Weber State University

Chemistry Program Review

Department of Chemistry
College of Science

Date: **Self study completed 11/15/07**

A. Program Mission Statement

revised: November 15, 2007

The mission of the Chemistry Department is to provide chemistry majors with the chemical skills and knowledge they need to successfully pursue their chosen professional careers and other activities following graduation from Weber State University. Included with this goal is the more global application to provide a solid foundation in theoretical chemistry and experimental techniques for other majors across campus including but not limited to: Physics, Microbiology, Botany, Zoology, Geoscience, Criminalistics, Allied Health, Engineering and others. We are also committed to providing: a solid chemical background for all preprofessional students; a general liberal education in chemistry for non-science majors (gen. ed.); and service that requires chemical expertise to the University and our community.

1. Philosophy Statement

The philosophy of the Chemistry Department is to promote learning and enhance understanding about the abstract submicroscopic world of atoms and molecules and the laws that govern their behavior. The Chemistry Department is committed to providing a cooperative learning environment with a hands-on experience for all students. Learning information from a book provides the foundation or knowledge base from which students draw connections in the real world. It is through experimental investigation that information presented in books becomes real and chemical principles are reinforced. Running an instrument, and collecting and analyzing data is quite different from answering questions at the end of a chapter. Moreover, the students gain confidence as they learn the underlying principles and techniques of running technical and sophisticated analytical instruments.

Part of a quality learning environment includes an open-door policy where student/faculty interaction outside of the classroom setting is encouraged. This additional interaction validates our commitment to students and provides a more comfortable atmosphere where students may ask the “dumb” questions without feeling inferior. Also, having access to faculty during the day provides more immediate feedback to questions. Students become more responsible for their learning when their questions concerning lecture, homework or other assignments are answered.

The strength of our program is derived from the dedication and commitment of the faculty and staff to optimize opportunities for the success of each student. We will continue to capitalize on the existing strengths, expertise and resources within the department to improve instruction and the delivery of course material. The development of ongoing assessment procedures will allow us to review our curriculum regularly and to make changes such that it presents modern aspects of chemical theory, instrumentation and research.

2. Uniqueness of the program

One of the unique features of chemistry compared with many other diciplines on campus

is the versatility of our program. All chemistry majors are required to gain a basic knowledge of chemistry principles and instrumentation with an emphasis on analytical skills. By the time a chemistry major is ready for graduation, he or she will have experience and, in some cases, expertise with many of the instruments we have in the department. The learning experience presented to our majors is unique because chemistry is one of the few academic disciplines included in a traditional liberal education that provides technical skills and training suitable for direct employment after graduation.

As part of the training process, the Chemistry Department in conjunction with the Center for Chemical Technology, has provided cooperative work experiences for many of our majors. Indeed, some chemistry students have the opportunity to work with industrial and governmental laboratories before they graduate. On occasion, faculty members have consulted with these companies and continue to maintain active partnerships. These partnerships stimulate faculty vitality and scholarly research activity. Moreover, they provide an outside source of funding to help maintain equipment here at WSU. When faculty are actively pursuing research interests, students become involved and the process benefits both the student and the community. Some of our students have been promoted beyond the internship and are presently employed with the same company. These companies often ask us to provide them with additional students as interns and full-time employees.

Another unique feature of the Chemistry Department is the impressive scholarship and collegiality of the faculty members. Of the twelve full-time (tenured or tenure track) faculty members, nine are authors and/or coauthors of commercially published chemistry text books and laboratory CD's. Four are authors of widely used materials. If in-house laboratory manuals are included, ten out of twelve are faculty have authored essential material for chemical education. Nine faculty members have mentored undergraduate research students in the past five years, and a some have made presentations outside the university and published papers in peer reviewed journals. Thus, a majority of the faculty are actively engaged in development and delivery of course material and/or occasional research.

Other departments or institutions can not always boast of having courses taught by the faculty members who are internationally recognized authors of the books used by the students in the course. Moreover, many of the laboratory sections offered at WSU are taught by full-time faculty members who have either authored the laboratory manuals and/or teach the lecture series. We do not offer any laboratory courses taught by instructor specialists. We currently cover some laboratory sections with a teaching assistant (TA). However, the TA is usually an upper classman who works directly with a faculty member who is simultaneously teaching another section of the same laboratory course. All laboratory students have access to the faculty member for any questions or concerns they may have during the laboratory exercise. Our laboratory classes are an integral part of the courses here, which allows for better correlation of laboratory exercises with lecture material.

Much of what we do in the Chemistry Department is considered service to other disciplines across campus. In general, the Chemistry Department has averaged 12.6 B.S. graduates per year for the last five years (see Table 1b, Appendix A) but our service courses are filled with 60-120 students per section with over 14,000 SCH's taught last year (see Table 1b, Appendix A). The Chemistry Department provides a knowledge base for many other disciplines on campus as diverse as pre-engineering to nursing. We offer upper division service courses in

biochemistry for life science majors and pre-professional students.

The service provided by the Chemistry Department is often directed towards the community and rendered beyond the boundaries of WSU. Many faculty members are actively involved in community science projects which promote science education at all levels. Numerous teachers from local school districts, some of which are former students, regularly request prepared materials for scientific experiments. Others request information on safe handling procedures and disposal of materials. Occasionally, faculty members travel to local elementary schools and give chemistry demonstrations. Over the years faculty members of the chemistry department, along with other members of the College of Science, have organized and directed the Utah State Science and Engineering Fair for junior and senior high school students. The Chemistry Department is actively engaged in community affairs because the faculty members generally strive to be involved with education at all levels.

Part of the community awareness and cohesiveness of the chemistry department can be attributed to the demographics of the faculty members. The Chemistry Department is probably unique in having four WSU alumni, who have gone on to earn a Ph.D. and return to Weber State to teach. Outsiders might perceive this faculty distribution as counter to diversity or a classic case of academic centralism or inbreeding. We consider the return of former students, as teachers, to be unique and an honor for WSU. All of the former WSU students, who are now faculty, are remarkably dedicated to student learning and the community. Over the past five years we have, through the replacement of retiring faculty, organized a nice mix of faculty members with respect to age and expertise. The six adjunct professors currently teaching chemistry at WSU are seasoned professionals with either a Masters or Doctorate degree and some have strong industrial connections. The adjunct faculty complement the strengths of the department and have proven to be valuable assets. It is through responsible hiring practices of the recent past and near future that the Chemistry Department will continue to build upon the solid foundation of success provided by present and former faculty. We have only had two faculty members leave the institution for reasons other than retirement in the past 15 years. A low employee turnover usually indicates satisfaction with work and the workplace environment. The Chemistry Department remains a respected positive influence in the university and general public served by the university.

Finally, the Chemistry Department is one of the few academic disciplines on campus which offers an extensive summer program every year. The number of students in the summer program remains strong. Our department is the only one in the area that still offers accelerated chemistry courses. The structure of the summer semester allows students the opportunity to complete a full academic year of course material in introductory, principles or organic chemistry in one semester. The principles and organic courses are taught in two six week blocks with no change in the course material from that offered during the regular academic year. The students attend lecture for 2.5 hours a day, four days a week. Along with the lecture, they complete two 3 hour 50 min laboratory assignments each week. These condensed courses are not recommended for some students due to the pace and intensity of the classes. The dropout rate can exceed 20% for the organic course but no significant difference has been found in academic performance of the those who complete the summer organic course as compared with students who complete the traditional course, as evidenced by their performance on an American Chemical Society national exam, administered at the end of the course.

B. Curriculum Overview

1. Degrees Offered: Associate and Bachelor Degrees in Chemistry

The Baccalaureate programs in chemistry are designed to prepare students for graduate school or for direct employment in secondary education, government, industry or business.

Type of Program	Description of Degree	Type of Degree Offered
Major	Chemistry Option I	Bachelor of Science
Major	Chemistry Option II	Bachelor of Science
Major	Chemistry Teaching	Bachelor of Science
Major	Chemical Technician	Associates of Applied Science
Major	Chemical Technician	Certificate
Minor	Chemistry	
Minor	Chemistry Teaching	
Minor	Chemistry Emphasis: BIS	
Minor equivalent	Physical Science Composite Teaching	

2. Four Year Programs in Chemistry: Option I, II and Chemistry Teaching

The American Chemical Society (ACS) Certified Bachelor's degree is the most challenging degree offered by the Chemistry Department at WSU, and meets the program guidelines established by the ACS. This particular degree can be augmented by adding an Honors component. The ACS certified degree in chemistry is often referred to as the Option I major for chemistry graduates. Students who take this degree usually plan on working in an industrial or governmental laboratory or attending graduate school in chemistry or chemical engineering.

The Option II major is not certified by the ACS and is slightly less rigorous than the option I major. However, the Option II major has built in flexibility for students who would like to emphasize a certain aspect of chemistry. The Option II major with a biochemistry emphasis is becoming more popular among pre-professional students (pre-medical, pre-dental and pre-pharmacy). Even though the Option II degree is not ACS certified, Option II majors who do not attend professional or graduate schools often find employment in industry.

The Chemistry Teaching major follows the curriculum established by the State of Utah and is offered for those students who wish to teach chemistry at the secondary education level with a bachelor's degree in chemistry. However, a Chemistry Teaching major is not required to teach high school chemistry in Utah. Most high school chemistry teachers take a major in

secondary education with a minor in chemistry.

Core Requirements Option I, II & Chemistry Teaching (24 hours):

Chemistry Course	Hrs	Description	Laboratory Component
Chem 1210, 1220	10	Principles of Chemistry (1 year)	1 full year
Chem 2310, 2320	10	Organic Chemistry (1 year)	1 full year
Chem 3000	4	Quantitative Analysis (1 semester)	1 semester

3. Changes to the core requirements over the past five years:

a. None.

Option I Required Courses (33 hours):

Chemistry Course	Hrs	Description	Laboratory Component
Chem 3020	1	Computer Applications in Chemistry	
Chem 3050	3	Instrumental Analysis	1 semester
Chem 3060	1	Applied Analysis	1 semester
Chem 3070	4	Biochemistry I	1 semester
Chem 3400	3	Molecular Symmetry and Applied Math for Physical Chemistry	
Chem 3410, 3420	8	Physical Chemistry (1 year)	1 full year
Chem 4540	4	Spectrometric & Separation Methods	1 semester
Chem 4600	4	Inorganic Chemistry	1 semester
Chem 4700	2	Special Topics in Chemistry	
Chem 4800	2	Research and Independent Study in Chemistry	1 semester
Chem 4990	1	Senior Seminar	

Option I Required Support Courses (18 hrs):

Course	Hrs	Description	Laboratory Component
Math 1210, 1220	8	Calculus I and II	
Phsx 2210, 2220	8	Physics for Scientists and Engineers (1 year)	

Phsx 2210L, 2220L	2	Laboratory course for 2210 and 2220	1 full year

4. Changes to Option I program over the past five years:

a. Two hours of Chem 4800 (Research and Independent Study in Chemistry) are now required.

b. One hour of Chem 4990 (Senior Seminar) is now required.

c. The Chem 4700 (Special Topics in Chemistry) requirement was increased from one hour to two hours.

d. Students must now complete 40 upper division credit hours.

Option II Required Courses (21 hours):

Chemistry Course	Hrs	Description	Laboratory Component
Chem 3020	1	Computer Applications in Chemistry	
Chem 3050	3	Instrumental Analysis	1 semester
Chem 3060	1	Applied Analysis	1 semester
Chem 3400	3	Molecular Symmetry and Applied Math for Physical Chemistry	
Chem 3410, 3420	8	Physical Chemistry (1 year)	1 full year
Chem 4700	2	Special Topics in Chemistry	
Chem 4800	2	Research and Independent Study in Chemistry	1 semester
Chem 4990	1	Senior Seminar	

Chemistry Option II electives (students choose at least 8 hours):

Chemistry Course	Hrs	Description	Laboratory Component
Chem 3070	4	Biochemistry I	1 semester
Chem 3080	3	Biochemistry II	
Chem 3090	1	Biochemical Techniques	1 semester
Chem 4540	4	Spectrometric & Separation Methods	1 semester
Chem 4600	4	Inorganic Chemistry	1 semester
Chem 4700	1	Special Topics in Chemistry	

Support Courses Required (18 hours)

Course	Hrs	Description	Laboratory Component
Math 1210, 1220	8	Calculus I and II	
Phsx 2210, 2220	8	Physics for Scientists and Engineers (1 year)	
Phsx 2210L, 2220L	2	Laboratory course for 2210 and 2220	1 full year
or			
Phsx 2010, 2020	8	General Physics (1 year)	
Phsx 2010L, 2020L	2	General Physics Lab (1 year)	1 full year

5. Changes to Option II program over the past five years:

a. Two hours of Chem 4800 (Research and Independent Study in Chemistry) are now required.

b. One hour of Chem 4990 (Senior Seminar) is now required.

c. The Chem 4700 (Special Topics in Chemistry) requirement was increased from one hour to two hours.

d. Students must now complete 40 upper division credit hours.

Chemistry Teaching Major Required Courses (4 hours)

Chemistry Course	Hrs	Description	Laboratory Component
Chem 2600	1	Lab Safety	
Chem 4570	3	Science Teaching Methods	1 semester

Chemistry Teaching Major Electives (student selects 7 hours):

Chemistry Course	Hrs	Description	Laboratory Component
Chem 3050	3	Instrumental Analysis	1 semester
Chem 3060	1	Applied Analysis	1 semester
Chem 3070	4	Biochemistry I	1 semester
Chem 3080	3	Biochemistry II	1 semester
Chem 3410	4	Physical Chemistry I	1 semester
Chem 3420	4	Physical Chemistry II	1 semseter

Support Courses Required (3 hours)

Course	Hrs	Description
Hist 3350	3	History & Philosophy of Science

6. Changes to the Teaching Major in the past five years.

a. Comm 1020 (Principles of Public Speaking, 3 hours) is no longer required.

7. Chemical Technician *Associate of Applied Science (A.A.S.)*

The Associate of Applied Science is designed to prepare students for direct employment as a chemical technician in an industrial or governmental laboratory. Course work of 63 total semester hours are required, 35 of which must be from within the program below.

Course Requirements for A.A.S. Degree (21 hours):

Chemistry Course	Hrs	Description	Laboratory Component
Chem 1210, 1220	10	Principles of Chemistry (1 year)	1 full year
Chem 2600	1	Laboratory Safety	
Chem 2990	1	Chem Tech Seminar (1 semester)	
Chem 3000	4	Quantitative Analysis	1 semester
Chem 3020	1	Computer Applications in Chemistry	
Chem 3050	3	Instrumental Analysis	1 semester
Chem 3060	1	Applied Analysis	1 semester

Support Courses Required (4 hours):

Course	Hrs	Description
Math 1010	4	Intermediate Algebra (or equivalent)

Elective Courses (10 hours, at least 4 must be 2000 level or higher).

Course	Hrs	Description
Chem 2310	5	Organic Chemistry I
Chem 2320	5	Organic Chemistry II
Chem 2890	1-6	Cooperative Work Experience
Chem 3070	4	Biochemistry I

Chem 3080	3	Biochemistry II
Chem 3090	1	Biochemistry Techniques
Chem 4540	4	Spectrometric & Separation Methods
Chem 4890	1-6	Cooperative Work Experience
Micr LS/SI 2054	4	Principles of Microbiology
Micr 3053	3	Microbiological Procedures
Micr 3254	4	Immunology
Micr 4154	4	Microbial Genetics
Micr 4252	2	Cell Culture
Btny LS1403	3-4	Environmental Appreciation
Btny SI2104	4	Plant Form and Function
Btny 2503	3	Biology of the Plant Cell
Geo PS/SI1110	3	Dynamic Earth / Physical Geology
Geo SI1115	1	Physical Geology Laboratory
Geo 2050	4	Earth Materials
Phys PS/SI1010	3	Elementary Physics
Phys PS/SI2010 or 2210	5	College Physics I or Physics for Scientists and Engineers I
Phys SI2020 or 2220	5	College Physics II or Physics for Scientists and Engineers II
Zool 2200	4	Human Physiology
Zool 3200	4	Cell Biology
Zool 3300	4	Genetics
Zool 4300	4	Molecular Genetics
CJ 1350	3	Introduction to Forensic Science
CJ 4110	4	Forensic Science I
CJ 4120	4	Forensic Science II

8. <u>Changes to the Associate of Applied Science in the past five years.</u>

Other courses may be used as electives if approved by the Chemistry Department Chair.

The courses in the Table below are no longer required.

Course	Hrs	Description
Engl 1010	3	Intro to Writing
Engl 2010	3	Intermediate Writing
Math 1050, 1060	7	College Algebra, Trigonometry
or Math 1080	5	Precalculus
Phsx 1210, 1220	8	General Physics
& Phsx 1210L, 1220L	2	General Physics Lab
or Phsx 2210, 2220	8	Physics for Scientists
& Phsx 2210L, 2220L	2	Physics for Scientists Lab

9. Chemical Technician: *Certificate of Proficiency (Institutional Certificate)*

Students have the option of taking a Chemical Technician Certificate by completing 41 hours in chemistry and required support and elective courses of the Associates of Applied Science degree. The major difference between the Associates degree and the Chemical Technician Certificate is that the 22 additional hours of general education required for the Associates degree is not required for the certificate.

Courses Required (21 hours)

Chemistry Course	Hrs	Description	Laboratory Component
Chem 1210, 1220	10	Principles of Chemistry (1 year)	1 full year
Chem 2600	1	Laboratory Safety	
Chem 2990	1	Chem Tech Seminar (1 semester)	
Chem 3000	4	Quantitative Analysis	1 semester
Chem 3020	1	Computer Applications in Chemistry	
Chem 3050	3	Instrumental Analysis	1 semester
Chem 3060	1	Applied Analysis	1 semester

Support Courses Required (10 hours)

Course	Hrs	Description
Engl 1010	3	Intro to Writing
Math 1010	4	Intermediate Algebra (or equivalent)

one additional course in oral or written communication	3	

10. Changes to the Associates of Applied Science and Chemical Technician Certificate:

a. Support and elective courses were changed as outlined above for the A.A.S degree.

11. Chemistry Minor & BIS Emphasis

The Minor in Chemistry is designed to give secondary emphasis to students majoring in another field other than chemistry. The Chemistry Minor also provides an option for Bachelor of Integrated Studies (BIS) majors who are emphasizing science in their degree. A minimum of 18 credit hours is required for both the minor and the BIS Program.

Chemistry Courses Required (10 hours)

Chemistry Course	Hrs	Description	Laboratory Component
Chem 1210, 1220	10	Principles of Chemistry (1 year)	1 full year

Minor Electives/BIS Electives (students select at least 8 hours):

Chemistry Course	Hrs	Description	Laboratory Component
Chem 2310	5	Organic Chemistry I	1 semester
Chem 2320	5	Organic Chemistry II	1 semester
Chem 2600	1	Laboratory Safety	
Chem 2990	1	Chem Tech Seminar	
Chem 3000	4	Quantitative Analysis (1 semester)	1 semester
Chem 3020	1	Computer Applications in Chemistry	
Chem 3050	3	Instrumental Analysis	1 semester
Chem 3060	1	Applied Analysis	1 semester
Chem 3070	4	Biochemistry I	1 semester
Chem 4550	3	Geochemistry	

12. Changes to the Chemistry Minor over the past five years:

a. None.

13. Chemistry Teaching Minor

Credit Hour Requirements: A minimum of 26 credit hours is required and students who select the Chemistry Teaching Minor must satisfy the Teacher Education admission and certification requirements.

Course Requirements for Teaching Minor(23 hours)

Chemistry Course	Hrs	Description	Laboratory Component
Chem 1210	5	Principles of Chemistry I	1 semester
Chem 1220	5	Principles of Chemistry II	1 semester
Chem 2310	5	Organic Chemistry I	1 semester
Chem 2320	5	Organic Chemistry II	1 semester
Chem 3000 or other approved chemistry elective	at least 3	Quantitative Analysis (1 semester)	1 semester

Support Courses Required (3 hours)

Course	Hrs	Description
Hist 3350	3	History & Philosophy of Science

If a student is not obtaining a Teaching Major in Sciences, the following courses are also required:

Course	Hrs	Description
Chem 2600	1	Laboratory Safety
Chem 3570	3	Foundations of Science Education
Chem 4570	3	Secondary Science Teaching Methods

14. Changes to the Chemistry Teaching Minor in the past five years:

a. Organic Chemistry II is now required.

b. For nonscience teaching majors, Chem 2600 and 3570 have been added.

15. Major changes to the 4 year programs in chemistry over the past five years

In 1998, Organic Chemistry at WSU was changed from an upper division to a lower

division course, Chem 2310 and 2320. This essentially erased 12 quarter hours or 8 semester hours of upper division credit from our program. Since then chemistry graduates have been granted a waiver of 7 upper division credit hours from the university's Curriculum Committee. Because the waiver was granted, a chemistry major could graduate with 33 instead of 40 upper division credit hours.

Recently, state and university officials have vigorously sought to standardize the 40 upper division credit hour graduation requirement. During fall of 2006, the WSU Chemistry Department faculty decided to conform to the upper division graduation requirement of 40 hours. As shown above, some additional upper division chemistry classes were added to the requirements, although all seven additional hours are not expected to come from chemistry courses.

16. Overview of general education and service courses

General Education Courses:

Course	Description	Primary Clientele
Chem 1010	Introduction to Chemistry	Non-science majors
Chem 1050	Introduction to General, Organic and Biochemistry	Service (see below)
Chem 1110	Elementary Chemistry	Service (see below)
Chem 1210	Principles of Chemistry	Chem Majors & Service
Chem 1360	Principles of Physical Science	Elementary Education

Service Courses:

Course	Description	Primary Clientele
Chem 1010	Introduction to Chemistry	Non-science majors
Chem 1050	Introduction to General, Organic and Biochemistry	Nursing (Allied Health)
Chem 1110	Elementary Chemistry part I	Science, Technology and Allied Health
Chem 1120	Elementary Chemistry part II	Science, Technology and Allied Health
Chem 1210	Principles of Chemistry part I	Science, Engineering, Criminalistics and preprofessional majors
Chem 1220	Principles of Chemistry part II	Science, Engineering, Criminalistics and Preprofessional majors
Chem 1360	Principles of Physical Science	Elementary Education

Chem 2310	Organic Chemistry part I	Life Sciences and preprofessional majors
Chem 2320	Organic Chemistry part II	Life Sciences and preprofessional majors
Chem 3070	Biochemistry part I	Life Sciences and preprofessional majors
Chem 3080	Biochemistry part II	Life Sciences and preprofessional majors

Chem 1010 is a dedicated service course which provides general education credit in physical science for non-science majors. Because Chem 1010 is a one semester course designed to introduce students who are non-science majors to the multiple facets of chemistry, the organization and range of topics covered varies according to instructor preference. In general, the Chem 1010 course covers an introductory discussion of chemical principles then moves to a survey of applied chemistry topics ranging from environmental and industrial issues to household products and cosmetics.

Chem 1050 was offered for the first time Fall semester 2001. The 1050 course is a one semester overview of inorganic, organic and biochemistry designed primarily for Weber State nursing students. It is similar to the two semester Chem 1110 and 1120 series, except that topics are not covered in as much depth. The course not only serves as a general education credit but is also a directed and dedicated service course for Allied Health Sciences. This course is offered live and online (see "Online" section C-15 below). The live version contains one 3 hour laboratory per week. The online version contains home laboratory exercises that satisfy the laboratory requirement.

Chem 1110 and 1120 are dedicated service courses which provide general education credit in physical science for Life Science, Allied Health Science majors and nursing students. Uniformity in these courses is approached in the same way as described for Chem 1210. This course is offered live and online (see "Online" section C-15 below). The live versions contain one 3 hour laboratory per week. The online versions contain home laboratory exercises that satisfy the laboratory requirements.

Chem 1210 and 1220 serve three functions: 1) a required courses for chemistry majors, 2) required service courses for pre-professional, other science and pre-engineering majors and 3) general education credit in physical science for all majors. Chem 1210 and 1220 present the fundamentals of chemistry which serve as an intellectual foundation for students requiring chemistry as part of their major program. With several sections and different instructors, uniformity in terms of topics covered and student preparation is always a concern. The content of this course is coordinated among the faculty members who teach Chem 1210 and 1220. All instructors use the same book and cover the same range of topics. One three hour laboratory per week is incorporated as an integral part of each course. A hybrid (online/live) version is now taught for Chem 1210 in which students meet four hours per week for discussion and lab work.

Chem 1360 is cross-listed as Physics 1360, and is team-taught. It is a dedicated service course which provides general education credit in physical science for elementary education majors.

This course was designed to prepare students who are interested in elementary science teaching and provides them with some tools for active science learning. This course contains one 3 h laboratory per week.

Chem 2310 and 2320 are required courses for all chemistry majors. These courses are also required for other science majors and pre-professional students who are preparing to take entrance examinations in dentistry, medicine, pharmacy and other professional careers. Uniformity in this course is approached in the same way as described for Chem 1210 and 1220. These courses contain a 3 h per week laboratory.

Chem 3070 and 3080 are upper division service courses which are required for chemistry and some life science majors. Although not required, these courses are often taken by pre-professional students. In some cases, students are required by a professional school to have biochemistry, and in others they take biochemistry to prepare more thoroughly for graduate school entrance exams. Chem 3070 contains a three hour laboratory session per week, but chem 3080 can be taken separately from the laboratory (chem 3090).

17. Changes and projected changes to course rotation

The chart below gives a view of current course offerings and rotations over the past three years. A major change in the rotation was the offering of more online sections which provided new opportunities for students to take classes beyond normal campus hours. In the future, a summer chem 1200 course may be offered on the Ogden campus. It is currently only offered at the Davis campus or online. This would help incoming freshman prepare on schedule for chem 1210 in the fall. Another possible change may be to add a section of traditional Chem 1120 to the Fall semester if faculty time is available. Currently only online 1120 is offered to students in the fall. Evening sections Chem 1210 and Chem 1220 have been taught for the past few years. Evening sections of Chem 2310 and 2320 were taught during 2006-2007. However, projected enrollments for 2007-2008 did not appear sufficient to justify teaching the 2310 and 2320 evening courses again this year, and they were not offered. All of the courses in the table were offered each year. Chem 3570, 4550, and 4570 are cross-listed courses taught by faculty from other departments. If enrollments remain flat, the number of sections offered for many of the service courses will remain the same. The number of sections offered will parallel the number of students enrolled, within limitations of the budget, classroom and laboratory facilities, instruments and equipment, and faculty time.

Course Rotation (2005-2008) (Numbers represent sections offered each semester (live / online or hybrid / independent study).

Course	Fall semester	Spring semester	Summer semester	Summer condensed	Online Lab	Traditional Lab
1010	6 / 3 / 1	6 / 2 / 1	2 / 2 / 1	no		

1050	1 / 1	1 / 1	0 / 1	no	X	X
1110	1 / 1	1 / 2	0 / 1		X	X
1120	0 / 1	1 / 1	0 / 1		X	X
1200	3 / 1	5 / 1	1 / 1	yes		
1210	4 / 1	2 / 1	1 / 1	yes		X
1220	1	4	1	yes		X
1360	1					X
2310	2	1	1	yes		X
2320	1	2	1	yes		X
2600	1	1				
2990		1				
3000	1	1	1	yes		X
3020	1	1				
3050	1	1				X
3060	1	1				X
3070	1	1				X
3080		1				
3090		1				X
3400	1					
3410	1					X
3420		1				X
3570	1					
4540		1				X
4550		1 alt. years				
4570	1					X
4600		1				X
4700	1	1				
4800	arranged	arranged	arranged			

*Clustered courses with sequential numbers in bold are 1 year series
* number of sections may change but rotation is projected to remain the same for the next 3 years

Over the past few years, Chem 1010, 1200, 1210, and 1220 have been successfully offered on the Davis Campus. Student numbers are expected to grow there over the next few years. These increases may necessitate adding more sections to accommodate demand. More faculty manpower may be needed to cover growth.

ACS curriculum guidelines are evolving to increase the flexibility with which students may emphasize a particular area of chemistry. In the future we may consider offering not just two optional bachelor degrees, but emphases in analytical, biochemistry, inorganic, organic, or physical chemistry. This would require developing and offering some new courses and substantial reorganization of the existing curriculum beyond the first semester of organic chemistry. Our ability to achieve this will likely be restricted by resources.

18. <u>Online courses</u>

Chemistry offers six courses online; 1010, 1050, 1110, 1120, Chem 1200, and Chem 1210. Chem 1010, with a five student enrollment, was the first online chemistry course offered Fall Semester, 1997. All of these courses have grown considerably over the past five years. Particularly, the Allied Health online chemistry courses (1050, 1110, and 1120) have expanded such that online now exceeds live enrollment. See the enrollment table below (data third week rolls). The enrollment numbers could potentially be greater still if it were not for faculty supplemental salary limitations imposed by the University.

Course	Spring 2007 (live / online)	Summer 2007 (live / online)	Fall 2007 (live / online)
Chem 1010	203 / 135 / 1	33 / 68	293 / 117 / 2
Chem 1050	37 / 68	0 / 80	18 / 76
Chem 1110	68 / 149	0 / 121	71 / 132
Chem 1120	0 / 86	0 / 88	0 / 74
Chem 1200	92 / 24	13 / 25	128 / 27
Chem 1210	120 / 45	35 / 20	161 / 14

Although many students enrolled in the online offerings are from the local area, a significant and growing number of out-of-state and foreign students are registering for online courses

Offering chemistry courses online has required the development of several unique pedagogies. In keeping with the mission and philosophy of the Chemistry Department, a pedagogy incorporating a hands-on experience for online students has been challenging. In order to provide a meaningful online experience in chemistry, the instructors of these courses have spent countless hours designing and implementing special instructional presentations including; at-home experiments and instruction manuals, complete online laboratory activities and supplemental tutorial material. Because of the difficult nature of learning chemistry concepts and science in general, the online Chem 1010 was designed to guide the students through difficult concepts using a step-by-step programmed learning methodology. Students work at their own pace when using programmed learning. This type of pedagogy allows beginning chemistry students the opportunity to review material over and over, lingering on more difficult topics and proceeding more quickly through easily understood material. The

online Chem1010 incorporates several safe and fun at-home experiments using common household chemicals that teach experimental techniques. An unanticipated benefit of the at-home lab exercise is the involvement of the entire family. Often, students share their lab experience with other family members and in the process the student becomes the instructor. Two examples of experiments which have proven very successful are: (1) electrolysis of water which helps the student understand the relationship between elements, compounds, formulas, and chemical properties; and (2) corrosion of an iron nail in a gelatin-indicator solution which helps the student understand concepts of oxidation-reduction reactions. Chem 1050, 1110 and 1120 are all laboratory based courses which incorporate the equivalent of 1 credit hour laboratory component. In order to accommodate the online students in these courses, initially an on-campus lab was offered and required of all students enrolled online. This requirement set limitations on the physical distance that a student could be from campus and complete the course. Over the past few years the instructors of these courses have designed and developed a set of online laboratory exercises. Now all off campus students, anywhere in the world, can complete the entire course. The design of the lab exercises includes a simulation of all data and observations that a traditional student would observe or experience in a real laboratory environment. The online experiments are identical to those used in the on-campus laboratories, and are graded using the same criteria. No formal assessment has ever been conducted on any of our laboratory courses separate from the lecture. However, online student performances in laboratory compare closely to those of on-campus students. A number of other chemistry departments, such as those of Idaho State and University of South Dakota, have favorably evaluated the online courses, including the laboratories. Mike Slabaugh and Spence Seager presented their online approach at a conference in Green Bay, Wisconsin in November, 2007, to a group of 50+ faculty members. No one openly criticized the program, and a number congratulated them on the development of a clever way to teach the experiments to health occupation students.

Experience with nearly a thousand online Chem 1010 students has shown that their performance in the online course is almost identical to student performance in the traditional classroom setting. However, an online course provides flexibility and versatility that is not possible in the traditional course. Many students are now able to take and successfully learn chemistry that otherwise would not due to work schedules, personal or family demands.

The Chemistry department has now added Chem 1200 and Chem 1210 to online listings. Since Chem 1200 does not include a laboratory component it is well suited for online delivery. Chem 1210 is a hybrid course requiring a live discussion and lab on campus, and is consequently limited to local students.

19. <u>Unique aspects and changes in the curriculum</u>

a. The Chem 1050 course was introduced fall semester 2001. The course is rather unique because it combines three areas of chemistry condensed into a one semester course; general, organic and biochemistry. This service course was designed to accommodate the WSU nursing chemistry requirement and to provide service to nursing students in remote areas through online delivery and online laboratory exercises. Although it is not universally accepted as an allied health prerequisite by all nursing and allied health programs around the country, the high demand continues to justify its existence. Many programs require the two semester Chem 1110 and 1120 series, however.

b. Students of physical chemistry typically spend a large fraction of their time and effort learning to apply mathematical concepts to real problems. While developing this skill is important, students often spend much of their time learning to apply, and sometimes just remember the math, and in the process, loose sight of the physical significance of the problems they are solving. The Chem 3400 course was designed to address this situation by focusing on important mathematical applications in physical chemistry, helping students hone their mathematical skills and understanding so that they are better prepared for subsequent physical chemistry courses. This course is a key part of the chemistry department's efforts to follow the American Chemical Society's undergraduate education guidelines, which require that chemistry programs provide students with a knowledge of differential equations, linear algebra and applied statistics. This course became part of the official curriculum Fall Semester, 2002 and is taught by the same chemistry instructors who teach physical chemistry. It has proved to be an invaluable aid to understanding the abstract and complicated concepts in the intensive Physical Chemistry (Chem 3410 and 3420) courses over the past five years.

c. The computer applications course (Chem 3020) was added during semester conversion in the fall semester 1998. The course emphasizes the applications of computers to data collection, analysis and presentation. The course also introduces chemical search engines and reference material which can be accessed through the Web. Obviously, computing applications continue to evolve at a rapid pace, and it is a continual effort to acquire them and stay current as new software appears.

d. Online laboratory instruction is a new type of pedagogy which attempts to present laboratory instruction in a virtual environment. The instructional methodology is relatively new to all chemistry programs across the nation. The Chemistry Department at WSU has developed online laboratories for two independent courses (Chem 1050 and the Chem 1110, 1120 series).

e. Biochemistry II (Chem 3080) and Biotechniques (Chem 3090) were added to the curriculum in 1998. A full year of biochemistry, including an optional laboratory in the second semester, provides new opportunities for Life Science majors and Pre-professionals. These courses also provide Option II Chemistry majors the opportunity to emphasize biochemistry within a bachelor's degree in chemistry.

f. In the Fall of 2006, the chemistry faculty voted to change the senior Chem 4700 (special topics) requirement from one to two hours. A variety of topics have been covered in this open course. Recent topics have included some aspects of practical chemical problem solving, industrial chemistry, introduction to computational chemistry, environmental chemistry, NMR spectroscopy, and polymer chemistry. Doubling the course content will be a significant effort for the chemistry faculty.

g. Several years ago Chem 4800 (2 credit hours) was required by our Department for option I graduates. This requirement was dropped due to the difficulty of performing chemistry research at WSU and because the ACS did not require undergraduate research for certification. At the Dean's request in the Spring of 2007, the Chemistry Department

compiled a list of instruments and equipment which was identified as essential to begin expanding general research capabilities beyond the few areas in which it is currently fruitful. This list contained tens of thousands of dollars worth of sophisticated instrumentation without which progress in areas such as organic, inorganic, organometallic, polymers, and some biochemical and analytical areas is virtually impossible. Specialty glassware is also often needed that is not available without a glass blowing shop. Even simple chemistry research projects rely on routine, daily access to a wide array of modern instruments. For example, the first step in characterizing a new substance is normally to determine its molecular formula. Nowadays this is routinely accomplished via high resolution mass spectrometry (HRMS). This instrument costs about a million dollars and is operated by a full-time, expert Ph.D. staff person. Once a formula is known, additional structural features are revealed by infrared and high field nuclear magnetic resonance (NMR) spectroscopic methods. State of the art NMR spectrometers start at around $300,000 and can easily reach over a million dollars. They must be maintained with expensive service contracts. The most complete characterizations often come from single crystal X-ray crystallography. Single crystal diffractometers cost over half a million dollars and are operated by a full-time Ph.D. crystallographer. Data analyses are often complicated even for simple, low molecular mass compounds. Maximum resolution and precision are needed to determine even small structures, such as peptides, while protein structure analyses require heroic efforts. For example, to grow a protein crystal suitable for X-ray crystallographic analysis usually requires thousands of attempts. While some of our faculty have and are utilizing off campus facilities (at the U of U, USU, Hill Field, and elsewhere), it is extremely inconvenient and slow where daily and sometimes even hourly analyses are required. Recent progress has been made by ordering an entry level 90 MHz nuclear magnetic resonance (NMR) spectrometer. Our Department has been without even rudimentary NMR Spectroscopy for nearly three years, despite our repeated efforts to focus attention on this problem. This neglect is difficult to understand for a University as large as ours, where the cost of this instrument is relatively small compared to the overall University budget. If undergraduate chemistry research is to be implemented, it seems that University priorities need to be reevaluated in some areas and programs so that it is better able to acquire and maintain such instruments and equipment. This is consistent with the Governor's expressed desire to emphasize science training and education. An equipment operation and maintenance endowment would be ideal if donors could be found. Some funding has recently been secured by the Chemical Technology Center (CTC) to acquire a new, hand-held X-ray fluorescence spectrometer. Infrared spectroscopy and analytical HPLC are also available via the CTC, which are most useful for ongoing bioanalytical projects. We recognize that Weber State does not have the resources to pursue some research areas. As much as possible, we have prioritized general purpose instruments to maximize their usage, and for which our faculty have expertise. Much of our present equipment, nevertheless, remains inadequate, antiquated and even inoperable. Departmental gas chromatographs, atomic absorption spectrometers, high performance liquid chromatographs, gas chromatography/mass spectrometer, capillary electrophoresis, ultraviolet spectrometers, X-ray fluorescence spectrometer, polarograph, potentiometer, potentiostat, conductimeter, calorimeter, polarograph, polarimeters, refractometers, spectrophotometers, and spinning band fractionating still, are over twenty years old.

Some instruments still in use are more than 40 years old. The Department does not own an X-ray powder diffractometer, a liquid chromatograph/mass spectrometer, preparative gas chromatography and preparative HPLC, a complete set of large synthetic glassware, vacuum manifolds, Schlenkware (for handling air sensitive materials), a photochemical reactor, glove boxes, high pressure equipment, and a variety of other vital research equipment.

In Fall 2006, our department restored the chemistry research component (Chem 4800, 2 credit hours) along with one hour of Chem 4990 (student seminar), this time for both ACS Certified (option I) and noncertified (option II) bachelor's degrees, to bring us more in line with the new ACS guidelines and the University 40 upper division credit hour requirement. Considerable concern remains in our department over our ability to deliver a real research experience in view of circumstances. University or college budget plans for acquiring and maintaining large, expensive laboratory instruments and research equipment are still small. Mechanisms to credit faculty with research and development time are puny and unrealistic. Physical space to conduct laboratory research is also very limited. Nevertheless, much pressure has built over the past five years to participate in undergraduate research, from groups on campus and from national organizations. An undergraduate research experience has become especially vital for chemistry and pre-medical students in recent years. Without it they are not competitive candidates for graduate and professional schools. Little can be accomplished without a large infusion of startup funding, ongoing maintenance and upgrade funding. We expect many challenges as we work to reach this goal over the next three or four years.

20. Entrance qualifications

The chemistry program is open to all WSU students interested in chemistry or other disciplines which require chemistry. There is no application procedure required nor mechanism set up to exclude anyone from chemistry. The number of students claiming to be Chemistry majors varies from year to year. In general, the number of declared Chemistry majors (according to Institutional Research) has fluctuated between 86 - 156 students (see Table 1b, Appendix A). The demographics of declared chemistry majors has also remained relatively constant over the past five years with about one third female and and two thirds male on average (see Student Demographics, Table 1b, Appendix A). The total number of students taking chemistry each year surged over 2004-2006 but in 2007 student FTE's (485.34) is nearly at the 2002 level of 469.31 (see Student FTE, Table 1b, Appendix A). The number of students taking chemistry in both traditional and online courses declined somewhat in the last year, but online SCH's are up substantially from five years ago. The chemistry faculty attribute the flat enrollment of late at least partly to the thriving economy, where potential students are working rather than attending school. This is consistent with historical trends.

21. Teaching pedagogies

Despite its fundamental contributions to our modern technological society, chemistry is a subject which arouses little enthusiasm and receives inadequate attention in the high schools. Relatively few students leave high school appropriately prepared to take chemistry courses at the

college level. Moreover, understanding of chemical concepts is often vague at best even among students who have taken some high school chemistry. The demand for preparatory chemistry (Chem 1200) has increased over the last five years due to better academic advising which has directed these unprepared students to this course. With the relatively large class sizes involved, and because the courses are extremely content intensive, the teaching format of most chemistry classes follows the traditional lecture format.

22. Enrollment trends and predictions

Chem 1010 enrollment continues to rise due to the increasing number of students who need to fill a general education requirement in physical science. As long as our society values a sound technical education to supplement a given major, such as business, the demand for chemistry and other science specialties should be strong. Over the next five years our SCH's should steadily increase because students will look to stable sectors in the economy for jobs and chemists are always in demand. The most surprising increase in SCH's lies in the area of online chemistry. Plans are underway to offer chem 1220 as a hybrid course similar to chem 1210 (with a live discussion and lab). At this point it is difficult to predict how this additional course would affect the total online SCH's but we project that they would increase.

We do not foresee a large increase in chemistry majors or graduates over the next five years. We believe the number will grow but at a very modest rate with a net increase of possibly 3 to 6 additional graduates by the year 2012. Again, the major increases in SCH's will occur in the chemistry service courses, especially the online service courses. We expect growth in the chemistry courses offered at the Davis Campus as the area experiences population growth. The Davis Campus proximity should attract Davis County students to come to Weber State.

C. Student Learning Outcomes

Faculty members within the Chemistry Department have identified and itemized a list of cognitive and technical skills desired of graduating chemistry majors. These skills are defined as student learning outcomes. We have also identified the individual courses within the curriculum which develop these skills or outcomes.

1. Student learning outcomes

At graduation, chemistry majors should have a set of fundamental skills that can be applied to a variety of situations. These skills include the following:

a. Problem-solving skills. Chemistry majors should be competent problem-solvers. They should be able to identify the essential parts of a problem and formulate a strategy for solving the problem. They should be able to estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the validity of their solution, interpret their result and connect it to related areas of chemistry.

b. Laboratory skills. Chemistry majors should be competent experimentalists. They should be able to design and set up an experiment, collect and analyze data, identify sources of

error, interpret their result and connect it to related areas of chemistry.

c. Presentation skills. Chemistry majors should be able to express (orally and in writing) their understanding of core chemical principles, the results of experiments, the analysis of problems and their conclusions.

d. Computer skills. Chemistry majors should be competent users of basic software, such as word processing, spreadsheet, and graphing programs. Strong presentation and organizing skills are complimented with computer knowledge in graphing and spreadsheets.

2. Identification of courses within the curriculum which teach desired skills

An assessment ranking of 1 to 5 has been given to each learning outcome category for all major courses. A ranking of 5 indicates that this course provides an intense development of the student learning outcome within the defined skill area. A ranking of 0 indicates that this course does not contribute significantly to the achievement of that particular student learning outcome.

Course #/Title	Student Learning **Problem-solving**	Student Learning **Laboratory skills**	Student Learning **Presentation skills**	Student Learning **Computer skills**
Chem 1210 Prin. of Chem I	3	2	1	0
Chem 1220 Prin. of Chem II	3	2	1	0
Chem 2310 Organic Chem I	3	3	1	1
Chem 2320 Organic Chem II	3	3	1	1
Chem 3020 Comp. Appl.	4	0	1	4
Chem 3030 Quant. Analysis	5	4	2	2
Chem 3050 Inst. Analysis	5	3	2	3
Chem 3060 Applied Analysis	3	5	2	3
Chem 3070 Biochemistry I	5	4	1	1
Chem 3080 Biochemistry II	5	0	0	1
Chem 3090 Biochem Tech.	4	4	3	3

Chem 3400 Applied Math.	4	0	2	3
Chem 3410 Physical Chem I	4	4	3	2
Chem 3420 Physical Chem II	4	4	3	2
Chem 4540 Spec & Sep	4	4	3	3
Chem 4600 Inorganic Chem	5	2	1	0
Chem 4700 Special Topics	2	0	2	1
Chem 4800 Independent Research	3	3	2	1

3. Assessment

a. Departmental Assessment

Assessment of learning outcomes has been ongoing in the Chemistry Department and in academia for some time. The Department's formalized strategy for assessing learning outcomes and subsequent improvement of the curriculum was used over the past five years.

Student Learning Outcomes	Assessment Measure	When Assessed
1. Knowledge & Comprehension of the core concepts of Chemistry	Organic Chemistry, ACS Exam National Scores Graduation GPA Science Scores from the GRE, DAT & MCAT	End of Organic Series at Graduation
2. a. Problem Solving Skills	Graduation Exit Survey ** Dual Survey	Graduation Clearance, 1st and 5th year after Graduation
2. b. Laboratory Skills	Graduation Exit Survey ** Dual Survey	Graduation Clearance, 1st and 5th year after Graduation
2. c. Presentation Skills	Graduation Exit Survey ** Dual Survey	Graduation Clearance, 1st and 5th year after Graduation
2. d. Computer Skills	Graduation Exit Survey ** Dual Survey	Graduation Clearance, 1st and 5th year after Graduation

b. ACS Assessment

The ACS Committee on Professional Training (CPT) requires that our Department submit an annual report that includes a list of graduate names, course

curriculum, faculty qualifications, and any changes or construction that were accomplished during the year. Every five years an extensive report is submitted to the ACSCPT that encompasses a summary of faculty vitae, faculty qualifications, faculty publications, salary ranges, course offerings, major instrumentation, course syllabi, sample examinations, library holdings, textbooks, enrollment data, and samples of student written reports. Copies of these reports are filed in the Department Office. The ACS reviews these reports, evaluates whether our Department is meeting ACS guidelines and accreditation criteria. The most recent five year report was submitted January 27, 2006. The response from the ACSCPT was that our Certified Bachelor's Degree Program and our Department were meeting ACS the accreditation requirements at that time. However, the ACSCPT will begin implementing new guidelines in March, 2008.

4. <u>Changes in curriculum due to assessment</u>

The following changes substantially improve the rigor and availability of the chemistry bachelor degrees offered by our department.

a. Two hours of chem 4800 (Research and Independent Study in Chemistry) are now required for both option I and option II chemistry majors. This requirement will be reviewed after two years to reassess its feasibility. This change more closely reflects current ACSCPT guidelines and student requests for a research experience.
b. One hour of chem 4990 (Senior Seminar) is now required for both options I and II. This requirement will also be reassessed after two years, since this course is taken concurrently with chem 4800.
c. The chem 4700 (Special Topics in Chemistry) requirement was increased from one hour to two hours.
d. Students must now complete 40 upper division credit hours for both options I and II. This brings these degrees into line with university requirements, and with other state universities, but is not required by the ACSCPT.

The following changes are justified by their demand only. The online laboratories involve only relatively safe, available household materials (salt, sugar, vinegar, baking soda, laundry bleach, etc.) and simple tools (rulers, measuring cups, scales, etc.). On-line laboratories have not been formally assessed, nor does the ACSCPT have guidelines associated with these laboratories. These courses are not required of Chemistry majors or minors.

e, Chem 1050, 1110, 1120 and the associated laboratory exercises are now available as fully online courses.
f. Chem 1200 is available online.
g. Chem 1210 lecture is available online, but the associated discussion and laboratories are still taught live on campus.
h. Chem 1010, chem 1200, chem 1210 and lab, and chem 1220 and lab are available on the WSU Davis Campus.

The following course number was changed to match the statewide articulation table.

i. Chem 3030 (analytical chemistry) was renumbered as Chem 3000.

D. Academic Advising

1. There are four mechanisms of academic advising available for students in chemistry

a. Chemistry major and minor advising is primarily the Chair's responsibility, but all faculty members informally counsel with students who have an interest in pursuing a given career and provide them with information regarding the program within chemistry that will best prepare them for their future aspirations. For example, the organic and biochemistry instructors are often approached by pre-professional students requesting information regarding requirements and preparation for medicine, veterinary medicine, dentistry or pharmacy. Along with personal advise, students are directed to the pre-professional advisors appointed by the College of Science. For those students interested in graduate school or industry, instructors who have had experience in both academia and industry are able to provide pertinent information for the students.

b. For the many students with questions concerning which classes they should take and course schedules in chemistry, our secretary, Margaret Read, is the primary point of contact for both Chemistry majors and nonmajors. Margaret is well versed in the Chemistry program and its requirements for each of the degrees offered. She has knowledge of university requirements and can often help students solve significant problems with scheduling and direction for graduation. Chemistry majors may meet as often as needed with the Department Chair to evaluate their schedule and help insure that they are on track.

c. The College of Science has a dedicated academic advising office housed in the Science Lab building, and now has a three quarter-time academic advisor, Ali Miller. The advisor is appointed by the College and serves students who are interested in science programs. The College advisor is usually involved in directing students who are relatively new to the University and who are just starting a program in science.

d. The Chemistry web page is readily available online. Students have access to all programs and program requirements from anywhere they have web access. One of the most difficult tasks for a new student is deciding which of the many chemistry courses is appropriate for their program. The Chemistry web page is designed to help the beginning student understand with which chemistry course they should start in accordance to the requirements of their program of interest. A Departmental handout is also passed out in on the first day of class for beginning courses (Chem 1010 to Chem 1210), which helps students decide.

2. Assessment

We have incorporated a survey section in the student exit interview which attempts to assess the effectiveness of the academic advising throughout the student's academic career here at WSU. This assessment process is providing information regarding strengths or weaknesses in the mechanism of academic advising. Generally, the information in the surveys provides

evidence of effective advising. Chemistry graduates have no major complaints. This indicates that advising is at least helping students to avoid critical obstacles.

A persistent problem is that many students do not declare chemistry as their major until beyond their freshman year. By that time they may have taken some of the wrong prerequisites, such as trigonometry based Physics 2010 and 2020 instead of calculus based Physics 2210 and 2220, in spite of the program outline in the catalogue. This sometimes occurs for chemistry majors who are also pre-medical students, since the Pre-med Program does not require calculus based physics. We advise all students of this problem as soon as they come in for help.

E. Faculty

1. Teaching standards expected of all faculty (contract and adjunct)

The academic preparation required of faculty in the chemistry department generally includes an earned Ph.D. in one of the recognized areas of chemistry (analytical, biochemistry, inorganic, organic or physical) or in a closely related area such as metallurgy, ceramic engineering, material science, or geochemistry. In addition, previous teaching experience and/or postdoctoral work, while not necessarily required, is considered a plus in hiring decisions for both tenure track and adjunct faculty.

ACSCPT accreditation standards include the adoption and use of appropriate textbooks and lab manuals, the preparation and administration of appropriate examinations and other materials used in student grading, and the use of appropriate laboratory equipment and experiments. Faculty members are expected to maintain teaching standards that meet the requirements of this accreditation. Faculty are made aware of the departmental teaching standards in initial orientation sessions conducted by the department chairman after faculty are hired, and by a continuing dialogue with experienced faculty of the department.

The ACSCPT guidelines for accredited chemistry programs require modern instruments in good operating order one of which is a nuclear magnetic resonance (NMR) spectrometer (cost $137,400 for a low end instrument). Thanks to a generous donor found by Chemistry faculty members, a substantial commitment from the Dean's Office, and funding from the Center for Chemical Technology, we are now in the process of ordering this instrument. While this is will be a great step forward, much of our other equipment is neither "modern" nor "in good operating order."

2. Typical contract and adjunct faculty teaching pedagogies.

It is assumed that the term *teaching pedagogies* refers to teaching methods. Most students in the Chemistry Department are taught primarily *lecture sessions* containing up to 150 students. However, these sessions are used in a variety of ways depending upon the preferences of the faculty and the number of students involved. Some faculty deliver traditional lectures, some place emphasis on lecture demonstrations in which students participate, others treat lecture sessions as discussions with an emphasis on student involvement, and still others make significant use of technology in the form of computer applications and presentations. Student performance in lectures is typically evaluated using examinations, quizzes, and reports.

In addition to lecture sessions, most chemistry courses also have a laboratory component in which students experience typical chemistry laboratory procedures, equipment and instrumentation, and the application of the scientific method to solving problems. Evaluation of student performance is done using laboratory report sheets, formal laboratory reports and notebooks.

3. Measures used to determine the quality of teaching

The quality of teaching (and student learning) in the Chemistry Department is determined in part by the traditional methods of formal peer reviews, scrutiny of exams, syllabi, and professional files, classroom visits and student evaluations. In Organic Chemistry, standardized American Chemical Society exams are administered and used both to evaluate student performance and compare that performance to national norms. The sequential nature of chemistry course work allows an evaluation of student performance to be made continually by faculty who instruct students previously taught by other faculty members. This constitutes an ongoing, though unofficial, peer review of teaching effectiveness. In the lower division laboratory programs, the grading of lab reports is shared by all faculty teaching in the program. In order to insure grading uniformity, the reports from all lab sections for a specific experiment are graded by one instructor. Once again, this allows the teaching effectiveness of all laboratory instructors to be "unofficially" compared and evaluated.

4. For contract and adjunct faculty, evidence of:

a. Effective creation and delivery of instruction.

In addition to the items described in (E-3) above, all faculty are required to submit course syllabi and examinations to the department secretary for inclusion in a file which is available for review during annual faculty evaluation meetings held with the department chair.

b. Ongoing evaluation and improvement of instruction.

Response: See (E-3) and E-4(a) above.

c. Innovation in instructional processes.

Change for the sake of change is not considered to be innovation in the chemistry department. Without exception, our faculty diligently work to correct, update, and improve their teaching materials virtually every day. In some courses significant applications of new computer-based technology and programs have been and continue to be incorporated. An example is the use of computer programs in both the physical chemistry laboratory and lecture. These programs allow students to study aspects of classical mechanics, quantum mechanics and statistical mechanics that are related to molecules, as well as do quantum mechanical calculations related to atomic and molecular orbitals and bonding. All classrooms have at last been equipped with multimedia and projection systems (including internet access) during the past five years.

This greatly expands the range of new technology that can be presented and utilized during class time. These systems are heavily used on a daily basis, especially by younger faculty members.

5. Faculty composition

The dedication, expertise, and experience of the twelve full time and six adjunct faculty of the Chemistry Department are strengths (see Table 1a, Appendix B). Presently, all tenured or tenure-track faculty members within the Chemistry Department have a Ph.D. degree with unique talents and technical expertise. Chemistry has always placed priority in hiring and maintaining qualified and experienced faculty who complement the design, goals and mission of the program. Chemistry is arguably the broadest of all scientific disciplines. Due to the eclectic and technical nature of chemistry, the program requires faculty members who are qualified to teach one or more of the subdiscipline chemistry areas including, but not limited to: general, inorganic, organic, physical and biochemistry, instrumentation, quantitative and qualitative analysis. Retiring faculty are replaced with individuals who have expertise in an area of need so that the ability to cover the core areas is maintained.

The twelve faculty members for Fall semester 2007 is barely adequate for the teaching loads applied (see Table 1b, Appendix B). With limited funding appropriated by the State Legislature, it is recognized that addition of new faculty is not likely in the near future. In order for the program to remain functional, effective, and provide breadth of understanding various subdisciplines, we must maintain the core expertise present in the department. If faculty are not replaced and teaching loads rise, dissatisfaction may lead some to leave the University for industry or other professions.

An obvious conclusion that can be made from the review of faculty loads is that without adjuncts and teaching assistants, the chemistry faculty loads would have been excessive every year for the past five years (see Total Yearly Credit and Total Faculty FTE, Table 1b, Appendix A). The Total Yearly Credit represents the total number of yearly credit hours that would be required of the regular full time faculty members in order to keep the program going without the aid of adjunct instructors and teaching assistants. The Total FTE indicates the number of full-time-equivalent (FTE) faculty required to keep the Chemistry program running at normal work loads for everyone (12 hours per semester). Presently, most faculty who are involved with online courses teach them as overload and are paid through Continuing Education. The added load is not considered part of the 12 semester hours they normally carry. This means that several faculty members are working considerable overtime hours to cover the additional course load, but they are also paid extra for this service. The five year trend has been for faculty members to take on more and more online and overload teaching to augment their salaries. Online course enrollments have been steady or slightly declined in the past two years, likely due to the enrollment / salary cap policy imposed by the University, outside competition, and the robust economy.

6. Plan for demographic diversity

Demographic diversity is an important issue these days in hiring faculty. Our department welcomes colleagues of various races, religions, sex, etc. However, it is not in the best interest of the Chemistry Department or the University to seek diversity just for diversity's sake.

A sound plan for promotion of diversity would require monetary assistance from the university in both advertising and salary offers with some sort of guarantee of base pay increase that at least keeps up with the cost of living. The history of small pay raises is not viewed favorably. Since faculty members must feel comfortable living in Utah, without a competitive offer, we will attract only those individuals whose desire to live here is greater than monetary concerns and this continues to be an obstacle to diversification. Turnover would also be a serious detriment to faculty morale and impact program integrity and efficiency.

7. Faculty Service and Professional Development

The full time faculty provide an update of activities beyond teaching loads that include areas of service and professional growth or scholarship. All contract faculty serve on at least one committee at the department, college or university level. The service rendered promotes the business of the department, college or university. Along with service all contract faculty are required to participate in professional growth or scholarship activities which may include: book writing, research, participation in national science societies, grant writing, seminars etc. The tenure-track faculty undergo internal and external reviews at the 2nd, 3rd, and 6th year of employment. These ongoing reviews of teaching, service and scholarship are designed to help the faculty member achieve tenure. Samples of teaching evaluations are included with each faculty member's professional file. The professional file is reviewed by the Department's Promotion and Tenure Committee, the College of Science Promotion and Tenure Committee, the Dean of the College of Science and the Provost if necessary.

All faculty members (including tenured faculty) are reviewed annually by the Department Chair. For all tenured faculty, at least two courses must be evaluated by students annually and those evaluations are reviewed by the Department Chair. Untenured faculty (including adjuncts) are required to have all courses evaluated, as required by PPM 8-11.

The teaching effectiveness within the Department is often reviewed in an indirect way. Students who take series chemistry courses must be prepared by one instructor in order to handle the material offered by another in the second semester of the series. The coordinated efforts of both instructors is invaluable to the student's progress. For example, all instructors teaching a series class are required to use the same book and cover the same topics. In this way teaching effectiveness can be assessed by student performance in the second semester of the series. Large overload and online teaching assignments obviously encroach on time that some faculty might spend pursuing traditional academic chemical research and development. However, they have also provided unique venues via which chemical education delivery and methods have been pioneered. No evidence is apparent from student evaluation data that overload teaching is eroding regular course teaching quality.

8. Teacher development

The development of effective chemistry teachers is ongoing through university programs such as the Teaching and Learning Forum which provides opportunities for instructors to learn new techniques in both traditional and online courses. There are also other groups on campus which provide yearly seminars on effective teaching, computing, and many other topics. Faculty register online through the "WSU Training Tracker." Faculty are encouraged to participate in as many seminars as possible.

As we discuss the evidence of effective teaching and teacher development, we must also point out that the effectiveness of a teacher and the quality of a program is limited by financial concerns and time constraints. Although funding and time alone do not guarantee quality, without them a quality chemistry program will never be completely realized. For example, it does not make sense for highly educated Ph.D. instructors to spend a substantial fraction of their time working as their own secretaries because the department can only afford one secretary. A faculty member may be an expert with a given instrument, without which the corresponding course cannot even be offered. With little equipment, dedicated instructors are also limited in the types of classroom presentations that are possible for students. Many relevant chemical demonstrations cannot be performed in classrooms that have no fume hoods or the help required to set up and maintain demonstration kits. If we want to generate effective teachers, adequate time must be provided to develop courses and perfect the delivery of course material. We must also limit the academic bureaucracy and provide meaningful time to pursue scholarly activities, outside funding, and collaboration with other faculty.

F. Support Staff, Administration, Facilities, Equipment, and Library

The number of support staff has remained the same for the past five years; one secretary, one lab manager and a science store manager (see Table 1b, Appendix A). The secretary handles much of the department business. The lab manager directs the setup and logistics of all teaching laboratories including the laboratory at the Davis campus. The lab manager usually hires a few students per semester to help prepare chemicals and deal with the ongoing needs of all laboratory sections. The Science Stores manager maintains the chemical inventory for Chemistry as well as other departments in the College of Science.

1. Evidence of the effectiveness of contract, adjunct and professional and classified staff

All classified and professional staff are regularly interviewed and their progress is reviewed at least annually by the Department Chair. In this interview, they review their job descriptions and make plans to improve department activities.

G. Relationships with External Communities

1. Description of the role and organization of the liaison mechanism.

The mission of the Chemical Technology Center is to enhance the learning environment at Weber State University. The Center involves students and faculty in applied research activities that also provide extra-curricular learning opportunities, service to the community, and generate resources and good will for the University.

The Chemical Technology Center…

1. involves students in meaningful extra-curricular learning activities.
2. provides support for students to assist them in their education.
3. obtains resources to support faculty development and enrichment.
4. provides service by working with community entities.
5. generates opportunities and good will for the University.

The Chemical Technology Center is designed to assist Utah businesses in developing new products thus enabling them to be more competitive in their respective markets. The Center conducts innovative, applied research in a variety of chemically-related areas, usually focused on challenges unique to each company. Due to the cooperative, multi-disciplinary nature of the Center, a large variety of technological opportunities exist here. Ranging from natural product chemistries to new separation technologies, the diversified areas of expertise among our faculty (e.g., chemistry, microbiology, botany, and geology) makes the Center a perfect place for entrepreneurs to receive aid in high technology research and development.

The Center cultivates an interaction between the Chemistry Department at Weber State and the commercial sector. This interaction creates benefits for the Chemistry Department by stimulating innovative applied research, providing new equipment or paying for maintenance of existing items, and offering advanced training and experience for the chemistry students. Many of the graduates are recruited and become employees of companies involved.

In response to industrial demand, the Chemical Technology Center also provides research and technological assistance to industry to help them comply with environmental regulations and Good Manufacturing/Lab Practice (GxP). Information concerning chemical and hazardous materials management as well as technological assistance for OSHA and FDA compliance continues to be an important and growing mission of the center.

The Director of the Center, Dr. Edward B Walker, also works with a much larger community, participating on various boards and councils for economic development and international communities. This year, he is a member of the committee to approve new analytical methods for the Association of Official Analytical Chemists (AOAC), an international organization responsible for establishing validated methods of analysis for the world community that are recognized as legally defensible in courts of law and regulatory agencies around the world. He is also the chairman of the technical program committee for the analysis of juices and beverages for this organization.

2. Industrial partners and project descriptions

Great Salt Lake Minerals: Explore the potential of harvesting beta-carotene from the Great Salt Lake.

Nutraceutical, Inc.: Develop new and innovative methods of analysis for dietary supplements, validate them and practice them. Supporter of efforts to formulate new phytopharmaceutical products.

Harmony Concepts: Aid in the development of better methods of synthesizing and analyzing many organometallic products for the dietary supplement market.

RJ Analytical: Provide assistance in developing new analytical methods for the dietary supplement and water treatment industries.

Artistic Precision Ent.: Helped to solve a manufacturing problem with "creative Color" spray colors for foods.

High-Country Thoroughbreds: Sourcing of chemical compounds for use in the horse-breeding and racing industry.

Photokinetic Coatings & Adhesives: Assist with test methods requiring FTIR spectroscopy and finding networking opportunities.

JLB, Inc. Supporting technology transfer of patented technologies.

3. Financial contribution to the chemistry program

The Chemical Technology Center provides financial assistance to the Chemistry Department through the maintenance, repair and acquisition of chemical instruments. The Center acquires state-of-the-art instruments and fosters industrial partnerships who allow WSU students to obtain experience and/or on-the-job training with expensive, specialized instrumentation that the Chemistry Department cannot afford. For example, the Nutraceutical Corporation occupies space in the Center Laboratories, where they keep and maintain instruments such as ICP, ICP-MS, GC, GC-MS, HPLC, HPLC-MS, HPLC-LSD, FTIR, dissolution, stability chambers, etc, that cost in excess of $1-million dollars and require more than $75,000 per year to maintain. Chemistry majors in our advanced instrumentation courses and our 2-year Chemistry Technician Program have the opportunity to use their equipment and *conduct experiments for free* as part of their laboratory course curricula. The Center also works closely with the 2-year Chem Tech Program, to arrange tours and COOP work experience with local industries. Most of the instruments above are owned by Neutraceutical Corporation and are used daily by their employees (some of whom are former students). Access to Weber State chemistry students and faculty has always been limited by instrument availability and by the appropriate training.

The Center generally brings in $100,000 - $200,000 annually through grants, contracts, and donations, to support itself and help the Chemistry program at WSU. In addition, to helping with educational efforts, the Center provides support for research efforts that lead to publications and presentations at scientific meetings for students interested in bioanalytical chemistry.

H. Results of Previous Program Reviews

Some of the weaknesses addressed in the 2002 Program Review persist. A major concern was inadequate funding. The main operating budget increased last year by $4,500 and adjunct and hourly student have seen similar increases. This operating budget ($19,500) would now only cover about half of our student laboratory expenses for the year. Student fee money has allowed our laboratory courses to continue running, replace some broken equipment, and purchase a new Fourier Transform infrared spectrometer. Fee money was used to upgrade computers and projectors in our lecture halls, which should logically be a University

responsibility. Fee money pays for many of our supplies and some of the hourly wages of student stockroom personnel.

Research involvement of several of our faculty is not much improved for the reasons described in other sections. Significant on-campus research activity has been possible only in few subdisciplines, such as analytical, bioanalytical, computational chemistry, and heavy oils.

The much debated issues in the public school system may preclude potential teachers from entering into the Chemistry Education major. Only two have graduated in the past five years. The Department has not modified the Teaching Major requirements from 2002, and this issue needs to be discussed again. Michelle More is the designated liason with the public schools, and she is actively involved with contacts at local schools. The entire curriculum will likely be reviewed when the new ACSCPT guidelines go into effect.

Little improvement has been observed on the issue of faculty time. Often it does not seem to be appreciated by administrators that some disciplines and subdisciplines are more time consuming to operate than others. Our experience and observation is that chemistry is among the most time consuming, especially the higher level courses (above the Principles courses). Opportunities for professional growth and service are nearly the same as in 2002.

Members of our Department are desirous to hire more female (or minority) faculty members, since we have many female (and minority) students. Hiring is primarily based on qualifications among the pool of applicants who apply, which continues to be dominated by white males. Wider advertizing may help provide a larger, more diverse pool in the future.

Regular faculty load is near the ACSCPT accreditation limit, and has not been reduced since 2002. While teaching assignments are met for the moment, few additional offerings will be possible if enrollment increases, except through overload and / or adjunct use.

One of the best links to local high schools has been the Science and Engineering Fair. However, Ogden School District has not been willing to require participation in the fair. The result is that only a handful of students voluntarily participated. Science Fair was required at Joseph's High School until last year when it was dropped due to insufficient parental support. The Chemistry Department is still among the most active in the college, supporting the Ritchey Science and Engineering Fair at the Dee Event's Center. Several Chemistry faculty members also participate in the Science Olympiad which is held annually in our buildings.

The majority of our chemistry students are pre-professionals. Efforts have been made in the lower level courses to interest students in the Chemical Technology program, and two year degree graduates are increasing lately. Many chemistry graduates were not chemistry majors in the beginning, and are recruited from lower division chemistry courses. University and Department representatives may need to improve advertizing our programs, course offerings, laboratory opportunities, etc., and need our help to provide current information. Some of the best local high school students are aware of the equipment and instrumentation limitations in our Department, and consequently go elsewhere to college. Better instrumentation would be a powerful recruiting draw.

Progress has been made on most of the remaining recommendations from 2002. Park Guymon has filled the role of full-time faculty member at Davis Campus. This will be largely covered by Charles Davidson after Park retires this year. Legal issues associated with intellectual property rights of professors who develop on-line teaching materials have been clarified, though perhaps not entirely resolved, since 2002. An old, donated analytical HPLC instrument was rebuilt and is now operational for laboratory classes. Faculty and students are in the process of developing laboratory experiments utilizing this capability. Our faculty will need

to continue to search for funding. Our Department could be generating more RSPG and OUR grant proposals than any other department on campus, but this has not been the case probably owing to shortage of time, frustrations over the condition of existing instruments and equipment, and pursuit of overload teaching opportunities. Systematic student counseling is now more available than before, if they want to take advantage of it. Diagnostic tools for placement have not been developed, and a regular advising schedule has not been used.

I. Program Support

1. Sources of Funding for the Chemistry Department

The WSU Budget Office provided the funding figures below.

Chemistry 205010 E &G Budget						
	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008
Faculty Salaries	$619,049.00	$642,041.00	$664,400.20	$693,908.60	$726,922.50	$763,110.85
Staff Salaries	$119,675.00	$125,038.00	$128,924.36	$133,965.28	$143,951.43	$150,893.53
Adjunct/Part-Time Faculty Wages	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 12,000.00	$ 12,475.00
Hourly Wages Staff	$ 18,000.00	$ 18,000.00	$ 18,000.00	$ 20,000.00	$ 22,000.00	$ 22,000.00
Current Expense	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 19,500.00
Travel	$ 2,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00
Total	$773,724.00	$813,079.00	$839,324.56	$875,873.88	$922,873.93	$970,979.38

Over the past five years, E and G Funding has increased by about 20%. The total expenditures including salary and benefits for all employees is presented below:

Total Expenditures

Year	Expenditures
2002-03	1,057,469
2003-04	1,071,697
2004-05	1,163,651
2005-06	1,226,781
2006-07	1,309,728

The price of chemicals and supplies increases at a rate that exceeds inflation. The current expense budget covers only a fraction of operating expenses. For example, telephone equipment charges are over $5,000 per year, which is over 25% of the entire budget. Consequently, we had no choice but to establish a laboratory fee schedule in 2002-2003. The following data concerning laboratory fees were provided by the WSU Budget Office.

Chemistry Student Lab Fee Index 316630					
Beginning Balance 2002-2003	$ 128.43				
	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Revenues	$ 34,839.89	$ 50,737.34	$ 73,902.41	$ 59,412.85	$ 58,114.50
Expenditures	$ (32,624.83)	$ (42,537.49)	$ (50,844.64)	$ (38,857.94)	$(103,988.28)
Beginning Balance 2007-2008	$ 8,282.24				

The cost to run our program has risen each year due to increases in glassware and chemical costs including: purchase, shipping, storage and disposal. The purchase of expensive capital equipment is unusual and not part of the regular operating budget. In 2006-2007 we began paying a larger fraction of adjunct, teaching assistant, and stockroom personnel wages associated with the laboratory operation from this budget, which accounts for the large expenditure increase. This is consistent with University policy that lab fee money be spent directly to benefit courses from which it was collected.

2. Breakdown of the operating budget

a. Hourly Wage Budget

This money is used to pay for student help. The student help is usually applied to teaching assistants which cover some laboratory sections, stockroom aids and lab report grading . The stockroom students are involved with all aspects of laboratory preparation for all chemistry laboratory sections. Our reliance on such students has grown considerably over the past five years. The department is currently working to reduce student hourly wages from what they have been in the past two years back to near the 2004-2005 levels so that student fee money saved can be used towards laboratory equipment.

b. Wage Related Institutional Budget

Our use of adjuncts has also grown over the past five years. This money is budgeted to pay for adjunct faculty salary and benefits. The money presently available in this budget is insufficient for our present use, but the shortfall has been made up partly with our current expense and student lab fee money. The latter is used only when an adjunct teaches a laboratory section.

c. Current Expenses

This budget provides limited funding to cover most of the non-wage related expenditures. The budget is meant to cover all of the office and some of the laboratory associated expenses Consumable costs have risen by 50% or more over the past five years. The current expense funding alone does not meet the Chemistry program's present or future needs. A $20 to $30 lab

fee is assessed for all chemistry courses numbered 1110 through 3070. Although E and G operating budgets were augmented 30% for 2007-2008, the increase only begins to make up for lean years. If appropriations do not continue to improve, the financial future of the Chemistry program will require us to shift more of the monetary burden of the program to the students taking chemistry, and the laboratories may never approach state-of-the-art.

d. Travel

The travel budget is a very modest allocation of money set aside for travel to national and international scientific meetings when a faculty member has research to present. Because it is difficult to conduct research with heavy teaching loads and few facilities, this money is not always used for travel, but is sometimes put back into current expense to cover overdrafts or to help purchase or maintain equipment. We would like to improve our ability to travel and participate, especially at nearby events, which is always a broadening experience.

e. The Capital Outlay Budget

The Capital Outlay budget is held by the Dean of the College of Science and is used for major equipment purchases. This budget is not normally part of the operating costs associated with the Chemistry Department or its routine operations. As an example, this budget was used in 1999 to purchase a $75,000 NMR spectrometer for the Chemistry Department. This was the least expensive instrument available at the time, and was in service for a few years, but in 2005 it developed a fatal problem on the main circuit board, and is now inoperable without a major repair expense. It was cheaply made and is inadequate now even for teaching undergraduate courses. Means must be found to improve this budget several fold so that quality, up-to-date, reliable instruments can be purchased.

3. Adequacy of Facilities

The facilities in the College of Science are nearly 40 years old. There is not enough space within the building to provide research rooms for all faculty members. Of great concern is that the College of Science tenure document requires research for promotion and tenure but there is little space or start-up funds provided to new faculty to meet this requirement. Faculty members are basically left on their own to find funds to purchase reagents and equipment to start research. The Research and Professional Growth Committee (RS&PG) and Office of Undergraduate Research provide $1,000 to $4,000 one time money through a competitive granting process. Even if one is awarded an RS&PG grant, the amount of money provided will only allow for very small research projects and only marginally helps establish a quality research program at Weber State. Funding through national science organizations is extremely difficult to acquire because we do not have adequate facilities to carry out the research. Much effort was expended by several faculty members last year writing an NSF CCLI grant which would have involved the purchase of an NMR instrument. It was not funded partly because NSF does not have a program specifically for funding this type of educational instrumentation, and because the instrument requested produces spectra that are considered marginal quality. However, it is very unlikely that a 300 MHz superconducting NMR spectrometer would be funded through NSF MRI when most of our faculty do not have an established record of NMR usage. Similar

scenarios exist for other major instrumentation. Faculty who want to do research find themselves in a vicious cycle of inadequate facilities and funding and are often obligated to seek help from outside sources such as the University of Utah or Utah State. Some faculty members in the Chemistry Department have continued to fight through the process because they are dedicated researchers. Consequently, progress continues at a rather slow pace using the equipment and instruments which are mostly designed for teaching rather than research. Standard published NMR spectra are now usually 300 MHz or better (having resolution at least 25 times better than our old 60 MHz instrument). Faculty members must contract with Hill Air Force Base or the University of Utah to have spectra run on their 300 MHz instruments and pay an instrument usage fee. Other instruments in the department are heavily used by students and are in constant need of repair. Most of the Department's instruments have no maintenance contracts and sometimes cannot be used for months or even years when they are in need of repair. Some repairs are made by faculty members, but often the problem is beyond our expertise. Money for maintenance and repair is very tight. Some used equipment and instruments have been donated to the department. These donated items are usually in disrepair or no longer supported and it is very difficult to find parts to remedy the situation. Some equipment is passed on to surplus for disposal. We have written several requests for outside funding to assist in updating outdated instrumentation. Only very limited awards have been granted which do not allow for a broad, quality undergraduate research program in chemistry. A state-of-the-art program in chemistry will require an order of magnitude greater funding to begin acquiring, implementing, and maintaining modern instruments and equipment. Moreover, new space will be needed.

Presently we have some serviceable equipment and instruments available for teaching basic courses. Because the freshman courses utilize relatively simple, inexpensive equipment, such as flasks, beakers, and balances, they are better able to function than higher level courses. Our organic chemistry laboratory has never been adequately equipped to utilize all 48 student stations at the same time. For several years we have had to stagger the schedule so that half of the students could use the equipment one week, while the other half uses it the following week. This creates unnecessary confusion among the students and difficulty for the instructors and staff people who must prepare and run two different lab experiments at the same time.

4. Adequacy of Library Resources

Our Chemistry Department meets the minimal library ACS accreditation requirements. The library is in a constant dilemma of trying to decide which journals should be kept, which should be added and which should be terminated. The decision is often based on student and faculty journal use. Attempts are made to weed-out non-used journals and save money. Recently, faculty voted to cancel ACS print journals and replace them with about double the number of ACS online journals for nearly the same cost, although this will take about a year to go into effect. We still rely on larger universities because the WSU library does not carry many important journals in either bound or online versions. The ease with which articles can be obtained online and via Interlibrary Loan is improving. Faculty have desktop access to the ACS Chemical Abstracts online through the Science and Technology Network (STN) International, but we do not have access to certain indices such as Science Citations. Utilization of these

resources will increase when students currently in the pipeline reach the new research requirements in their senior year.

J. Program Summary

Despite the difficult aspects of budget realities and aging facilities, WSU remains a good place for undergraduate education. We have an excellent reputation and success rate in preparing students for pre-professional programs. The Chemistry program will move forward because the faculty members are dedicated to helping students and making the program work. If we approach the next five years with optimism, the program will weather financial storms and will continue to achieve success. We expect our students to understand problem solving skills and thus we are compelled to use these same skills as we approach the question of how to best meet the needs of our future students with limited resources.

Appendix A

Department of Chemistry

Student and Faculty Statistical Summary
(data provided by Institutional Research)

	2002-03	2003-04	2004-05	2005-06	2006-07
Student Credit Hours Total [1]	**14,079**	**17,365**	**16,760**	**15,904**	**14,560**
Student FTE Total [2]	**469.30**	**578.83**	**558.67**	**530.13**	**485.33**
Student Majors [3]					
Chemistry	86	98	83	156	105
Program Graduates [4]					
Associate Degree	4	11	3	7	11
Bachelor Degree	14	15	16	7	11
Student Demographic Profile [5]	**86**	**98**	**83**	**156**	**105**
Female	27	36	25	57	28
Male	59	62	58	99	77
Faculty FTE Total [6]	**21.38**	**23.94**	**23.60**	**23.70**	**25.35**
Adjunct FTE	10.39	12.89	12.61	12.23	13.86
Contract FTE	10.99	11.05	10.99	11.47	11.49
Student/Faculty Ratio [7]	**21.95**	**24.18**	**23.67**	**22.37**	**19.15**

[1] **Student Credit Hours Total** represents the total department-related credit hours for all students per academic year. Includes only students reported in Banner system as registered for credit at the time of data downloads.

[2] **Student FTE Total** is the Student Credit Hours Total divided by 30.

[3] **Student Majors** is a snapshot taken from self-report data by students in the Banner profile as of the third week of the Fall term for the academic year.

[4] **Program Graduates** includes only those students who completed all graduation requirements by end of Spring semester for the academic year of interest. Students who do not meet this requirement are included in the academic year in which all requirements are met. Summer is the first term in each academic year.

[5] **Student Demographic Profile** is data retrieved from the Banner system.

[6] **Faculty FTE** is the aggregate of contract and adjunct instructors during the fiscal year. **Contract FTE** includes instructional related services done by "salaried" employees as part of their contractual commitments. **Adjunct FTE** includes instructional-related wages that are considered temporary or part-time basis. Adjunct wages include services provided at the Davis campus, along with on-line and Continuing Education courses.

[7] **Student/Faculty Ratio** is the Student FTE Total divided by the Faculty FTE Total.

Revised: November 15, 2007

DEPARTMENT OF CHEMISTRY
CONTRACT AND ADJUNCT FACULTY PROFILE

Table 1b

NAME	Gender	Ethnicity	Rank	Tenure Status	Highest Degree	Years at WSU	Expertise
Slabaugh, Michael R.	M	white	Adjun	1978	Ph.D.	36	Bio/Organic Chem
Lloyd, Barry A.	M	white	Prof	1992	Ph.D.	22	Physical Organic
Walker, Edward B.	M	white	Prof	1988	Ph.D.	26	Bio/Anal Chem
Miner, Bryant A.	M	white	Adjun	1969	Ph.D.	43	Inorganic/ Physical
Guymon, E. Park	M	white	Prof	1970	Ph.D.	42	General
Stoker, H. Stephen	M	white	Prof	1975	Ph.D.	39	Inorganic
Seager, Spener L.	M	white	Prof	1966	Ph.D.	46	General/Physical
Davidson, Charles F.	M	white	Prof	2004	Ph.D.	11	Inorganic/Physical
Johnson, Todd M.	M	white	Prof	2001	Ph.D.	13	Bio/Organic
Berghout, H. Laine	M	white	Assoc	2007	Ph.D.	8	Physical/Structure
Lippert, J. Andreas	M	white	Assoc	2006	Ph.D.	8	Anal/Instrument
More, Michelle B.	F	white	Assoc	2007	Ph.D.	8	Inorganic/Teach
Davies, Don	M	white	Assoc		Ph.D.	7	Organic/Synthesis
Ashby, Kyle	M	white	Assis		Ph.D.	3	Analytical

Banks, Lavoir	M	white	Adjun		Ph.D.	9	General
Davidson, Robert	M	white	Adjun		MS	7	Physical
Herzog, Timothy	M	white	Adjun		Ph.D.	2	Organometallic
Hartman, Laird	M	white	Adjun		Ph.D.	30+	Continuing Education
Aprill, Wayne	M	white	Adjun		MS	1	General
Russell, Geoffrey	M	white	Adjun		Ph.D.	2	Material Sciences

CONTRACT STAFF PROFILE

Table 2a

NAME	Gender	Ethnicity	Job Title	Years at WSU	Expertise
Miller, Karen J.	F	white	PStaff	37	Stock/Supplies
Pedersen, Douglas V.	M	white	PStaff	35	Lab Manager
Read, Margaret	F	white	CStaff	2.5	Dept. Secretary

Appendix C

External Community Liason Mechanism

Name	Organization
Dr. Edward Walker	Center of Excellence for Chemical Technology Center

Appendix D

Review Team Members:

Thomas Richmond Professor of Chemistry, University of Utah, outside member

Michael Pugh Professor of Chemistry, BYU Idaho, outside member

Brent Horn Assistant Professor, Criminal Justice Department, WSU

Karen Nakaoka Professor, Microbiology, WSU