EASTERN OREGON UNIVERSITY

Program Portfolio
Chemistry/Biochemistry
2010-2011

Description of Program

Eastern Oregon University's Chemistry and Biochemistry Program prepares students for productive and satisfying careers in research, technology, health, environment, public service and teaching. By enthusiastically sharing its knowledge and love of learning, the Program also serves the general education needs of the University and the geographically broad community.

The Chemistry degree requires 62 hours of major requirements and 34 hours of supportive and prerequisite course requirements in physics, mathematics and computer science. The Biochemistry degree requires 55 hours of chemistry, 33 hours of biology, and 20-23 hours of supportive and prerequisite course requirements in physics and mathematics. Chemistry and biochemistry majors are required to complete a research experience by taking at least one credit of CHEM 401 (Research). Furthermore, our students are strongly encouraged to present the results of their research experiences at scientific meetings and in publications such as the *Eastern Oregon Science Journal*. We encourage our students to get involved in research as early as possible so that they may benefit fully from this experience. Students are deeply involved in all aspects of these research projects, from taking active participation in the design and implementation of experiments to the dissemination of the results at regional, national and international scientific meetings. Finally, we require our majors to complete a capstone class in which students independently research a topic in the chemical sciences chosen by the faculty. Successful completion of the capstone course requires students to write a professional-quality paper and deliver a 40-50 minute oral presentation to the faculty and their peers.

The program also offers a 3/2 transfer program in chemistry and chemical engineering in conjunction with Oregon State University, in which students complete three years of chemistry coursework at EOU and two years of chemical engineering coursework at OSU to receive B.S. Chemistry and B.S. Chemical Engineering degrees.

Recent Programmatic Changes (Spring 2008 – Fall 2009)

A permanent course prefix was obtained for the Organic NMR Spectroscopy course (CHEM 437). The program discussed the possibility of adding an additional Learning Outcome in the area of civic engagement to reflect the numerous outreach activities currently carried out by the EOU Chemistry Club (Student Affiliate of the American Chemical Society), as well as service learning components of several chemistry courses. Beginning Spring 2010, the number of lectures in the third term of General Chemistry (CHEM 206) (5 credits), will be increased from 3 per week to 4 per week, while decreasing the laboratory time from 6 hours to 3 hours per week.

How Program serves the Mission of the University and needs of region

The Chemistry and Biochemistry Program provides two separate degree programs and supports the physical science liberal arts core. Graduates of these programs are highly sought after in the private and public sectors, and find employment as teachers, research chemists, or chemical technicians in industry, government labs and state or federal agencies. Most graduates continue to pursue advanced degrees in the physical and life sciences, the health professions, and in the Master of Arts in Teaching (MAT) program.

Vertical Curriculum Mapping: Chemistry/Biochemistry (PLOs)

Course Levels	Benchmark/ Expected Standard of Performance	1 **Content Knowledge** (courses required of all major	2 **Applied Learning Skill** (course required of all majors)	3 **Inquiry and Integrate Learning** (course required of all majors	4 **Communication and Critical Thinking** (course required of all majors)
	Program sets benchmark				
400-Level		440, 441, 442, 421, 411,450, 451	422, 412, 443, 444, 445, 454,437, 401	401, 437	407, 437, 443
300-Level		320, 340, 334, 335, 336,360	321, 338, 339, 361	361, 321, 339	320, 339
200-Level		204, 205, 206, 285	204, 205, 206, 285	204	204, 206
100-Level					

I. Program Objectives/Outcomes

1. **Content Knowledge:** Students will understand the basic chemical/biochemical principles and content in the major specialty areas, which include inorganic, organic, physical, analytical, and biochemistry.

2. **Applied Learning Skills:** Students will acquire safe chemical/biochemical laboratory practices and techniques including the use of instrumentation and computers.

3. **Inquiry and Integrated Learning:** Students will be able to design and conduct chemical/biochemical research with appropriate documentation including literature searches.

4. **Communication and Critical Thinking:** Students will understand the importance of the discipline to modern society and be able to communicate chemical/biochemical information both orally and in writing to their peers and the public.

II. Four-Year Assessment Cycle: Chemistry & Biochemistry

Year	Outcome to be Assessed
2009 (Spring)	1
(Fall)	1
2009-2010	1
2010-2011	4
2011-2012	2
2012-2013	3

III. Curriculum Assessment Plan

Year	Outcome	Course	Assignment/ Task	Assessment Tool	Levels of Achievement
2010-2011	**4**	**CHEM 407**	**preparation of a technical paper and seminar presentation**	**departmental rubri**	**proficient, adequate, developing.**

Degree Program Outcomes Assessment

2010-11

Degree Program: Chemistry & Biochemistry
Outcome Assessed: 4. Communication and Critical Thinking: Students will understand the importance of the discipline to modern society and be able to communicate chemical/biochemical information both orally and in writing to their peers and the public.
Course / Activity: CHEM 407 (Senior Seminar)

Summary of Assessment Results

Performance Criteria	Assessment Method	Measurement Scale	Minimum Accepted Performance	Results
Program Generated Presentation Criteria	***CHEM 407 Scoring Rubric***	***%***	***18/30 (60%)***	***86%***

Note: See "Supporting Documentation" tab or for detailed records of the summary. The assessment representative for each department must archive supporting student samples

Explanation of Assignment / Activity / Prompt

Students were given a chemistry topic and were required to choose a specific example or application. They were then required to research their chosen topic (first term) and prepare both a written paper (second term) and a 50-minute oral presentation (third term) given in front of peers, faculty, and family.

Analysis of Assessment Results

This is a first time assessment; there are no previous data to compare results to. Based on this assessment, 86% of EOU students met or exceeded the minimum accepted performance level.

Closing the Loop: Strengths, Weaknesses, Conclusions, Recommendations

Because this is a 3-term senior class worth only one credit, students tend to procrastinate doing the work. Some suggestions for remedying this include: making the class worth more than one credit, assigning faculty mentors for each student, and requiring that each student pass the previous term prior to moving on.

Eastern Oregon University

Degree Program Outcomes Assessment

Spring
2009

Degree Program: Chemistry & Biochemistry
Outcome Assessed: 1. Content Knowledge: Students will understand the basic chemical/biochemical principles and content in the major specialty areas, which include inorganic, organic, physical, analytical, and biochemistry.
Course / Activity: CHEM 336 (Organic Chemistry III)/content-based examination (Spring 2009)

Summary of Assessment Results

Performance Criteria	Assessment Method	Measurement Scale	Minimum Accepted Performance	Results
Objective based multiple choice exam	standardized American Chemical Society exam	***%***	***35.7%***	***79%***

Note: See "Supporting Documentation" tab or for detailed records of the summary. The assessment representative for each department must archive supporting student samples

Explanation of Assignment / Activity / Prompt

Students were given the standardized American Chemical Society exam in Organic Chemistry which features 70 multiple choice questions. The exam is cumulative for the entire three term organic chemistry sequence (CHEM 334, 335, 336).

Analysis of Assessment Results

Relative to previous years, the results were poorer than average. For example: in the previous year (2007-08), 92% of students achieved the minimum performance criterion.

Closing the Loop: Strengths, Weaknesses, Conclusions, Recommendations

This is one of the most challenging classes that science students routinely take. The performance on the standardized exam for this year's class mirrored consistent poor performance on instructor created tested examination modes for the entire year which were non multiple choice based. On the basis of this year's CHEM 336 assessment, the Chemistry & Biochemistry program will undertake the following pedagogical changes:
(i) Addition of an instructor-led study session to be held on Friday afternoons.
(ii) Creation of a peer-led study session to be held during the evening.
(iii) Continued ongoing annual assessment of the CHEM 336 course.

Degree Program Outcomes Assessment

Fall 2009

Degree Program: Chemistry & Biochemistry
Outcome Assessed: 1. Content Knowledge: Students will understand the basic chemical/biochemical principles and content in the major specialty areas, which include inorganic, organic, physical, analytical, and biochemistry.
Course / Activity: CHEM 204 (General Chemistry) Pre- and post-course content-based examination (Fall 2009)

Summary of Assessment Results

Performance Criteria	Assessment Method	Measurement Scale	Minimum Accepted Performance	Results
Objective based multiple choice exam	Standardized American	***%***	***35%***	***94%***

	Chemical Society exam			

Note: See "Supporting Documentation" tab or for detailed records of the summary. The assessment representative for each department must archive supporting student samples

Explanation of Assignment / Activity / Prompt

Students were given 20 selected questions from the standardized American Chemical Society exam in General Chemistry. The exam covers the first term of the General Chemistry sequence (CHEM 204). The exam was given at the beginning of the course and at the end of the course to track student learning.

Analysis of Assessment Results

The post course assessment showed that most students (92%) performed at or above the minimum performance criterion. This compared to 61% of students for the pre-course assessment, thereby demonstrating increased mastery of content knowledge. Relative to Fall 2008 (82% achieving the minimum standard), this year's results showed a slight improvement.

Closing the Loop: Strengths, Weaknesses, Conclusions, Recommendations

The performance on the standardized exam for this year's class mirrored consistent good performance on instructor created testing examination modes throughout the Fall term which were non multiple choice based. The strong performance for this year's CHEM 204 class may have been facilitated by the recent introduction of a peer-led ChemExcel CHEM 210 course that provided students with parallel problem-based examples of lecture course content. On the basis of this year's CHEM 204 assessment, the Chemistry & Biochemistry program does not at this time propose any substantive changes.

Key Programmatic Assessments

The aforementioned outcomes are supported by the chemistry and biochemistry curriculum. A matrix displays the correspondence of teaching and learning opportunities with the intended outcomes of the program (see below).

Correspondence of teaching and learning opportunities with program outcomes

	Content Knowledge	Applied Learning Skills	Inquiry and Integrated Learning	Communication and Critical Thinking
CHEM 204	x			
CHEM 204L	x	x		
CHEM 205	x			
CHEM 205L	x	x		
CHEM 206	x			
CHEM 206L	x	x		x
CHEM 210	x			
CHEM 285	x	x		
CHEM 320	x			
CHEM 321	x	x		
CHEM 334	x			
CHEM 335	x			
CHEM 336	x			
CHEM 338	x	x		
CHEM 339	x	x		x
CHEM 340	x			
CHEM 401	x	x	x	x
CHEM 407	x		x	x
CHEM 411	x			
CHEM 412	x	x		
CHEM 421	x			
CHEM 422	x	x		
CHEM 437	x	x		
CHEM 440	x			
CHEM 441	x			
CHEM 442	x			
CHEM 443	x	x		
CHEM 444	x	x		
CHEM 445	x	x		
CHEM 450	x			
CHEM 451	x			
CHEM 454	x	x		

The following major assessments are significant and summative samples taken from this learning matrix:

- Chemical principles and content assessment is sampled in key courses using selections from ACS standardized tests for chemistry content knowledge. These tests are applied as pre- and post assessments in CHEM 204, CHEM 450 and CHEM 451. Comprehensive American Chemical Society standardized exams are administered in CHEM 206, at the end of the general chemistry (first-year) sequence, and CHEM 336, at the end of the organic chemistry (second-year) sequence. Data are collected, summarized and reported each biennium (see Appendix I). Additionally, a pre/post assessment is conducted in CHEM 206 to measure knowledge of instrumentation and awareness of environmental issues connected to the service learning experience in this class.

- Safe and proper use of laboratory equipment and instrumentation is assessed using a laboratory final examination in year in the CHEM 204 course. The program plans to implement another laboratory exam in CHEM 422 Instrumental Analysis Laboratory. CHEM 285 Chemical Safety offers specific instruction in lab safety, lab procedure, and proper use of equipment.

- Students' ability to conduct research is assessed in the CHEM 401 Research (capstone) course. Students work on a stated problem, develop specific methodology to explore, conduct a study, collect data, analyze data, and report findings. Assessment of this outcome is determined by tracking the percentage of students delivering a formal presentation at the Spring Symposium or other professional conference, or publishing a paper in the award-winning *Eastern Oregon Science Journal* or external peer-reviewed scientific journals. Data are collected for these assessments each year (see below and in Appendix II).

Percentage of Graduates with Research Publications or Presentations

Year of graduation	# Chemistry and Biochemistry graduates	# Graduates with research presentations or publications	Percentage graduates with research presentations or publications
2002-03	5	5	100%
2003-04	4	4	100%
2004-05	8	7	88%
2005-06	7	3	43%
2006-07	10	10	100%
2007-08	13	9	69%
2008-09	10	7	70%

- Students' ability to communicate chemical principles and technical information orally and in writing is assessed in the CHEM 407 Seminar (capstone) course. Each student prepares a

literature review and delivers a 40-50-min oral presentation, both assessed using a standard rubric (see Appendix III). Data from these experiences are collected each year.

Current Programmatic Assessment Data/Reflections/Recommendations of Curriculum and Instruction

Based on the assessment of student content acquisition using ACS standardized tests, students performed at the national average. Although the ACS test is satisfactory in the assessment of content knowledge, the tool is inadequate in measuring applied laboratory skills. Based on feedback from students and recent alumni, it was determined that the biochemistry curriculum was not adequately preparing students in the use of fundamental chemical instrumentation. The faculty determined that these observations required a program modification to better support student learning in this area. Therefore, a change in the curriculum to include CHEM 421 Instrumental Analysis and CHEM 422 Instrumental Analysis Laboratory was implemented in Fall 2007. Furthermore, we plan on implementing an exit examination for CHEM 422 to ensure that students graduate with a fundamental understanding of modern instrumentation.

Since 2002, the assessment of CHEM 407 Capstone has been extensively modified. Previously, students were expected to give two oral presentations and a written paper on a narrow topic from within a broad subject area chosen by the faculty. Based on the poor quality of the presentations and the paper, the faculty decided that students should only give one high-quality longer presentation and write a paper of expanded scope. A system of faculty and peer review was also implemented for the paper writing and drafting process. Furthermore, with the addition of more electronic resources for scientific literature, students are now expected to research and use scholarly articles on their chosen topic. A specific rubric was developed to provide guidance in specific areas of assessment

Assessment of the CHEM 336 (organic chemistry) course during Spring 2009 revealed relatively poor performance on the ACS standardized test. Consequently, the program has added an instructor-led study session on Friday afternoons, as well as a peer-led study session to be held during the evening. Ongoing and future assessment of the CHEM 336 will be carried out to track the effectiveness of these changes.

Based on a Spring 2008 General Education pilot assessment for the third term of General Chemistry (CHEM 206) (5 credits) it was determined that students in this class had insufficient knowledge of the core lecture course material. At the same time, the allocated laboratory time was not being used efficiently. Consequently, beginning Spring 2010, a change in curriculum will be implemented to increase the number of lectures from three per week to four per week, while decreasing the laboratory time from six hours to three hours per week.

Programmatic Assessment: Synthesis and Recommendations

Based upon programmatic assessment data and student accomplishments that have been analyzed by the faculty, the following programmatic medications or adjustments are recommended:

• The Program plans to administer American Chemical Society graduate school entrance exams to all graduates.

• All biochemistry majors are now required to take the CHEM 421 and CHEM 422 instrumentation courses.

• The Program plans to implement an exit examination for CHEM 422 to ensure that students graduate with a fundamental understanding of modern instrumentation.

• To increase student success in CHEM 336 (Organic Chemistry) the program has added an instructor-led study session to be held on Friday afternoons, as well as a peer-led study session to be held during the evening.

• The number of lectures in the General Chemistry CHEM 206 course will be increased from 3 per week to 4 per week to ensure that students receive sufficient coverage of core material.

Student Accomplishments

Students in the Chemistry and Biochemistry program are part of a vigorous and nationally recognized Student Affiliate Chapter of the American Chemical Society ("EOU chemistry Club"). Club members regularly organize and perform educational outreach events in the local community to promote chemistry and science including hands on activities and magic shows at grade schools and middle schools, promoting and judging science fairs, and organizing science events for Boy Scouts and Girl Scouts. The club regularly supports major institutional outreach programs such as the Girls in Science and the Robotics tournament. The club has also established partnerships with local organizations like the Grande Ronde Model watershed. Club members participate in water monitoring and stream clean up activities.

In addition to regularly presenting research posters at national and regional conferences of the American Chemical Society, Club members are also involved in the organization of sessions or other educational activities. In June 2007 the club organized all undergraduate sessions at the Northwest Regional Meeting of the American Chemical Society (ACS) in Boise, ID. These included inviting the President of the American Chemical Society, Dr. Katie Hunt, to deliver the Eminent Scientist lecture, organizing two poster sessions, coordinating a graduate school recruiting breakfast and organizing two career-oriented workshops and a tour of Micron. In September 2006 the club was responsible for organizing a nanotechnology workshop for undergraduates at the National Meeting of ACS in San Francisco. The club invited Mrs. Sharyl Majorski from Central Michigan University to lead the hands-on activities and provided assistance to participants during the workshop. Club member Alison McKay also received the great honor to introduce Dr. Robert Grubbs, Nobel laureate in chemistry at a plenary session. In addition, the club regularly takes part in the Chem Demo Exchange at national ACS meetings presenting hands-on activities with household chemicals. The program's emphasis on providing undergraduate research opportunities leads to students presenting research at national conferences (typically 10-15 students present their research each year at the American Chemical Society national meetings) and publishing their research in the *Eastern Oregon Science Journal*, as well as in international peer-reviewed journals such as *Biochemistry*. Faculty in the program have been successful in obtaining extramural funds to

support the integration of teaching and undergraduate research (see Faculty Accomplishments Section).

Upon graduating, our students are successful in obtaining employment or gaining entry to post-baccalaureate degrees, including PhD programs, Master of Education, and health care professional schools.

Recent examples of student publications (2008 - 2009) include:

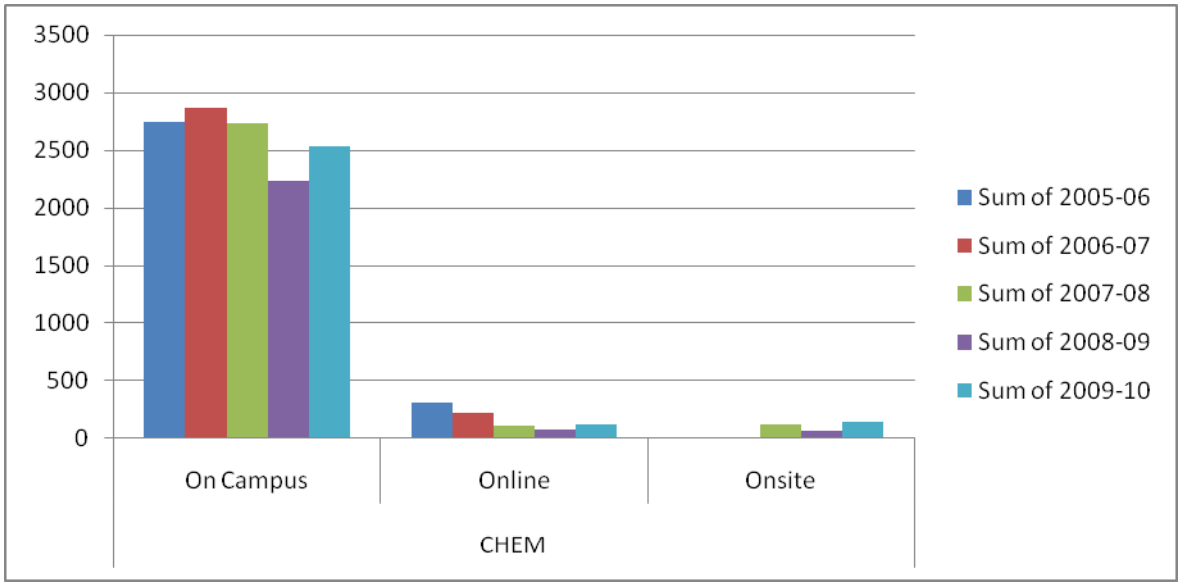
Pixton, D. A.*, Petersen, C. A.*, Franke, A., van Eldik, R., Garton, E. M., Andrew, C. R. *J. Am. Chem. Soc.* **2009**, *131*, 4846-4853. Activation parameters for heme-NO binding in *Alcaligenes xylosoxidans* cytochrome *c'*: The putative dinitrosyl intermediate forms via a dissociative mechanism.

*Indicates EOU student author

Enrollment and Program Performance

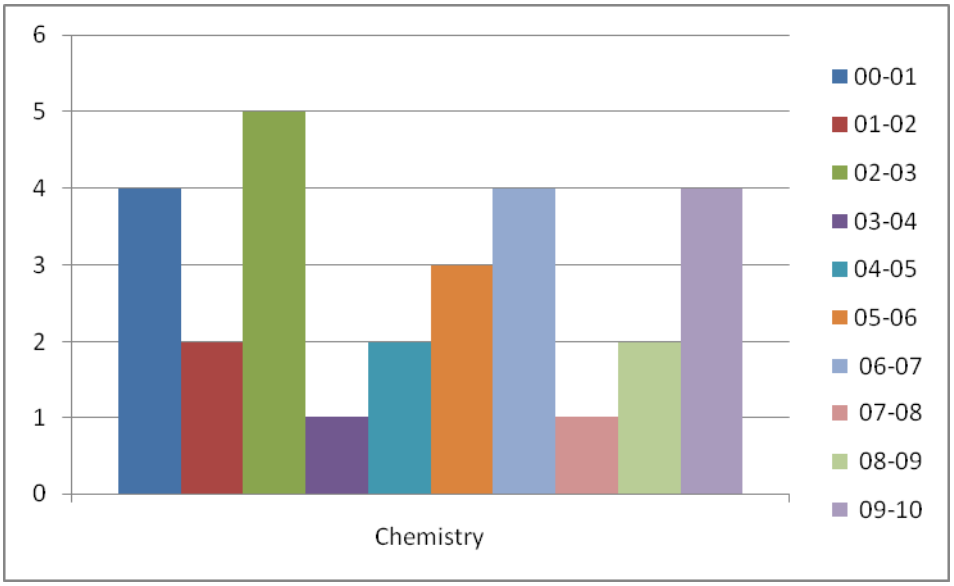
5 Year Student Credit Hours Generated by 'CHEM' Course Prefix

		Data				
Prefix	Campus	05-06	06-07	07-08	08-09	09-10
CHEM	On Campus	2747	2868	2730	2236	2539
	Online	305	224	109	77	117
	Onsite	0	0	115	64	144
CHEM Total		3052	3092	2954	2377	2800
Grand Total		3052	3092	2954	2377	2800



Eastern Oregon University
5 Year Graduation by Major

	Data									
Bachelors	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10
Chemistry	4	2	5	1	2	3	4	1	2	4
Grand Total	4	2	5	1	2	3	4	1	2	4



Commentary on Enrollment and Graduate Trends

The Chemistry and Biochemistry Program serves many EOU students. Prior to the 2005-06 academic year, the program averaged 300-500 students per year in the 100-level Introductory Chemistry sequence. In 2005, OHSU removed CHEM 101, 102, 103 from their required coursework for pre-nursing. Since then, the Chemistry and Biochemistry Program has averaged approximately 200 students per year in the Introductory Chemistry sequence. For the past 4 years the program has also typically served 200 students per year in the 200-level General Chemistry sequence for science and pre-professional majors, 110 students annually in the upper-division Organic Chemistry sequence, and 60 annually in the Research course. The combined total of graduates in Chemistry and Biochemistry has risen from 3 in 1999 to 10 in 2007, with 11 projected for 2007-08.

Program and Course Scheduling Requirements

The following course schedule is designed to support both lower division general education and service course needs of the University as well as support a four-year opportunity for students to complete the major in Chemistry or Biochemistry.

Given below are the minimum requirements needed by term over a two-year period to ensure adequate support of student success. In every possible circumstance, historically small enrollment courses offered each academic year are collapsed into larger sections that span a two-year time frame. Where laboratory space controls class size, these maximums are noted.

The following CHEM courses are general education courses:

Course	General Education Category
CHEM 101, CHEM 101L, CHEM 102, CHEM 102L, CHEM 103, CHEM 103L; CHEM 204, CHEM 204L, CHEM 205, CHEM 205L, CHEM 206, CHEM 206L	SMI

The following CHEM service courses are *requirements* outside the chemistry and biochemistry program:

Course	Requirement For
CHEM 101, CHEM 101L, CHEM 102, CHEM 102L, CHEM 103, CHEM 103L	Dental hygiene program
CHEM 204, CHEM 204L, CHEM 205, CHEM 205L, CHEM 206, CHEM 206L, CHEM 334, CHEM 335, CHEM 336	Biology major; Pre-professional health programs (pre-medicine, pre-dentistry, pre-physical therapy, pre-veterinary medicine, pre-pharmacy)
CHEM 450, CHEM 454	Pre-dentistry
CHEM 441, CHEM 444	Physics minor

The following CHEM courses are "CHEM Excel" peer-led courses that support student success in the 100- and 200- level chemistry series.

Chem Excel Course	Supports learning in:
CHEM 105	CHEM 101, CHEM 101L
CHEM 106	CHEM 102, CHEM 102L
CHEM 107	CHEM 103, CHEM 103L
CHEM 210	CHEM 204, CHEM 204L, CHEM 205, CHEM 205L, CHEM 206, CHEM 206L

General Education and Service Course Schedule

FALL YEAR 1	**FALL YEAR 2**

Course	Load Hours	Enroll 2005-06	Course	Load Hours	Enroll 2006-07
CHEM 101 (1)	3	50	CHEM 101	3	49
CHEM 101 (2)	3	41	CHEM 101 (2)	3	48
CHEM 101L (1)	2	25	CHEM 101L (1)	2	29
CHEM 101L (2)	2	25	CHEM 101L (2)	2	28
CHEM 101L (3)	2	24	CHEM 101L (3)	2	26
CHEM 101L (4)	2	17	CHEM 101L (4)	2	13
CHEM 105	1	13	CHEM 105	1	9
CHEM 204	4	74	CHEM 204	4	80
CHEM 204L (1)	3	17	CHEM 204L (1)	3	21
CHEM 204L (2)	3	19	CHEM 204L (2)	3	20
CHEM 204L (3)	3	19	CHEM 204L (3)	3	18
CHEM 204L (4)	3	19	CHEM 204L (4)	3	21
CHEM 210	1	13*	CHEM 210	1	13*
CHEM 334	4	32	CHEM 334	4	30
CHEM 450	4	16	CHEM 450	4	20

WINTER YEAR 1 **WINTER YEAR 2**

Course	Load Hours	Enroll 2005-06	Course	Load Hours	Enroll 2006-07
CHEM 102 (1)	3	43	CHEM 102	3	40
CHEM 102 (2)	3	40	CHEM 102	3	25
CHEM 102L (1)	2	28	CHEM 102L (1)	2	23
CHEM	2	27	CHEM	2	16

102L (2)			102L (2)		
CHEM			CHEM		
102L (3)	2	27	102L (3)	2	26
CHEM			CHEM		
106	1	7	106	1	7
CHEM			CHEM		
101	3	18*	101	3	18*
CHEM			CHEM		
101L	2	18*	101L	2	18*
CHEM			CHEM		
205	4	54	205	4	68
CHEM			CHEM		
205L (1)	3	18	205L (1)	3	18
CHEM			CHEM		
205L (2)	3	18	205L (2)	3	18
CHEM			CHEM		
205L (3)	3	18	205L (3)	3	12
CHEM			CHEM		
205L (4)	3	-	205L (4)	3	19
CHEM			CHEM		
210	1	13*	210	1	13*
CHEM			CHEM		
335	4	31	335	4	27
CHEM			CHEM		
338 (1)	3	14	338 (1)	3	13
CHEM			CHEM		
338 (2)	3	13	338 (2)	3	15
CHEM			CHEM		
338 (3)	3	-	338 (3)	3	4
CHEM			CHEM		
441	1	2	441	1	4
CHEM			CHEM		
444	3	1	444	3	4
CHEM			CHEM		
451	4	11	451	4	16
CHEM		1	CHEM		
454	6	0	454	6	11

SPRING YEAR 1 **SPRING YEAR 2**

Course	Load Hours	Enroll 2005-06	Course	Load Hours	Enroll 2006-07
CHEM			CHEM		
103	3	60	103	3	58
CHEM	2	30	CHEM	2	26

103L (1) CHEM			103L (1) CHEM		
103L (2) CHEM	2	30	103L (2) CHEM	2	31
107 CHEM	1	7	107 CHEM	1	9
206 CHEM	3	46	206 CHEM	3	61
206L (1) CHEM	6	16	206L (1) CHEM	6	23
206L (2) CHEM	6	22	206L (2) CHEM	6	19
206L (3) CHEM	6	20	206L (3) CHEM	6	16
206L (4) CHEM	6	9	206L (4) CHEM	6	22
210 CHEM	1	9*	210 CHEM	1	9*
336 CHEM	4	28	336 CHEM	4	26
339 (1) CHEM	3	12	339 (1) CHEM	3	7
339 (2) CHEM	3	12	339 (2) CHEM	3	13
339 (3)	3	-	339 (3)	3	3

Major Course Requirements Schedule

FALL YEAR 1

Course	Load Hours	Enroll 2005-06
CHEM 204	4	74
CHEM 204L (1)	3	17
CHEM 204L (2)	3	19
CHEM 204L (3)	3	19
CHEM 204L (4)	3	19
CHEM	4	32

FALL YEAR 2

Course	Load Hours	Enroll 2006-07
CHEM 204	4	80
CHEM 204L (1)	3	21
CHEM 204L (2)	3	20
CHEM 204L (3)	3	18
CHEM 204L (4)	3	21
CHEM	4	30

334			334		
CHEM 320	3	17	CHEM 320	3	15
CHEM 321	6	16	CHEM 321	6	16
CHEM 440	4	7	CHEM 440	4	7
CHEM 443	3	4	CHEM 443	3	6
CHEM 450	4	16	CHEM 450	4	20
CHEM 401	8	18	CHEM 401	8	14
CHEM 407	1	7	CHEM 407	1	10

WINTER YEAR 1 **WINTER YEAR 2**

Course	Load Hours	Enroll 2005-06	Course	Load Hours	Enroll 2006-07
CHEM 205	4	54	CHEM 205	4	68
CHEM 205L (1)	3	18	CHEM 205L (1)	3	18
CHEM 205L (2)	3	18	CHEM 205L (2)	3	18
CHEM 205L (3)	3	18	CHEM 205L (3)	3	12
CHEM 205L (4)	3	-	CHEM 205L (4)	3	19
CHEM 335	4	31	CHEM 335	4	27
CHEM 338 (1)	3	14	CHEM 338 (1)	3	13
CHEM 338 (2)	3	13	CHEM 338 (2)	3	15
CHEM 338 (3)	3	-	CHEM 338 (3)	3	4
CHEM 421	3	4	CHEM 421	3	5
CHEM 422	6	4	CHEM 422	6	5
CHEM 441	4	2	CHEM 441	4	4
CHEM	3	1	CHEM	3	4

444			444		
CHEM 401	8	16	CHEM 401	8	15
CHEM 437	2	10	CHEM 437	2	8
CHEM 451	4	11	CHEM 451	4	16
CHEM 454	6	10	CHEM 454	6	11

SPRING YEAR 1			**SPRING YEAR 2**		
Course	Load Hours	Enroll 2005-06	Course	Load Hours	Enroll 2006-07
CHEM 206	3	46	CHEM 206	3	61
CHEM 206L (1)	6	16	CHEM 206L (1)	6	23
CHEM 206L (2)	6	22	CHEM 206L (2)	6	19
CHEM 206L (3)	6	20	CHEM 206L (3)	6	16
CHEM 206L (4)	6	9	CHEM 206L (4)	6	22
CHEM 285	1	22	CHEM 285	1	22
CHEM 336	4	28	CHEM 336	4	26
CHEM 339 (1)	3	12	CHEM 339 (1)	3	7
CHEM 339 (2)	3	12	CHEM 339 (2)	3	13
CHEM 339 (3)	3	-	CHEM 339 (3)	3	3
CHEM 340	4	9	CHEM 340	4	12
CHEM 401	8	18	CHEM 401	8	16
CHEM 442	4	3	CHEM 442	4	5
CHEM 445	3	3	CHEM 445	3	4
CHEM 360	4	8	CHEM 411	4	7
CHEM 361	3	3	CHEM 412	3	2*

Based on 2006-07 enrollment data (from the 5-year enrollment table):

Total SCH required per academic year (General Education and service courses and major courses) = 2868

Total faculty load hours = 225

Staffing
The Chemistry and Biochemistry Program at Eastern Oregon University is composed of six faculty members, each of whom has a Ph.D. in the chemical sciences. Four are tenure/tenure track and two are adjunct faculty.

.5 FTE Anna G. Cavinato, Professor (analytical chemistry), Chair of the Division of Science, Mathematics, and Technology, and faculty advisor to the award-winning Student Affiliate of the American Chemical Society

1.0 FTE Ronald B. Kelley, Associate Professor (organic chemistry)

1.0 FTE Jeffrey N. Woodford, Associate Professor (physical chemistry)

1.0 FTE Colin R. Andrew, Professor (biochemistry/inorganic chemistry), Discipline Representative, and faculty advisor to the award-winning *Eastern Oregon Science Journal* which features student publications of undergraduate research

1.0 FTE Lorna Williamson, Assistant Professor (organic chemistry/introductory chemistry)

.75 FTE Abel Mendoza, Assistant Professor (analytical/environmental chemistry)

Faculty Accomplishments
Faculty are actively engaged in research projects leading to publications in peer-reviewed journals. Dr. Cavinato's research interests include the development of nondestructive methods of analysis and environmental monitoring. Dr. Kelley's research interests include the investigation of naturally occurring compounds in plant sources. Dr. Woodford's research interests include the theoretical study of materials possessing strong hydrogen bonding. Finally, Dr. Andrew's research centers on the structure and reactivity of metal-containing proteins. Faculty regularly publish their research in peer-reviewed journals. Some recent examples include: Dr. Andrew's "Activation parameters for heme-NO binding in *Alcaligenes xylosoxidans* cytochrome *c'*: The putative dinitrosyl intermediate forms via a dissociative mechanism." published in 2009 in the *Journal of the American Chemical Society*, and Dr. Woodford's "Detecting weak interactions between Au^- and gas molecules: a photoelectron spectroscopic and Ab Initio study" also published in 2009 in the in the *Journal of the American Chemical Society*. Dr. Kelley is the

author of a forthcoming book chapter: R. B. Kelley, 2010, “Boraginaceae” family treatment (*sensu stricto*), in B. G. Baldwin, et al, (eds.), The Jepson Manual, Vascular Plants of California, 2nd edition, University of California Press, Berkeley (in press).

Chemistry and Biochemistry faculty are active in securing extramural funding to support research and education from agencies such as the National Science Foundation, the Oregon Sea Grant, and the U.S. Department of Agriculture, as well as foundations such as the M. J. Murdock Charitable Trust. For example, in 2008 Dr. Colin Andrew successfully renewed his National Science Foundation grant “RUI: Novel Heme Chemistry of Cytochrome c´” which provides funds ($395,132) to support his research with undergraduates throughout 2008-2012. Dr. Andrew also serves on the NSF review panel for Molecular Biochemistry. Dr. Anna Cavinato earned $84,662 from Western Regional Aquaculture in 2007 for her project “Determining Ripeness in white sturgeon females to maximize Center yield and quality of caviar,” and the collaboration among Drs. Cavinato, Woodford, and Kelley was successful in obtaining $182,640 from the National Science Foundation in 2002 to implement curricular transformations across most laboratory courses with the introduction of gas-chromatography/mass spectrometry and Fourier Transform Infrared Spectroscopy. Drs. Cavinato and Andrew have also recently received grants from the M. J. Murdock Charitable Trust “Partners in Science Program” to host and mentor local high school teachers in their research labs. Over the years, Dr. Cavinato has organized several symposia at national and regional meetings and has served on the ACS Taskforce for Undergraduate Programming at national meetings. She also serves on the NSF review panel for the Course, Curriculum, Laboratory Improvement (CCLI) program. Dr. Cavinato is also a board member of the Division of Analytical Chemistry of the American Chemical Society as well as the Richland local section of the ACS. Dr. Woodford served as chair of the local ACS Richland section (2007), and is currently serving on the General Chemistry First Term Exam Committee of the ACS Examinations Institute. He has also served as a reader for the AP Chemistry exam (2008 and 2009). During his recent sabbatical (2008-2009), Dr. Woodford carried out research at University of Nebraska-Lincoln Department of Chemistry with Prof. Gerard S. Harbison and Prof. Xiao C. Zeng, leading to a publication in the 2009 edition of *Journal of the American Chemical Society* (described above), as well as other manuscripts in preparation. A research poster presented by Dr. Woodford at the 237th National Meeting of the American Chemical Society, Salt Lake City, UT 2 “DFT Study of the Explosive Tetraacetone Tetraperoxide” was also the subject of a press conference at the meeting.

Innovative teaching by Chemistry and Biochemistry faculty includes: POGIL, the integration of instrumentation in the upper-division lab curriculum, student research, service learning, installation and application of MicroLAB interfaces in the General Chemistry Lab, General Chemistry Lab manual written by Prof. Jeff Woodford and Professor Emeritus Richard Hermens, Chem Excel, the development of DDE courses and labs-at-a-distance and on-campus weekend DDE labs. Dr. Andrew serves as the faculty advisor for the *Eastern Oregon Science Journal*, a journal featuring the research of undergraduate students at EOU. The journal has received numerous national commendations, including “First Place Special Merit” awards from the American Scholastic Association in 2007 and 2008.

Chemistry and Biochemistry faculty provide outreach activities in the community including: Girls in Science coordinated by Prof. Cavinato (this acclaimed outreach program to promote science to sixth-eighth grade girls has garnered six national awards from the American Chemical Society as one of the most outstanding outreach activities to young women.. Dr. Cavinato is also the faculty advisor to the award-winning Student Affiliate of the American Chemical Society (EOU Chemistry Club). Over the past ten years the club has received ten national awards (commendable or outstanding). In 2008-09 the club was one among thirty five in the nation to receive an outstanding award out of 360 chapters nationwide. Other outreach activities of the chemistry club include: Science Fair judging at the elementary school, K-12 career days, other K-12 school visits, Chemistry Extravaganza, Chemistry Scouting Merit Badges, Chemistry Olympiad, service learning. Other outreach accomplishments of faculty include Dr. Colin Andrew's service on the La Grande Air Quality Commission and Dr. Cavinato's appointment as board member of the Grande Ronde Model Watershed.

Minimum Staffing Requirements

1) Current assessment of Faculty
Based on the current faculty in chemistry, the following total FTE are available:

Total = 5.25 FTE

2) Efficiency Ratios

Load/Faculty On Campus

Based on the 2008-09 SCH, the ratio of SCH to faculty in CHEM Course prefix is 546.
Teaching load hours/5.25 FTE = _42.86_ load hours per faculty member.

Total SCH: 2,337

ON Campus SCH: 2.236

ONLINE SCH: 77

ON SITE SCH: 64

SCH/Faculty Need

On campus _____cr hr/ 36

Summary Recommendations/Observations
The Chemistry and Biochemistry Program should be commended for supporting student accomplishments such as the nationally recognized EOU Chemistry Club and the *Eastern Oregon Science journal*. Additionally, the program continues to increase its numbers of Chemistry and Biochemistry majors and to provide outstanding undergraduate research opportunities. The program's graduates are successful in obtaining employment and admission to post-baccalaureate degree programs. The Girls in Science outreach event also receives national awards, and the program's faculty members are successful in obtaining extramural funding and publishing.

To continue and build on these successes, the Chemistry and Biochemistry Program faculty must have time to do student-centered research, the program must expand physical capacity for research, and the program should seek another tenure-track faculty member.

Administrative Review of Program (Dean Marilyn Levine)
Administrative Assessment of program portfolios will consist of three areas of commentary: assessments conducted relating to student learning outcomes; comments on enrollment indicators; program goals and observations. If appropriate other observations will be offered.

1. Assessment of Program Outcomes:
In the content assessment exercise for the Chem 334-336 sequence, the faculty compared the current, poorer performance on the cumulative examination with previous years. The faculty have added more review sessions and will continue to monitor and assess the Chem 336 examination results.

The examination at the earlier sequence, Chem 204, was more successful in having students obtain the minimum standard of performance. They were able to compare this result with previous years and found higher performance levels had taken place. The Chem 204 success might have increased because of the innovative peer-led EXCEL program for Chemistry (ChemExel).

The matrix of learning outcomes and the substantive discussion of these outcomes is exemplary. The Chemistry faculty have demonstrated a real cycle of learning assessment. In addition the Chemistry program is a leader in undergraduate research production and number of graduates has increased and there is a solid record of student presentations at professional conferences and publications in peer-reviewed journals. The *Eastern Oregon Science Journal* has garnered a national award. The utilization of the assessments has led to changes in curriculum and the content in some of the curriculum.

2. Enrollment Indicators:
The SCH have been declining in Chemistry, but the graduates, when one includes the biochemistry major grads is on the upswing. As the report mentions, the pre-professional majors take some of the chemistry sequences, but may not major in Chemistry.

3. Program Goals and Observations:

Although the Chemistry faculty have extensive mentoring and training of students, their program plans include more study sessions and closer scrutiny of several courses and their results. I highly commend their reflective practices as well as their substantive accomplishments.

The faculty in Chemistry constitute the most active faculty in the college in terms of grants written and received and they publish extensively. Given the high teaching load, this is an exceptional accomplishment. If campus enrollments were to be increased, and the new environmental studies major could grow, or alternatively if we could apply for some more major grants, I would recommend planning on workload reductions and on the merits of accreditation and what it would take to accomplish those two goals.

Other Observations:
The excellent teaching practices of the Chemistry faculty are demonstrated by the high caliber of students they produce. The section on Student accomplishments is of superlative quality, in terms of student research, the ability to convey that work in professional ways, and the national and international recognition garnered by the students and the department. As just one example, the project by Professor Andrews is based on these strengths in undergraduate research and his leadership has been recognized by two distinctive NSF Undergraduate Research grants.

Appendix I.

Course Assessments for CHEM 204 and CHEM 450 (Fall 2004)

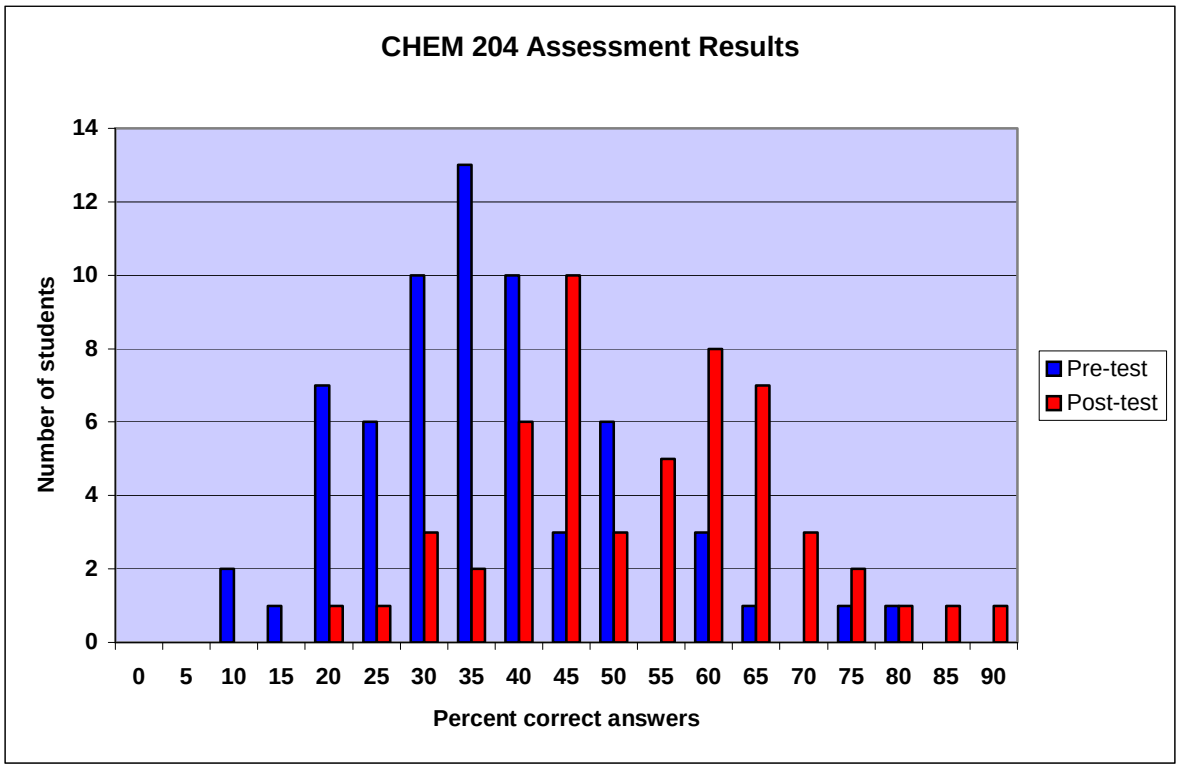
Assessment results:

The American Chemical Society (ACS) provides standardized examinations which are used throughout the country to assess students' learning in core required courses for a chemistry degree. The chemistry program routinely administers the General Chemistry Full Year Examination at the end of spring term. To assess the efficacy of CHEM 204 to contribute to the fundamental program outcome of "*understanding the basic chemical principles in the major specialty areas which include inorganic, organic, physical and analytical chemistry*", a pre-test and a post-test were administered at the beginning and the end of Fall term 2004. The test, comprising of 20 questions taken from ACS standardized exams, aims at assessing students' ability to understand fundamental principles of matter composition and the electronic configuration of elements, use appropriate chemical nomenclature, balance chemical reactions and apply simple stoichiometric relationships to the solution of problems related to chemical reactivity. A copy of the pre-test and post-test are enclosed.

The following table summarizes the results of the assessment:

	PRE-TEST	POST-TEST
Total points possible	20	20
Students in this group	64	54
Mean score	7.23	10.63
Median score	7.00	11.00
Standard deviation	2.77	3.00
Highest score	16	18
Lowest score	2	4
% correct answers	**36.15**	**53.15**

The following graph presents the distribution of students' answers for pre-test and post-test.



Clearly these results show a strong improvement in students' performance. The percentage of correct answers rose from 36.15 to 53.15, representing a 32% improvement over the course of the term. The national norm reported for a similar test by the ACS is 41.03. Thus the performance of our students in CHEM 204 exceeds the national standards.

Outcomes in CHEM 450 was also measured in part by comparing class performance in standardized tests administered to students at the beginning and the end of the course. In the case of structural biochemistry, the assessment consisted of 20 multiple choice questions, selected from the ACS standardized biochemistry exam. The data are summarized in Tables 1 and 2,

Table 1. Pre-course test results (CHEM 450)

Distribution of scores (out of 20)

11	9	9	9	9	9	7	7	6	5	5	4	3

13 students
Mean score = 7.15 (35.8%)

Table 2. Post-course test results (CHEM 450)

Distribution of scores (out of 20)

13	12	12	10	10	10	9	9	9	8	8	7	6

13 students
Mean score = 9.46 (47.3%)

The data show the following.

(i) comparison of the class score before (35.8%) and after the course (47.3%) shows a clear improvement in performance.

(ii) the overall class score compares favorably with national average (*e.g.* mean score of the 1992 ACS Biochemistry exam was 44%).

Appendix II

Assessment of Student Research Outcome

• Be able to design and conduct chemical/biochemical research with appropriate documentation including literature searches.

Year of graduation	# Chemistry and Biochemistry graduates	# Graduates with research presentions or publications	Precentage of graduates with research presentions or publications
2002-03	5	5	100%
2003-04	4	4	100%
2004-05	8	7	88%
2005-06	7	3	43%
2006-07	10	10	100%
2007-08	13	9	69%
2008-09	10	7	70%

Student Presentations (regional, national, and international), 2008-2009

*Indicates EOU student author

Servid, S.A*., Cavinato, A.G. "Noninvasive characterization of maturity status to optimize caviar yield and quality in white sturgeon". 235th American Chemical Society National Meeting, New Orleans, LA, **April 2008**.

Troutman, K.*, Boethin, T**.***, Hammers, M.M *., Twombly, L.R.*, Servid, S.A.*, Cavinato, A. G. "Rapid screening method for nonlethal detection of bacterial kidney disease in Pacific salmon". 235th American Chemical Society National Meeting, New Orleans, LA, **April 2008**.

C. A. Petersen*, D. A. Pixton*, R. van Eldik, and C. R. Andrew, "Activation Parameters for Nitric Oxide Binding to *Alcaligenes xylosoxidans* cytochrome *c′*: Probing the Putative Dinitrosyl Heme Intermediate" *235th National Meeting of the American Chemical Society,* New Orleans, LA, **April 2008**.

James P. Barnett*, Nicholas Root*, Christopher S. Mello*, Nolan Schmidt*, K. W. Wade Elliott*, and J. N. Woodford, "Calculation of Equilibrium Self-Assembly Constant of 2-Amidopyrimidine", 235th National Meeting of the American Chemical Society, New Orleans, LA

K. Wade Elliott* and J. N. Woodford, "Vibrational Averaging of Chemical Shielding for Self-Assembling Molecules", 235th National Meeting of the American Chemical Society, New Orleans; LA.

D. S. Kelley*, D. W. Erickson*, D. L. Canavan*, and R. B. Kelley, "Analysis of pyrrolizidine alkaloid in *Cacaliopsis nardosmia*" 235th National Meeting of the American Chemical Society, New Orleans; LA.

W. R. Parker*, K. L. Miller*, and R. B. Kelley, "Comparing pyrrolizidine alkaloids in *Onosmodium decipiens* and *O. virginianum*", 235th National Meeting of the American Chemical Society, New Orleans; LA.

J. L. Arnst*, C. A. Davis*, K. W. Elliot*, E. M. Garton*, D. A. Pixton*, and C. R. Andrew, "Steric accessibility of the heme center in cytochrome *c′* and its effect on molecular recognition" *237th American Chemical Society National Meeting*, Salt Lake City, UT, **March 2009**.

A. A. Julian*, D. S. Kelley*, R. B. Kelley "Analysis of pyrrolizidine alkaloid in *Rainiera stricta*" 237th National Meeting of the American Chemical Society, Salt Lake City, UT, **March 2009.**

C. Kee*, C. M. Flesher*, B. I. Turner*, J. A. Cox*, N. T. Root*, and R. B. Kelley, "Analysis of pyrrolizidine alkaloids in *Onosmodium helleri*", *237th American Chemical Society National Meeting*, Salt Lake City, UT, **March 2009**.

Student Publications (2008-2009)
(Peer-reviewed journals)

Pixton, D. A.*, Petersen, C. A*, Franke, A., van Eldik, R., Garton, E. M., Andrew, C. R. *J. Am. Chem. Soc.* **2009**, *131*, 4846-4853. Activation parameters for heme-NO binding in *Alcaligenes xylosoxidans* cytochrome *c'*: The putative dinitrosyl intermediate forms via a dissociative mechanism.

Appendix III

CHEM 407 Seminar Scoring Rubric

*STUDENT NAME:*_____

*MANUSCRIPT TOPIC:*_____

OVERALL CONTENT:

	Outstanding 20	Satisfactory 10	Unsatisfactory 0
Technical Information			
Depth of Information			
Command of background material			

Written draft:

	Outstanding 5	Satisfactory 3	Unsatisfactory 0
Organization			
Grammar and spelling			
Notation			
Clarity of writing			
Bibliography and other supporting documentation			

Seminar presentation:

	Outstanding 5	Satisfactory 3	Unsatisfactory 0
Organization			
Grammar and spelling			
Quality of slides			
Length of presentation (45-50 min required)			
Knowledge of subject matter; ability to answer questions			
Speaker's attributes: speaking volume, eye contact; physical appearance, etc.			

Comments: