergraduates are able to take part in vigorous, ongoing research programs, then it is necessary that at least some fraction of the professors in the Department take it upon themselves to run research groups. At present, four of the six professors in the Department have groups of three or more students working in their laboratories.

The dilemma for the University is how and whether to grant workload credit for the teaching/contact aspects of running a group (in addition to the three units of research release). A substantial portion of running a group is simply another form of teaching and administration – it is not research. "Research" in the more commonly recognizable form (at USF) of reading/thinking/ writing must take place outside of and in addition to running the group. It would seem that out of simple fairness and a desire to encourage this enlivening activity, the University might be amenable to granting some small, balanced degree of workload credit to those who choose to take on this task. This idea is further discussed in the curricular and workload proposals outlined in the Preliminary Development Plan.

The purpose of the remainder of this section is to list some of the various tasks associated with running a laboratory research group. The nature and magnitude of these tasks are neither obvious to, nor easily anticipated by, someone who has never had to do them. Thus it is understandable that most professors and administrators at USF either discount them altogether or substantially underestimate what they entail.

In this summary we first list activities related to actual *contact* hours with undergraduate and graduate research students, and then we list activities related simply to running the group operation. Hour-per-week estimates are based on an average five or six student group composed of both graduate and undergraduate students. The time estimates are split out to show the approximate difference between how time is allocated during the normal school year and how it is allocated during intersession and summer. These estimates are drawn from the combined experiences of Professors Curtis, Spector, and Cobley as amassed over the last several years.

Activities Related to Actual **Contact Hours**
With Research Students

		Hours Per Week	
		Academic Year	Summer/Intersession
1	Discuss research projects with individual students, orient new students, monitor progress in understanding of continuing students.	4.0	8.0
2	Select/assign readings to each student as project and student's understanding evolve.	2.0	4.0
3	Prepare, conduct weekly group meetings where professor and students take turns addressing the group regarding research progress and/or current literature reports.	1.5	1.5
4	Teach new synthetic/analytical/preparative techniques to individual students as they need them and become ready for them.	1.5	4.0
5	Supervise and direct writing, re-writing, re-writing... of master's degree theses and senior theses.	2.0	6.0

6	Review/edit students' resumes and cover letters as they apply for jobs and/or graduate schools. Counsel with students as to their career goals and interests. Write recommendation letters.	0.3	0.5
7	Help prepare students who are going to be giving departmental presentations on their work or on literature topics (includes attending practice seminars).	0.5	0.5
8	Troubleshoot technical difficulties with chemical manipulations and/or instrumental techniques that students invariably encounter as they attempt to execute their research project.	1.0	4.0
9	Write "Directed Study" forms, deal with associated (grading) paperwork.	0.1	-0-
10	Provide students with written protocols for a wide range of laboratory manipulations.	0.3	0.5
11	Train students in safe practices, handling of hazardous materials, and/or radioisotopes.	0.2	0.2
	TOTALS	13.4	29.2

Noncontact Activities Associated With
Maintaining an Active Group and Laboratory

		Hours Per Week	
		Academic Year	Summer/Intersession
1	Physically organize the laboratory.	0.5	0.5
2	Organize hazardous waste for disposal/recycling.	0.2	0.2
3	Order necessary equipment and chemicals so as to keep the students supplied with what they need; manage inventory, storage, and usage.	0.25	1.0
4	Accounting work associated with research grants.	0.25	0.5
	OVERALL TOTALS	14.6	31.4

These tasks *must* all happen in addition to reading, thinking, grant writing, and publication writing on the part of the faculty member.

One may certainly choose to argue about the exact magnitudes of some of the individual time estimates listed here, but none of them is likely to be off by more than 20% or 30% either way. The main point is that there is considerable effort that must go into running a group that is not currently recognized by the University on an official basis.

The system as it is now works due to the drive, enthusiasm, and willingness to sacrifice on the part of the Chemistry faculty. It would be a significant morale boost to the Department and a statement of support if the University could recognize the above efforts as being worthy of some small degree of workload credit. This idea is discussed in greater detail in the Preliminary Development Plan.

4 Department 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 the graduate program, which is handled by the Graduate Advisor. The Department meets every three or four weeks during the academic year to handle whatever issues are submitted as agenda items by either the Chair or by other faculty members in the Department.

4.1 Chairmanship

The Department Chair attends to the state of the Department budget, supervision of staff, teaching assistant assignments, workload distribution, yearly chemical purchases (the big summer bid), year-long instrumentation problems and repair negotiations, course scheduling problems, outside accreditation agency relations (ACS), part-time faculty selection, full-time faculty searches when they arise, teaching assistant. assignments, and the *many* other logistical details involved in running the complex technical entity which the Chemistry Department is.

The Chair receives four units of workload credit for this effort. There is some question as to whether this is an appropriate amount. Not only does the Chair have to attend to the job quite closely over intersession and summer, but the nature of the job is such that it extracts a psychological toll considerably in excess of what the simple time requirements would indicate.

The Chair is held accountable for a vast array of issues over which he or she has relatively little control or authority. The Chair becomes the focus for frustration from all directions. He or she is always "on-deck" for myriad student problems and complaints. The phone rings constantly, and the mail box fills up with paperwork every day. There are seemingly endless meetings. In the course of executing the job, the Chair must extract numerous small administrative tasks out of his or her colleagues in the Department; this consistently puts the Chair in the position of having to be a nag and makes him or her vulnerable to passive aggression.

As a result of all of the above, the chairmanship is a decidedly unpopular job. Our experience as a Department is that the career-impeding and quality-of-life-degrading nature of the job is sufficiently high that considerable levels of tension arise in the Department as people compete to keep their heads off the chopping block. The system as it is works because faculty members essentially "volunteer" to take the job on, typically with great trepidation and heaviness, when it becomes apparent that their number is up. Department members all know that with the chairmanship come levels of stress and constant distraction such that it is very nearly impossible to run a research group and publish or put more than the minimum effort into one's teaching. It is even harder to maintain a positive outlook on one's job.

Most chemistry departments around the country offer considerably better incentives in terms of workload credit and extra pay so as to make the chairmanship a less objectionable burden. The job also tends to be structured so as to carry with it a more balanced level of real authority at most institutions (our Chairs have only that level of authority which they can maintain on the basis of charm and persuasion; this is not always adequate to the task at hand). Reform in this area would be welcome.

One important point that needs to be made is that the chairmanship role in a laboratory science department, especially one such as Chemistry or Biology, involves a level of logistical complexity that is not obvious to someone who has never had to face it. It might be likened to running an academic department *in addition to a* small business with attendant issues of inventory control, equipment performance/maintenance, employee safety, and waste management.

4.2 Graduate Advisor

The other position of governance in the Department is that of Graduate Advisor. This job, although much smaller and less stressful than the chairmanship, is nonetheless substantial and important.

The Graduate Advisor must coordinate the selection of students for admission into the program and the making of offers of graduate scholarship support. He or she must bird-dog every single offer through each and every stage of the admissions process – otherwise, as experience has shown us, the offers will get lost somewhere or not get out in time. He or she must correspond with students and their sponsors making inquiries about the program and those who have been accepted prior to their arrival here. The Graduate Advisor must also handle departmental advertising in *Peterson's Guide*, the ACS graduate-school finder, and our listing in the *ACS Directory of Graduate Research.*

When students arrive, the Graduate Advisor is their first contact and must in many cases help them to arrange dormitory rooms, rides from the airport, etc. Later, when something goes awry with their scholarship allocation, the Graduate Advisor must calm them down and then help them straighten it out. Thus, the Graduate Advisor is on call for fire-fighting and problem-solving *12 months per year.*

The Graduate Advisor job also involves a significant amount of lobbying for money for the students and trying to help them figure out how to make ends meet while they are here. As is summarized in Section 10 of this Self-Study and in Appendix 10, there is a significant gulf between the combined support package (in the form of graduate scholarship support and teaching assistantship stipends) which we are able to offer here at USF and the going rate nationally.

5 Department Facilities

This section deals with departmental space and equipment. Appendix 11 contains a map of the fourth floor of Harney Science Center and a key indicating how space there is allocated, as well as an inventory of all the instrumentation and equipment available in the Department.

5.1 Space

We note that approximately 30% of the office space on the floor is being used either by Biology faculty (Rooms 437 and 440) or emeritus faculty (Room 402). This doesn't represent a crisis for us now, but something will have to change when we add a new faculty member (hopefully in Fall 1994). The new faculty member is going to be added in the organic area, and it is most logical that his or her research work will be conducted in Room 430 after some renovation/expansion (see Preliminary Development Plan).

Also, graduate and undergraduate research students need desks to work and study at. When our undergraduates have a desk in a research lab somewhere from which to operate as the day proceeds, we find a much higher level of identification with the Department and willingness to put energy into it (not just in research, but in terms of our club/social activities, etc...). We are now nearing full capacity and could definitely use more space for our research students. This is another reason why it would be helpful to us if we could reclaim our office space.

Our primary problem with regard to teaching space is that the Biochemistry laboratory and Nursing Chemistry laboratory courses must share the same space. The Biochemistry laboratory is an important part of our upper-division program, and it deserves to have its own dedicated laboratory space. This would allow for a more customized and sophisticated complement of equipment and apparatus to be left permanently in place for the Biochemistry laboratory students. Our Biochemistry students are not being well-served by the current situation. In the Preliminary Development Plan that accompanies this document, we put forth a potential solution to this problem.

Another substantial problem concerns the Organic Chemistry laboratories. The lab-bench fixtures and the ventilation provisions in these laboratories are out of step with the times. We are in need of rather substantial renovation to bring these laboratories into the 1980s.

5.2 Equipment

As an inspection of the equipment inventory will indicate, we are reasonably well-equipped for such a small department. Our NMR facility is certainly adequate, we have two high-quality UV/Vis spectrophotometers with complementary strengths and weaknesses, and we have fairly modern GC, HPLC, and FTIR instruments. We have serviceable, workhorse-type centrifuges on this floor and access to more sophisticated ones in the Biology Department. We have most of the equipment listed in the set of recommendations published by the American Chemical Society as being appropriate for an accredited department.

Four major areas in need of improvement do stand out, however:

1 The analytical balances being used by the students in Quantitative Analysis are 30 years old. They bear little resemblance to the ones our students will encounter in the real world, and they are the cause of some frustration on the part of the students, since they are rather fragile and tricky to use. We need to upgrade to modern electronic balances sometime in the mid-term future.

2 We have no spectrofluorimeter in the Department. We do have access to an antiquated instrument in the Biology Department, but it is in relatively poor repair and its capabilities are quite limited. This impacts the students in the Instrumental Analysis (Chemistry 460) course, the Organic laboratory (Chemistry 232-234), and the Quantitative Analysis course (Chemistry 260).

3 Our departmental Atomic Absorption (AA) spectrometer is on its last legs. The electronics and optics are showing their age (about 20 years), and replacement parts are no longer available. This instrument will need to be replaced soon.

4 The equipment in the Physical Chemistry laboratory course is all on the order of 20-30 years old, and some of the experiments themselves (since they are to a large degree dictated by the equipment available) have fallen out of step with the times. In the Preliminary Development Plan that accompanies this Self-Study, we delineate our near-term plans to merge the P-Chem laboratory with the Instrumental Analysis laboratory and form an "Integrated Laboratory." To do this properly will require at least some new equipment.

Relevant to the general topic of equipment is the fact that we have no departmental capital budget provision. The Dean's Office has been able to help us with several small capital purchases over the course of the last few years, but the lack of a locally controllable and predictable capital allocation of our own keeps us from really being able to plan equipment upgrades and acquisitions in a rational manner. On a couple of occasions during the 1980s we had the opportunity to acquire large-ticket items (NMR, FTIR) as a result of University (CEFA) bond issues. While extremely beneficial when they come along, such events are hard to predict or plan for, and they are not the optimal means by which to develop a department.

6 Staff Support

The Chemistry Department currently has the following *permanent* staff support structure:

- Department Secretary (Miss Lindy Chris) — Full-time, recently upgraded from half-time
- Stockroom Manager (Mr. Charles George) — Half-time, now in second year
- Instrument Technician (Mr. Andy Huang) — Half-time (shared with the Biology Department)

The full-time position for secretary is probably just about right. Work gets backed up on occasion, but not habitually or intolerably.

The half-time positions for stockroom and instrumentation, however, are inadequate.

6.1 Stockroom Manager

The stockroom manager has a very large and rapidly expanding job on his hands. Not only must he handle the huge job of inventory storage and tracking, but he must interface with a large number of laboratory course students and student preparatory workers for the laboratory courses. Student preparatory workers require close supervision if they are to do their jobs safely and effectively. With our increasing enrollments, and hence numbers of laboratory sections, it is becoming very clear that the logistical complexities of the job have exceeded what is appropriate for a half-time position. At the current levels of student through-put in the laboratories, he is just barely able to keep the stockroom(s) organized and handle the supervision of the student preparatory workers for the General Chemistry (Chemistry 111/113) course. As a result of this, a fairly large amount of *faculty* time goes into preparatory work and preparatory worker supervision in the other lower-division courses – Nursing (116), Organic laboratory (232,233,234), and Quant. (260).

State and Federal regulations require that ever-increasing levels of attention be devoted to hazardous waste management and handling, chemical storage and safety, and student worker supervision/training. Joe Murphy of the Environmental Safety Office is helpful to us in this regard and interfaces well with the stockroom manager, but his University-wide job keeps him from spending very much time in the Chemistry Department. The person doing the already logistically quite complex stockroom management job must also attend to these important regulatory compliance functions. By stretching the stockroom manager too thin, we invite potential legal problems.

6.2 Instrumentation Technician

We currently share Mr. Andy Huang with the Department of Biology. The workability of this arrangement has been on the decline for some time now. The job is simply too big. By being spread too thin, Andy is prevented from really knowing and understanding the departmental instruments (the NMR instrument would be the most glaring example, but there are others) well enough to keep them in optimum condition and stay ahead of problems. As a result, Andy is in a perpetual crisis/fire-fighting mode, which involves lots of running back and forth between Departments and broken instruments. Individual faculty members end up having truly significant portions of their time and energy consumed by problems that would best be handled by the instrumentation technician.

6.3 Student Workers

The budget for student worker support has been growing over the last several years as SCH in the Department has increased (see Section 7 on "Budget History"). This is a welcome trend, but we must point out that there is a hidden problem that comes with it. Student laboratory preparatory workers require skilled and careful supervision. Without a full-time professional person in the stockroom, the proliferation of student help can translate into a drain on faculty time and present the Department with a large potential for chaos. In the worst-case scenario, serious safety – and hence, legal – consequences may arise.

7 Budget History

7.1 Operating Budget

The graph in Appendix 12 shows how the operating budget for the Department has grown over the last six years. If we compare this graph with the numbers contained in "Enrollment Statistics" (Appendix 4), we see that the operating budget has approximately doubled over the same period of time that the teaching load in the Department has doubled (where here we equate departmental teaching load with total SCH and hence student throughput). If inflation is taken into account, however, it is then clear that we have lost some ground. Unfortunately, the costs of chemicals and small scientific equipment items seem to inflate at a rate rather above the standard rate of inflation; hence, this small loss of ground is definitely felt.

7.2 Student Employment Budget

Although precise numbers for the student employment budget (largely composed of teaching assistant stipends) are not available except for the last two years, this budget category has also approximately doubled as enrollments have gone up. The student employment figure in 1991-92 was $50,833; in 1992-93 it was $76,529. There will probably be a similar increase for the 1993-94 academic year.

7.3 Capital Budget

As discussed in Section 5 on "Department Facilities," we have no departmental capital budget allocation. The Dean's Office has been able to help us at times with small capital expenditures, and twice during the 1980s we were able to purchase large-ticket items (NMR, FTIR) as a result of University (CEFA) bond issues.

8 Student Advising and Orientation

Each year we hold an orientation workshop for new students (including transfer students) a few days before classes begin. Materials describing the orientation workshop are located in Appendix 13.

Student advising in the Department is handled by faculty during the registration periods according to the list below:

- Professor Gruhn — Freshmen
- Professor Spector — Sophomores
- Professor Curtis — Juniors and Seniors in Pure Chemistry
- Professor Jones — Juniors and Seniors in Biochemistry
- Professor Cobley — Juniors and Seniors in Biochemistry
- Professor Summerhays — Undeclared Science Students Interested in Chemistry

The heaviest advising loads in the present system are handled by Professors Gruhn and Spector each fall. The loads, however, are not crushing ones. This fall (1993) for example, only six of the 13 entering freshman Chemistry majors had not been advised already by one of the faculty during the voluntary summer advising sessions (*vide infra).* They were handled by Professor Gruhn. On the order of eight sophomore students were handled by Professor Spector, as well as two transfer students. Professor

Curtis handled only four upper-division students and one freshman. No Undeclared Science majors sought out Professor Summerhays.

In addition to their listed assignments, the rest of the faculty try to be available to help with any overflow on the freshman end should it occur (only one such instance occurred this year).

Many new students are advised during the several preregistration periods for freshmen that are held over the summer. In this case, each faculty member volunteers to advise freshmen for a day or two in the summer independent of the assignments listed above.

USF is committed to providing its students with readily available, quality academic advising. The Chemistry Department shares this commitment and does its best to fulfill this function.

One problem that does seem to persist within the current system is that many students are apparently able to get by without seeing their advisors often enough or even at all. We wonder if there is some substantial amount of forging of signatures going on.

A possible plan for revamping our advising system is laid out in our Preliminary Development Plan.

In addition to the efforts of the faculty, we would note that a substantial portion of our departmental orientation (and general public relations as well) is handled by the Department Secretary, Miss Lindy Chris. Her welcoming and hospitable attitude towards students is very valuable to us in this regard.

9 Student Activities

The Chemistry Department conducts several social functions for its students each year. The goal is to strengthen the student-faculty interaction and help to introduce the students to the real world of the chemistry professional.

- Orientation Workshop
  Each year we have a new-student Orientation Workshop (see Appendix 13).

- Fall Social Function
  Each year we have some kind of fall social function. In years past this has included either a volleyball/pizza evening for students and faculty at the Koret Health and Recreation Center, or a departmental barbecue at Professor Cobley's house. This year we are changing gears a bit, and we will be having a "meet the faculty" evening (dinner included), where each professor in the Department will present a ten-minute synopsis of his or her research interests to the students. The goal here is to introduce the idea that undergraduates have the opportunity to get involved in meaningful research during their latter two years here.

- Career Night
  Each spring semester we have an evening (again, dinner included) in which various chemistry professionals from industry are invited onto campus to give a brief (10-15 minute) presentation of what their work is about and what the details of their own career paths have been. There is an extended social period afterward during which the students are able to talk informally with the speakers. This event is partially arranged and staged by our section of Student Affiliates of the American Chemical Society (SAACS).

- Spring Field Trip
  We usually have a field trip in the spring of each year to some local chemical or chemistry-related industrial site. Trip sites have included: Raychem Corporation, Landec Labs, Stauffer Chemical, Genentech Corporation, and others. This event also is partially planned and staged by SAACS.

- Spring Departmental Awards Banquet
  At the end of the academic year, we hold an Awards Banquet during which we recognize our graduating seniors for their efforts and their accomplishments and hand out ACS certificates and various awards (SAACS award, Mel Gorman Memorial GPA award, ACS Polyed Award, ACS Analytical Chemistry Award, American Institute of Chemist's Award, and Outstanding Freshman Chemistry Student Award). This event is heavily attended and usually quite satisfying for all who participate. Again, SAACS has a hand in the organization.

Other activities:

- Science Open House
  Each fall semester (until 1993), there has been a College of Arts and Sciences *Science Open House* (beginning in Fall 1993, and in alternate years to come, the Bay Area Math Meet will alternate with the Science Open House). At the Science Open House, approximately 300 high school students from the Bay Area are brought in to enjoy, among other things, a now-famous Chemical Magic show put on by Professors Gruhn and Spector, and a tour of the Chemistry Department and the research laboratories, with short presentations/demonstrations by the professors and graduate students. We usually find a role for at least some of our undergraduates in this production. They sometimes serve as Tour Guides or demonstrators of the NMR, etc.

- Talks at Undergraduate Research Conferences
  We send undergraduate students to give talks on their research at local undergraduate research conferences (sometimes held here, as was the case last year).

- Talks at Elementary and Middle Schools
  This year, for the first time, we will be sending a group of our upper-division undergraduates (under the auspices of SAACS) out to local elementary and middle schools to make presentations and do demonstrations for the students.

In Appendix 13 we include some of the orientation materials that are given to incoming students by the Chemistry Department.

10 Graduate Program

10.1 Description of the Program

The master's degree program currently has 12 students in it. Of these, about 70% are supported by teaching assistantships, and about 80% receive or have received some level of scholarship support (typically on the order of 60-80% of the cost of tuition – now at $5,800 per year). A copy of our *Peterson's Guide* entry describing the program is located in Appendix 14. Also included in this appendix is a copy of the Department Synopsis that we send out each year to a list of over 250 schools worldwide in an ongoing promotional effort.

Our graduate program is a thesis-based program wherein a student learns enough about the literature in his or her research advisor's area and performs enough original research to produce a professionally written, scholarly master's degree thesis. Students are accepted into the program individually by the faculty members who are willing to commit to taking them into their research groups. Thus, students know who they will be working for when they arrive, and they usually will have been reading reprints and/or review articles sent to them by their advisors as well as brushing up on topics suggested by their advisors in initial correspondence.

What our graduate students attain over the course of completing the graduate program with us consists primarily of the following elements:

1 The ability to use the library and research the chemical literature in order to penetrate deeply their research area (many of the students in the graduate program take the Chemical Literature course, Chemistry 380). The professional importance of this area of expertise is partly responsible for why master's-degree-level chemists are in high demand by industry.

2 Thorough experience and practice in some range of either chemical or biochemical methodologies such that significant, original research can be carried out.

3 Thorough grounding in how to correctly apply the scientific method to one's own work so as to interpret data properly, draw conclusions, set them in context, and consider possible courses for future research.

4 The ability to synthesize their understanding of the literature in their area and the significance of their own contribution in a well-written, professionally-presented thesis. This ability is also at the heart of industry's demand for master's degree holders.

Several examples of master's theses recently produced by our students are available for review at USF.

Students leave the program in a good position either to enter industry (our master's degree program graduates typically find good jobs in short order once they start looking) or to go on to study for the Ph.D. (see Section 12 of this Self-Study, "Student Epilogue").

Aside from the successful completion of a thesis, graduate students are required to deliver a Departmental Seminar on their research toward the end of their time here. There are no specific course requirements, although most of our graduate students do end up taking one or two of our upper-division courses according to the advice of their research director (Inorganic and/or Instrumental Analysis as well as the Literature and Seminar courses are frequent choices). The lack of advanced course options is a definite weakness and will be addressed later in this section.

10.2 Role of the Graduate Program in the Department

The role of the graduate program in the Department is a multidimensional one. The existence of the program not only directly benefits the relatively small number of students who go through it and the community into which they then enter, but it benefits the whole Department in several ways. Importantly, the existence of active and externally-funded research groups provides an arena for truly significant and professionally preparatory research to be performed by our *undergraduates.* By participating as members of active groups, they learn how science is conducted in the places they will be going after they leave us. They learn to attend and present at group meetings, they learn how to work cooperatively as members of an active team, and they learn how to contribute to the physical/logistical functioning of an active research laboratory. The graduate students play a very important part as role models and mentors to the undergraduates in this context.

The graduate students also play a vital role as teaching assistants in the lower-division laboratory courses. Without them we would have no stable and reliable source of person-power to make the teaching laboratories and all the preparatory work happen. Very importantly, while it is *possible* for the Department to recruit some fraction of its teaching assistants from off-campus, our students tend to disfavor these people – even though they may lack the foreign accents that are often lightning rods for criticism early in the semester. The reason is simply access. Off-campus teaching assistants are usually off-campus except for the laboratory hours that they are required to be here. Our graduate student teaching assistants are here all hours of the day and night. Thus they serve as a very valuable learning resource for the students. Many of them work as part of the University's tutoring staff in addition to their laboratory assignment and office hours. Thus the presence and participation of our graduate students is woven very thoroughly into the fabric of our undergraduate program here at USF.

Lastly, the existence of the graduate program greatly enlivens the intellectual atmosphere of the Department and helps to make possible much higher levels of scientific activity, and hence research productivity, than could ever be achieved without it. This empowers faculty in their quest for external funding and enables them to hold together groups that have the necessary "critical mass" of enthusiasm, energy, and power to actually produce significant bodies of work. This directly benefits our undergraduates.

In Appendix 15 we include an interesting article on the interplay between the undergraduate and master's degree programs at the College of William and Mary – a highly regarded liberal arts institution with a strong undergraduate focus and small graduate programs in some of the sciences. Although the parallels between USF and William and Mary are not exact (their master's degree program brings with it state money), it is clear from President Verkuil's message that they consider their graduate programs to be important synergistic complements to their undergraduate programs; *overall quality is enhanced by their existence.*

We include this small bit of propaganda on account of the very prevalent, but we believe mistaken, view held by many outside of the laboratory sciences that graduate programs by definition detract from the quality of undergraduate programs. This point of view misses the synergistic dynamic that exists between the undergraduate and graduate programs in a properly integrated and well-balanced department. We would assert that the USF Chemistry Department is not far away from the goal of being properly integrated and well-balanced in this regard, although there is room for improvement. As mentioned earlier in this Self-Study, we would like to be able to get back to more historical levels of at least 50-60% participation by all undergraduate majors in research. We have recently undertaken measures to try to increase undergraduate interest in research (see Section 9 on "Student Activities"). As the narrative in the next section will indicate, we are also very much interested in trying to improve the quality of our entering graduate students (not the *quantity*; we feel that the master's degree program is probably about as big as it needs to get).

10.3 Challenges Facing the Graduate Program

10.3.1 Student Quality

We are at something of a disadvantage at USF when it comes to recruitment of graduate students in Chemistry. Graduate student financial support in the form of scholarships, though very generous by historical USF standards, is rather thin when compared with most other schools (full tuition remission is a matter of course in a large fraction of the departments we're competing with; we average 60-80% tuition coverage by scholarships). Compounding this problem is the fact that our teaching assistant stipend – again, quite generous by USF standards – is substantially lower than normal on a national basis. The most recent Georgia Institute of Technology survey of graduate programs (Appendix 10) shows that the average teaching assistant stipend nationally is about $5,600 per laboratory section after tuition and fees are subtracted. We pay $2,850 before tuition and fees. Add to this the fact that our students must survive in one of the most expensive cities in the country, and it becomes clear that we face an uphill battle in terms of recruitment.

The result of all this is that we cannot be as selective in our admissions as most competing institutions. We still get a significant number of good students, but we also get some of the other kind. Apart from the occasional domestic student (currently two of twelve students), we rely on international students who either want to come to San Francisco for some particular reason (family ties in many cases), or who couldn't get a more lucrative offer from somewhere else – usually because of a poor GRE or Test of English as a Foreign Language (TOEFL) score. A survival strategy we have evolved is to accept students a little further down the TOEFL ladder than most other schools. What we have found is that if we admit students in the 560-580 range, they will be able to handle their chemistry courses (upper-division undergraduate offerings such as Inorganic or Instrumental Analysis) and communicate quite adequately in the laboratory for their first year here, and then they will in most cases be able to serve quite well as teaching assistants in their *second* year. Thus, if the student has enough outside financial support to get through the first year without a teaching assistantship, he or she can come here and make a successful go of it. If we try to be more selective than this and admit students in the 600 range, very few will accept, since they usually receive more generous offers from other institutions.

The current system *is* working (see Section 12, "Student Epilogue," which shows where our master's degree recipients go after they leave us). We have successfully developed a workable strategy for dealing with the kind of student pool that we are in a position to attract and retain. By not letting first-year international students teach, we can generally assure that our undergraduates get laboratory teaching assistants who can communicate effectively in English. The willingness, positive attitude, and around-the-clock accessibility of these master's degree students makes them generally preferable to the off-campus teaching assistants we have tried. Through patience and hard work on the part of the faculty research advisors, we are able to see over 80% of our entering graduate students all the way through to the successful completion of their degrees.

Importantly, almost all of these graduate students complete the program in two and one-half years or less. We do not have a large cadre of "hangers on" who are simply trying to figure out what to do with themselves. The students are serious about the program, they generally have very clear goals with respect to future career/educational plans, and the timing of their progress through the program tends to be quite crisp.

10.3.2 Graduate Curriculum

As mentioned previously in this section, one major weak point is that we have no specific course requirements for our graduate program. This has evolved out of the fact that for the last several years, we have not had the person-power to run any of the advanced courses listed in the Catalog (see also Section 2, "Chemistry Curriculum"). Most of our students do, however, take at least one or two courses. For example, Professor Curtis advises most of his students to take the senior-level Inorganic course. Professor Spector advises most of her students to take the Instrumental Analysis laboratory. Professors Cobley and Jones often advise their students into the advanced Biochemistry courses (Chemistry 450 and 451). Most graduate students take the Chemical Literature course (Chemistry 380), and those who are deemed to need help on the their English skills (usually about half of each incoming class) are advised into the Seminar course (Chemistry 685), where they present at least two seminars to the class (usually the second one is based on their research project). Recently Professor Cobley has explored the route of taking students over to the University of California at San Francisco to attend a graduate-level Biochemistry course there and receive credit here.

There is clearly room for improvement. It would be preferable, both for our graduate students and for our upper-division undergraduates, if we could run at least one or two advanced elective courses per year in the Pure Chemistry area. The most logical choice would probably be to try to put on the listed courses in Spectroscopy (Chemistry 630) and Reaction Mechanisms (Chemistry 631). These could possibly be offered as team-taught courses, where different segments would emphasize different aspects of the topic at hand – e.g., organic vs. inorganic reaction mechanisms, or theoretical vs. applied spectroscopy. Another very attractive possibility would be to offer the Polymer Chemistry course (Chemistry 670) again. This course was popular when we offered it before, due to its great relevance to the world of industrial chemistry.

We very much hope that we will be able to improve our program in this regard when we bring a new faculty member on board as a result of the rapidly expanding enrollments in our lower-division courses (see Appendix 4 on Enrollment Statistics for more information on this latter point). In our Preliminary Development Plan we also describe a small curricular change in the upper-division offerings that should help us to facilitate this enhancement.

11 Questionnaire Results (Summary)

The massive mailing and administration of the Educational Testing Service (ETS) Program Assessment Questionnaires regarding the Chemistry Department to faculty, undergraduates, and alumni produced a correspondingly massive amount of data to sift through.

Sample ETS questionnaires, together with supplementary questions developed by the Chemistry Department, are in the binder accompanying this report. The raw data and supplemental question responses are available for review at USF.

Fortunately, the Summary Data Report provided by ETS boils the raw data down into a digestible and at least somewhat useful form. In this section, we will note and briefly discuss trends, strengths, and weaknesses about the Department that these data appear to uncover. In almost no case does a given response with regard to our Department deviate by a full standard deviation from the ETS "comparative data set" drawn from a large sampling of schools (available for review at USF). For this reason, we have chosen to take *one half* of a standard deviation as the potential "flag" for noting a given question or category that probably needs to be thought about.

One general and important trend worth noting in the data is that our alumni sample group (53 responses) is in almost every case much more generous to the Department than the current student sample group (six responses). This could simply be a statistical fluctuation due to the small sample size of the student response pool, but there are probably a few other factors worth considering. The first has to do with the broader perspective that comes from exiting USF and living in the real world, where the comparative strengths and weaknesses of one's training are brought into clearer focus and made obvious in one's daily interactions with colleagues from different backgrounds. In general, current students in a program are susceptible to the notions that (a) much of what they are being forced to learn is of questionable utility, and (b) they are being put through an unnecessarily stressful and difficult experience by an overly demanding faculty. These perceptions fade quickly with a little maturation and experience.

Scholarly Excellence
Both faculty and alumni rate the Department high in this category; current students and graduate students rate it as average. The questions from which this category is drawn seek to measure the degree to which students are challenged and stimulated by the program.

Curriculum
Current undergraduate and graduate students rate us below average in this category. Inspection of the questions from which this category is drawn indicates that this problem arises primarily because of our lack of advanced course offerings for our pure Chemistry ACS students and graduate students.

Alumni don't seem to share this frustration.

Available Resources
Current students and graduate students (surprisingly, not faculty) rate the Department quite harshly in this area. Inspection of the individual questions indicates that the students feel very strongly that the University does not adequately support their program financially.

Student Satisfaction with Program
Reassuringly, all students and alumni give the Department an approximately average (according to the comparative data set) rating in this crucial category. Evidently, in spite of the problems identified, they are generally about as happy as everybody else.

Resource Accessibility
All current students rate us low in this area. Inspection of the individual questions reveals that the main reason here is dissatisfaction with the financial aid situation.

Employment Assistance
Graduate students rate us especially harshly here. This is somewhat paradoxical, since they generally have a rather easy time finding employment or getting into decent doctoral programs (see Section 12, "Student Epilogue"). The perception appears to be that the University's Career Services Center offers no help at all.

Faculty Research Activities
The Chemistry Department faculty show a "mean scale percent" of 43% vs. the comparative data set value of 30%. It looks like we're at least holding our own here.

Student Accomplishments in Last Twelve Months
Our undergraduates are not doing too well in this area. Their "mean scale percent" is at 24% vs. a value of 39% for the comparative data set. These numbers could be expected to vary hugely according to *which* six undergraduate students turned in questionnaires – was it the research-active group, or the more "course of least resistance" group? Even if it was the research-active group, it is generally not until the senior year that students are in a position to give talks on their work, and it is generally not until sometime after this that their names appear on publications. We conclude that the relatively low score in this area probably does *not* represent a serious problem, especially in view of the successful pattern of student placement evident in Section 12 ("Student Epilogue"), but it probably *does* represent something we need to think about. A more concerted effort to get our students to present their research work would probably be in order.

12 Student Epilogue

In this section we include a list of where our recent graduates (over the last five years) have been going after leaving USF.

Our students do quite well after leaving us. Those who wish to go on to graduate school tend to get into quite decent Ph.D. programs: UC Santa Barbara, UC Irvine, UC Davis, UC Los Angeles, Clemson, Texas A&M, Brigham Young University, MIT, University of Indiana, Purdue, and others. We have also placed students in a number medical school programs recently: UC San Diego, UC San Francisco, UC Davis, University of Kentucky, Creighton University, University of Tennessee, Temple University, Tulane University, and others.

Those who wish to enter industry also find plenty of opportunities. Recent graduates have found positions at: Clorox Technical Center, Pacific Gas & Electric Research Center, Finnigan Instruments, Anresco Analytical Labs, Biorad, Hewlett Packard, Chiron Corporation, Syntex, Genentech Corporation, and Chemical Waste Management Company.

We feel proud of the accomplishments of these students and the general high degree of acceptance our students experience when they hit the real world. Our students' track record stands as the single most important statement as to the integrity of our program and the fact that we are doing our job as a Department.

Internships and Placements

Undergraduate Student Internships

[redacted]

Quality Control Assistant for the U.S. General Services Administration (USGSA) (Fall 1991 - May 1993)

UCSF research

Hewlett Packard Summer Internship, 1988

Hewlett Packard, Menlo Park

Research technician, Argonne National Laboratory, Chicago (Summer 1991 and 1992)

Lab Assistant, Genetics Laboratory, Kaiser Hospital, Oakland

PG&E Internship, Summer 1989, 1990

Landec Research Assistant (Summer 1989 and 1990)

PG&E Research Center, San Ramon

Air Quality Control Labs, San Francisco

Hewlett Packard

Biochemistry research at U.C. San Francisco, Summer 1990

Analytical Chemistry at Air Quality Control Labs, Summer 1993

PG&E Research Center, San Ramon

Undergraduate Student Placement

[redacted]

UC San Diego Medical School, 1988

Clorox Technical Center, Chemical Waste Management, 1992

Genentech, 1988

M.D./Ph.D program at U.C. San Francisco, 1989

Creighton University Medical School

Ph.D. in Chemistry, U.C. Santa Barbara, 1992

Graduate program in Materials Science, University of North Texas, 1993

[redacted]

Ph.D. in Chemistry, U.C. Davis, Fall 1991
Post-Doc in Oxford, England, 1991 - 1993

Environmental Engineering, Ph.D. program at Michigan State

Clorox Technical Center, Pleasanton, 1991
Chevron Research, 1989

PG&E Research Center, San Ramon, 1988

Environmental Science, Ph.D. program at Michigan State, 1990

Ph.D. candidate (Chemistry) U.C. Santa Barbara, 1991

Ph.D. in Chemistry, U.C. Santa Barbara, 1992

Tulane University Medical School, 1989

San Jose State University, M.S. program

Ph.D. candidate in Chemistry at U.C. Santa Barbara, 1991

Creighton University Medical School, 1989

UCSF research
UCSF Biochemistry 1990
Ph.D. program at UC Santa Barbara, 1991 - present

[redacted]

University of Tennessee Medical School, 1989

University of Tennessee Medical School, 1991

Unknown Biotech Company, 1991

U.C. San Diego Medical School, 1987, now at UCSF as an intern

Temple University Medical School, 1990

<u>Graduate Student Placement</u>

[redacted]

Ph.D. candidate, Clemson, 1992

Ph.D. candidate at UC Davis, 1991 - present

Chemist with Perkin Elmer Corporation, 1993

Texas A & M University, Ph.D. in Biochemistry 1989

Syntex, 1993

MAT, Menlo Park, 1990

Chemist at PG&E, Diablo Canyon facility, 1993

[redacted]

Coca Cola, Quality Control Chemist, Summer 1992
Anresco, Inc., Nutritional Analysis Chemist, February 1992 -

Ph.D. candidate in Chemistry at Indiana University, 1991

Director, In Hee Trading Co., Ltd. (a scientific equipment company)
Seoul, Korea

Ph.D. program in Biochemistry at Texas A & M University

Ph.D. candidate at the University of Hong Kong, 1990 - present

Ph.D. from U.C.L.A. in 1990

Ph.D. candidate in Biochemistry at the University of Texas, 1991

Ph.D. and D.V.M. University of Colorado

High School Teacher

Ph.D. - U.C. Davis, 1990

Ph.D. candidate at UC Irvine, 1992

Ph.D. in Biology, Texas A&M University, 1990

Genencorp International, Staff Scientist

Peninsula Labs, Belmont

Genentech, Staff Scientist

Research Scientist, Chiron Corporation

Ph.D. program in Chemical Engineering at Brigham Young University, 1993

Chemical Waste Management, 1992

Appendices