University of San Francisco

College of Arts and Sciences

Department of Chemistry

Preliminary Development Plan

December 1993

In this document we will outline action steps and goals that, for the most part, flow directly and logically from the issues discussed in the various sections of the Self-Study.

Our *fundamental goal* within the Department is to improve the overall quality and competitiveness of the undergraduate program and the graduate program. We hope both to enhance the quality in our service-oriented courses (GEC, General, Organic, Analytical, and Nursing) and to refine/improve our upper-division offerings so that our undergraduate majors and our graduate students leave us in a strong position for the competitive world they face. In pursuing these goals it is of great importance to us that we also maintain our strong commitment to an active research environment where students can participate as members of vigorous, externally-funded research teams.

The details of how we plan to pursue the above objectives will emerge from what follows.

1 Faculty Size, Workload, and Curriculum

The three issues listed above are so inextricably linked together that we choose here to discuss our near- and mid-term future hopes for the Department in the context of all three.

At the conclusion of the Department Overview and Mission section in the Self-Study, we refer the reader to the enrollment statistics contained in Appendix 4 of the Self-Study. There, we note the rapid growth currently taking place in our lower-division course offerings. This growth is already placing considerable strain on our ability to cope as a faculty – especially in the freshman and Organic areas. We have now had to split the General Chemistry lecture course into two sections simply to keep the section sizes below 100 (an important issue with respect to the quality of instruction). The amount of work and logistical hassle associated with running the General Chemistry and Organic Chemistry laboratory courses has grown with enrollments and is now on the verge of overwhelming our current staffing levels. By fall of 1994 we will also be participating as a faculty in the full-scale implementation of the new Science GEC course.

It is clearly a priority for us to hire another full-time faculty member who can help us to handle the increased teaching load in the Department. As of this writing we are in the process of searching for a new person on the basis of an anticipated position for the fall of 1994. The primary responsibilities, at least initially, of the new person will be to help with the Organic laboratory and lecture components of the curriculum, as well as the Science GEC course and possibly Quantitative Analysis. The new member may also end up eventually having a hand in at least one of the two (alternating years) advanced courses we hope to offer *(vide infra)*.

As a mechanism to efficiently capture a "picture" of where the time and energy in the Department goes now and where we hope to see it go in the future, we include here four spreadsheets that display all the courses in our curriculum along with their attendant workload credits.

The spreadsheet entitled "NOW.000" (attachment 1) shows the current (1993-94 academic year) situation. Although we would hasten to point out that accounting (bean counting?) exercises based on workload units can be both misleading and incomplete, this chart shows that a five-and-one-half person faculty is probably just enough to cover the current amount of work being done in the Department right now.

In the spreadsheet entitled "FUTURE.001" (attachment 2), we display a vision of where would hope to be a year from now. For simplicity, we assume here that enrollments in the 1994-95 academic year will be the same as for 1993-94 – although in all probability they will go up by at least some amount. The

impact of possible enrollment increases will be discussed further on in this section. There are a number of important changes and assumptions enfolded in this chart. In what follows we will list and discuss each of these.

1) Workload Credit Adjustments. Detailed accountings submitted by faculty that list the amounts of time it takes to deliver their various courses indicate that we should probably make some minor modifications to the actual workload credit values granted for certain courses. Specifically, delivering General Chemistry even as one lecture section and supervising all the laboratories for a 200-student enrollment should be granted eight units. If delivered as two lecture sections, it should be nine. The Nursing Chemistry course should be increased to six, and the Organic laboratory courses should be upped to five. The Department is in unanimous agreement on these values. In the FUTURE.001 spreadsheet, we assume that these changes have been implemented.

2) Curricular Changes. As discussed in the Self-Study, our ACS pure chemistry majors receive comfortably over the minimum required hours in laboratory instruction, but are in some jeopardy of being judged as under the minimum requirement for advanced course lecture hours. The lack of advanced course options also undermines the credibility of our graduate program. In order to address this problem, we hope to be able to consolidate the Instrumental Analysis and Physical Chemistry laboratory courses into a single nine-workload-unit (six-semester-credit-hour) "Integrated Laboratory" course. This will decrease the total number of laboratory hours by 45 and the number of laboratory-lecture hours by 15. At the same time we hope to offer one advanced lecture course worth three units. This will contribute 45 lecture hours to the curriculum. The net changes will be -45 laboratory hours and +30 lecture hours. In FUTURE.001, we assume that this change has been implemented.

A second curricular issue has to do with the prechemistry course (Chemistry 001). This course is essentially a course in problem solving and elementary chemical principles similar to the level taught in high school. In order to improve the academic quality of what we can deliver in General Chemistry, our intent starting with the Fall 1994 semester is to administer a Chemistry Placement Test. This should allow us to identify those 20% or so of the students who wish to take General Chemistry, but who will almost certainly do poorly if they do. It is also our desire to do whatever we can in order to see that the existing prerequisite of high school chemistry actually gets enforced (every year a certain number of students seem to end up in General without having taken chemistry in high school – they typically have great difficulty passing the course). Students who do poorly on the Chemistry Placement Test will be routed into the Prechemistry course – now to be offered twice a year in anticipation of greater demand. It would also be very beneficial, in our opinion, if we could screen the incoming Nursing students in this manner. Many of these students would benefit from the Prechemistry course if they were to take it (almost none do now). Short of substantially lowering class sizes in General Chemistry and Nursing Chemistry by offering more sections of each, we believe that the imposition of a placement exam is probably the single most effective step we can take towards enhancing academic quality in these courses.

Third, we show in FUTURE.001 that the new Science GEC course is being run at a level of 500 students per semester in four 125-student lecture sections.

3) Research Groups. In this scenario we assume that the University has decided to take the view that the contact/teaching hours involved in running a research group are indeed worthy of some small level of workload recognition. The amount we assume in this scenario is one unit of credit per semester for groups of four or more. This is, of course, somewhat arbitrary. The main point is that the credit should be small enough to ensure that no one can "research" his or her way out of the classroom, yet large enough to show that the University officially acknowledges the legitimacy and importance of this work. This work is very much woven into the fabric of our Departmental identity, and having it take place entirely "off the books" sends a confusing and at times disheartening message.

4) Other Departmental Functions. Shown at the bottom, but not included in the totals, are the old levels of recognition that the Department was allowed to grant for the jobs of Graduate Advisor and NMR Expert/Contact Person. It would be the Department's preference to return to this prior practice.

1.1 Even More Optimistic Futures

The scenario outlined in FUTURE.001 is, we believe, realistic and attainable. It shows how the Department will be improved by the addition of one more member and how we intend to bring ourselves more clearly into compliance with the ACS guidelines for accreditation. The total work to be done in the Department under this scenario is certainly at least close to the 6.5 faculty staffing level we hope to attain.

This is not to say that FUTURE.001 is an optimal scenario. It allows us to cover all the bases and improve from where we are now, but we would certainly like to shoot higher than this. The Department is in unanimous agreement that the way to improve this scenario is to evolve toward better student/professor ratios in the lower-division course offerings. In the spreadsheet entitled FUTURE.002 (attachment 3), we show how modest improvements in student/professor ratio in Nursing Chemistry, General Chemistry, and the Science GEC course would impact the Department. It is readily apparent that even modest improvements in this regard rapidly give rise to the need for another full-time faculty member.

FUTURE.003 (attachment 4) is our most optimistic scenario. Here we lower section sizes in General Chemistry all the way down to 50 for the first semester and 65 for the second semester. For the Nursing Chemistry course, we assume that the School of Nursing has agreed to come more into line with the rest of the nation in terms of the chemistry content of their curriculum. Thus we show two 60-student sections of Chemistry 116, which would now be comprised of General and Organic chemistry plus laboratories (no Biochemistry). The second semester, Chemistry 117, would consist of a single 100-student section of a two-unit lecture course on the basics of Biochemistry. We further assume in this scenario that the GEC science course will be taught using the pedagogically very desirable section size of 30. Obviously we could keep going from here. For example, we could consider getting General Chemistry all the way down to 30 students per section. This would be wonderful if the University could afford it.

1.2 Impact of Enrollment Growth

As mentioned previously, the future scenarios outlined in the spreadsheets make no provision for enrollment increases. This could easily cause the section sizes to exceed the targets laid out in the various scenarios. For the 1994-95 academic year, enrollment growth in General Chemistry will probably be at least partially offset by the imposition of the Chemistry Placement Test. We hope this will also be true in the Nursing Chemistry course.

It is our great hope as a Department that the University will begin to apply higher admissions standards as a result of the growing application pressure. If this very positive step is taken, then the enrollment growth of the last few years should begin to taper off as we pursue quality over quantity on a University-wide basis.

1.3 Biochemistry/Molecular Biology Duplication

A separate but very important curricular issue concerns the current level of duplication between the Chemistry and Biology Departments in the area of biochemistry/molecular biology. If the two Departments could find a politically acceptable way to cooperate, USF could put together a first-class Biochemistry/Molecular Biology program with integrated laboratories and a very powerful curriculum. As it is, we hobble ourselves and end up delivering an adequate but considerably less-than-optimal program to the students. Given sufficient encouragement by the University, we should be able

to find a much better way to utilize the resources currently available between the two Departments. We hope that the enrollment increases being experienced by both Departments may allow for some easing of the turf-protecting mentality that has paralyzed us for so long and kept us from realizing our full potential in this regard.

2 Department Governance

In this section of the Self-Study one primary issue stands out. There is something wrong with the current structuring of the Chairmanship. There need to be greater incentives built into this position and greater levels of authority such that it becomes a job worth doing rather than a career-damaging ordeal. There is some movement in the College towards reevaluating the current structure, and we applaud these efforts. We hope that as this process goes forward it will become clear that running a laboratory science department requires levels of year-round planning and logistical attentiveness that go quite far beyond the norm on a University-wide basis.

3 Staff Support

In this section of the Self-Study we note that the current staffing levels of half-time Stockroom Manager and half-time Instrument Technician are increasingly inadequate. As a result of too little stockroom management (i.e., laboratory preparatory worker supervision), we continually flirt with disabling levels of chaos, undergraduate teaching laboratory experiments that crash due to incorrect reagent solutions, and potential safety problems. As a result of too little instrumentation support, we often find ourselves lurching from crisis to crisis and trying to "make do" with inadequately maintained instruments. In many cases faculty members are forced into the technician's role – not a cost effective or appropriate use of their time. Frequently students find themselves frustrated in the middle of a laboratory course due to a down instrument and an overbooked technician who cannot always be found or respond in a timely fashion. We definitely need some help here.

4 Space/Equipment/Budget

The most immediate space problem facing us concerns the laboratory and office space requirements that our new faculty member will be needing as of Fall 1994. There is unutilized floor space in Harney 430 (currently Professor Spector's research laboratory) that could be pressed into service after some renovations. Proper office space will be more difficult. As mentioned in the Self-Study, we currently have 30% of our office space occupied by Biology or Emeritus faculty. We need to open up one of these offices in order to house our new person.

The second space issue that bears mentioning here is the lack of dedicated space for the Biochemistry laboratory course. This course is currently taught using the Nursing Chemistry laboratory during its off-semester (Spring) and in the research laboratories of Professors Jones and Cobley. This is far from an ideal situation, and it portends to become unworkable altogether if the current enrollment bulge in the lower-division courses translates into any significant increase in upper-division students taking the Biochemistry laboratory course. We need to find a way to get our Biochemistry students into a dedicated laboratory space where experiments and equipment can be left set up. One possibility would be to renovate the research laboratory in Harney 436 for this purpose, but this would be expensive and it would mean the loss of valuable research space to the Department. Another possibility would be to find a way to integrate our Biochemistry laboratory with the new Molecular Biology laboratory in the Biology Department, as already alluded to above.

In the "Budget History" section of the Self-Study, we showed that although the Department budget has grown significantly over the years, it has not grown quite fast enough to reflect the combined effects of both enrollment increase and inflation. Laboratory science courses require that significant expendables-related and equipment-related purchases be made for each and every student who goes through the program. Thus, increased enrollments bring with them immediate and substantial expense increases. Ignoring these costs impacts the academic quality of the Department's offerings.

A second point made in this section of the Self-Study concerns the lack of a locally-controllable capital budget category. Our last major departmental acquisition was made in 1989 (FTIR) as a result of a major University bond issue. We now need to spend some rather intimidating amounts of money in the general **Space/Equipment** category. Specific needs and ballpark estimates are as follows:

	Need	Estimate
1	Acquire more equipment to handle the increased student loads in the Organic laboratories.	$20,000
2	Upgrade reagent heating and ventilation systems in the Organic laboratories.	$50,000-150,000
3	Acquire a departmental spectrofluorimeter (to be used in Quantitative Analysis, Integrated Laboratory, and Organic teaching laboratories as well as research).	$30,000
4	Acquire numerous small capital items to better equip the Biochemistry laboratory course.	$25,000
5	Acquire new equipment items to help modernize our Physical Chemistry Laboratory capabilities and facilitate merger with Instrumental Analysis into the new Integrated Laboratory course.	$15,000
6	Acquire modern electronic balances for the Quantitative Analysis teaching laboratory.	$20,000
7	Renovate H436 from a Physical Chemistry research laboratory into a dedicated Biochemistry teaching laboratory (???).	$20,000 (?)
8	Renovate unused space in H430 so as to accommodate new Organic faculty member	$25,000

5 Student Advising and Orientation

In the Self-Study we described our current approach to advising within the Department. The current system is working reasonably well, but we are considering a new system for implementation next year that may work better. In the new system, Professor Gruhn will continue to advise freshmen. This is a large load, but it turns out to have a significant pedagogical payoff, in that Professor Gruhn thus forms at least an acquaintance with all incoming freshmen. This is valuable because it paves the way for otherwise shy students to approach him for help and guidance during the course. After this initial year, all students would be assigned a permanent advisor without regard to the biochemistry/pure chemistry demarcation. Importantly, they would not be allowed to obtain signatures from *anyone* except their assigned advisor. It is our hope that this system will allow us to keep closer tabs on how

our students are doing and what they are doing. We would also like to explore the possibility of some way to institute a more effective signature checking protocol at the Registrar's Office. This would also help enforce student-advisor contact.

6 Graduate Program

In Section 10 of the Self-Study, we discussed in detail the nature and origin of our difficulty in recruiting high-quality students and domestic students into our graduate program. The simple answer to this problem is, unfortunately, also the most difficult one: an increased level of support for the program. If we could get our combined level of support from scholarships (effectively tuition remission) and teaching assistant stipends up to 70-75% of the national average (from *ca.* 50%), we would be in a considerably better position to attract higher-quality students.

This idea will be difficult to promote at USF. For one thing, our students already receive quite generous levels of support by USF standards. Second, there is a general lack of appreciation for the highly synergistic interaction that takes place between the undergraduate and graduate programs in the Chemistry Department. Discouragingly prevalent at USF is the damaging idea that healthy graduate programs, almost by definition, detract from the quality of undergraduate programs. We must communicate to the University the fact that our relatively small number of graduate students serve as an integral component of our entire operation and that an investment in graduate student quality is also a *direct* investment in the quality of the undergraduate program (the particulars of their contributions to the Department are fully described in Section 10 of the Self-Study). Our only option is to keep lobbying the University on this and hope that eventually the relative uniqueness of our situation will be appreciated.

We are also pursuing strategies for enhancing graduate student quality *apart* from increased University support, but these strategies are, as yet, of only limited scope and power. One of the professors in the Department, for example, is currently able to augment University scholarship support with additional tuition remission money from the National Science Foundation. Several of us are at least occasionally able to offer summer support to graduate students from research grants (it is easier, however, to get summer support for undergraduate researchers due to the priorities of Research Corporation – one of our more frequent sources of outside money). In a welcome development, one of the new students scheduled to arrive in the Department this January is coming here from the very best university in Taiwan explicitly because of the scientific interests and publications of one of the faculty members. We are also about to start directing increased, personal correspondence to the chairs of the various undergraduate programs around the world from which we have obtained some of our better international graduate students.

Obviously, the more visible we become through scientific publications, external support, and directed promotional efforts, the better the position we will be in to attract and retain quality students. We have made encouraging progress in this regard over the last few years, but we clearly need to make more.

As mentioned previously in this document, we hope to improve our graduate curriculum in the near future by being able to offer at least one advanced course per year. Thus all of our graduate students will be able to participate in two advanced courses during their time here – in addition to any upper-division undergraduate courses they choose (or are advised) to take. The breadth and credibility of the graduate program will be significantly enhanced by this change – as will that of the undergraduate program, since these courses will also serve our upper-division majors.

Attachments: 4

NOW.000

Course number and title		fall	spring	
		(teaching workload units)		
001 Prechem			3	
111, two lecture sections		9		(2 secns of 100 stds ea.)
113 two lecture sections			9	(2 secns of 85 stds. ea.)
116 Nursing		5		(120 stds in one secn)
230,231 Organic lec		3	3	
232 Org lab		3		
233/234 Org lab			6	
236 Fund Organic lec		3		
260 Quant Anal lec/lab			4	
340, 341 Phys Chem lec		3	3	
342 Phys Chem lab			6	
350,351 Biochem lec		3	3	
352 Biochem lab			6	
356 Fund Biochem lec			3	
380 Chemical literature			2	
385 Undergrad Seminar			1	
420 Inorganic lec		3		
450, 451 Adv. Biochem lec		2	2	
460 Instrum.Anal lec/lab		6		
GEC run through		1	1	
CHAIRMANSHIP		4	4	
TOTALS		45	56	=101
				(about 5.6 faculty at 18 wkld
				units/fac)

FUTURE.001

Course number and title		fall load	spring load	
		(teaching workload units)		
001 Prechem		3	3	(now twice per year)
111, two lecture sections		9		(assumes two 100 std secns)
113 one lecture section			8	(assumes one 170 std secn)
116 Nursing		6		(assumes one 120 std secn)
230,231 Organic lec		3	3	
232 Org lab		5		
233/234 Org lab			5	
236 Fund Organic lec		3		
260 Quant Anal lec/lab			4	
340, 341 Phys Chem lec		3	3	
342 Phys Chem lab	(DELETED)		(6)	
350,351 Biochem lec		3	3	
352 Biochem lab			6	
356 Fund Biochem lec			3	
380 Chemical literature			2	
385 Undergrad Seminar			1	
420 Inorganic lec		3		
450, 451 Adv. Biochem lec		2	2	
460 Instrum.Anal lec/lab	(DELETED)	(6)		
400 Integrated Lab	(NEW)		9	
CHAIRMANSHIP		4	4	
SUB TOTAL		44	56	= 100
ACS advanced course	(NEW)	3		
GEC science course	(NEW)	4	4	(assumes 125 std secns)
allow 1 unit/grp/semester	(NEW)	4	4	(assumes 4 groups)
TOTALS		55	64	=119
				(about 6.6 faculty at
				18 wkld units/fac)
OTHER				
graduate advisor	(OLD)	1	1	
NMR tech.	(OLD)	1		

FUTURE.002

Course number and title		fall	spring	
		(teaching workload units)		
001 Prechem		3	3	
111, three lecture sections		11		(assumes 65 std secns)
113 two lecture sections			9	(assumes 85 std secns)
116 Nursing, two lec secns		8		(assumes 60 std secns)
230,231 Organic lec		3	3	
232 Org lab		5		
233/234 Org lab			5	
236 Fund Organic lec		3		
260 Quant Anal lec/lab			4	
340, 341 Phys Chem lec		3	3	
342 Phys Chem lab	(DELETED)		(6)	
350,351 Biochem lec		3	3	
352 Biochem lab			6	
356 Fund Biochem lec			3	
380 Chemical literature			2	
385 Undergrad Seminar			1	
420 Inorganic lec		3		
450, 451 Adv. Biochem lec		2	2	
460 Instrum.Anal lec/lab	(DELETED)	(6)		
400 Integrated Lab	(NEW)		9	
CHAIRMANSHIP		4	4	
SUB TOTAL		48	57	= 105
ACS advanced course	(NEW)	3		
GEC science course	(NEW)	10	10	(assumes 50 std secns)
allow 1 unit/grp/semester	(NEW)	4	4	(assumes 4 groups)
TOTALS		65	71	=136
				(about 7.6 faculty at
				18 wkld units/fac)
OTHER				
graduate advisor	(OLD)	1	1	
NMR tech.	(OLD)	1		

FUTURE.003

Course number and title		fall	spring	
		(teaching workload units)		
001 Prechem		3	3	(now twice per year)
111, four lecture sections		12		(assumes four 50 std secns)
113 three lecture sections			11	(assumes three 65 std secns)
116 Nursing I, two lec secns		8		(assumes two 60 std secns)
117, Nursing II, one section			2	(assumes one 100 std secn)
230,231 Organic lec		3	3	
232 Org lab		5		
233/234 Org lab			5	
236 Fund Organic lec		3		
260 Quant Anal lec/lab			4	
340, 341 Phys Chem lec		3	3	
342 Phys Chem lab	(DELETED)		(6)	
350,351 Biochem lec		3	3	
352 Biochem lab			6	
356 Fund Biochem lec			3	
380 Chemical literature			2	
385 Undergrad Seminar			1	
420 Inorganic lec		3		
450, 451 Adv. Biochem lec		2	2	
460 Instrum.Anal lec/lab	(DELETED)	(6)		
400 Integrated Lab	(NEW)		9	
CHAIRMANSHIP		4	4	
SUB TOTAL		49	61	= 110
ACS advanced course	(NEW)	3		
GEC science course	(NEW)	17	17	(assumes 30 std secns)
allow 1 unit/grp/semester	(NEW)	5	5	(assumes 5 groups)
TOTALS		74	83	=157
				(about 8.7 faculty at
				18 wkld units/fac)
OTHER				
graduate advisor	(OLD)	1	1	
NMR tech.	(OLD)	1		