Chemistry Minor

5-Year Program Review

Fall 2014

History, Mission, and Vision of the Program

The William Woods University Chemistry Minor has traditionally been designed to 1) provide our students the necessary chemistry-related background and credentials for direct entrance into the workforce, 2) provide the prerequisite coursework for graduate or professional school, 3) support the biology major, and 4) engage our students in developing a greater understanding of the chemical nature of the world.

As chemistry is a central science forming the conceptual framework for theory and research advancement in the scientific arena, its value to our society is unquestionable. Chemistry provides insight into the world about us, such as descriptions of the subatomic nature of matter, pharmaceutical design at the molecular theory level, and macro-scale manufacturing technologies of mega-ton production of fertilizers, polymers, and fuels.

Philosophically aligned to the stated mission, vision and goals of William Woods University, the Chemistry Minor enables students to acquire necessary research skills, improve their understanding of the theoretical foundations of the science, and heighten their awareness of the continuous proliferation of scientific knowledge. Integrally tied to the students' overt educational experiences is the appreciation that learning is a continual rather than finite process by which individuals develop into capable, successful professionals in a technology-based society.

Within the Chemistry Minor are two 100-level lecture-lab courses (4 hours each) which meet the General Education requirement for eight credit hours of laboratory science (lecture-lab combined). Students' progress is assessed using the Natural Sciences Rubric.

Section 1: Student Data

A: Demographics Chart

William Woods University							
Assessment Data							
Program: Chemistry							
		Academic Year					
		09/10	**10/11**	**11/12**	**12/13**	**13/14**	
Declared Minors		14	25	35	26	33	

Graduated Minors		2	6	8	8	7	
Retention Rate: IPEDS definition[1]							
University		74.1 %	66.8 %	76.2 %	70.5 %		
Program							
		Cohort Year					
Graduation Rate: IPEDS definition[2]		**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	
University		43.8	52.4	50.2	50.5	56.3	
Program							
Graduation Rate: Transfer Students[3]							
University		67.7 %	71.2 %	68.8 %	63.2 %	66.7 %	
Program							
[1] = % of full-time, first-time students that return to the institution in the subsequent fall semester							
[2] = % of the full-time, first-time cohort that graduate within 6 years							
[3] = % of transfer students new to the institution in the fall semester that graduate with a bachelors level degree							

Reflection on the Demographic Data:

Because the Biology major is growing so fast, the size of chemistry classes and number of labs needed has grown to the point that we needed to get adjunct faculty. The past two years, adjuncts have taken one to two of the lab classes to keep the full-time professor's course load down to the maximum number he is allowed to teach. If the current trend of growth for the program continues, it will be necessary to hire another full-time chemistry instructor to keep class sizes appropriate to the University's philosophy and mission. Our program works in support of the Biology major, and our retention percentages are based on the numbers for the major.

B: Placement Numbers (do not need specific student names, aggregated data on students is appropriate)

Chart 1B: 1

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Number of Graduates (total graduates, not cohort)	2	6	9	8	7
Employed Within Field			4	3	2
Employed Outside of Field		1	1	3	1
Graduate School		3	4	1	4
Not known	2	2		1	

Careers for which these students would be prepared, and the state or national demand for each:

Several professional fields that require a chemistry background include:
Chemical industry—manufacturing, research and development, sales and marketing, quality assurance
Forensics
Patent law
Petroleum chemistry
Agricultural chemistry
Food chemistry
Analytical and organic chemistry
Environmental chemistry
Pharmacy
Science education
Veterinary Medicine

Demand for employees in the chemical industry is expected to increase through the period ending 2022 as indicated by the following data from United States Department of Labor Bureau of Labor Statistics Employment Projections (www.bls.gov.)

2012-2022 National Employment Matrix Title	**Percentage Change**
Agricultural and food science technicians	**+6.6**
Biological technicians	**+10**
Food scientists	**+10.8**
Chemical technicians	**+9.4**
Geological and petroleum technicians	**+15.1**
Environmental science and protection technicians, including health	**+18.8**
Forensic science technicians	**+5.8**
Biochemists and biophysicists	**+18.6**
Geoscientists, except hydrologists and geographers	**+15.8**
Chemistry teacher, postsecondary	**+13.7**

C. Courses (chart)

1. Notation marking General Education courses offered.

Chart 1C: 1

Course	Year 2010-2011 (course enrollment)	Year 2011-2012 (course enrollment)	Year 2012-2013 (course enrollment)	Year 2013-2014 (course enrollment)
CHM 114 General Chemistry I	FALL (37/40) SPRING N/A	FALL (28/40) SPRING N/A	FALL (33/40) SPRING N/A	FALL (51/60) SPRING N/A
CHM 115 General Chemistry I lab	FALL (18/20) SPRING N/A	FALL (28/40) SPRING N/A	FALL (33/30) SPRING N/A	FALL (51/60) SPRING N/A
CHM 124 General Chemistry II	FALL N/A SPRING (33/40)	FALL N/A SPRING (18/40)	FALL N/A SPRING (24/40)	FALL N/A SPRING (42/60)
CHM 125 General Chemistry II Lab	FALL N/A SPRING (20/14)	FALL N/A SPRING (18/40)	FALL N/A SPRING (24/40)	FALL N/A SPRING (42/60)
CHM 314 Organic Chemistry I	FALL (11/20) SPRING N/A	FALL (23/30) SPRING N/A	FALL (9/30) SPRING N/A	FALL (15/20) SPRING N/A

CHM 314 H Organic Chemistry I	FALL N/A SPRING N/A	FALL (3/30) SPRING N/A	FALL (3/30) SPRING N/A	FALL (1/20) SPRING N/A
CHM 315 Organic Chemistry I Lab	FALL (13/20) SPRING N/A	FALL (23/30) SPRING N/A	FALL (9/30) SPRING N/A	FALL (15/30) SPRING N/A
CHM 315 H Organic Chemistry I Lab	FALL N/A SPRING N/A	FALL (3/20) SPRING N/A	FALL (1/15) SPRING N/A	FALL (0/5) SPRING N/A
ELECTIVES				
CHM 200 Introductory Project	FALL N/A SPRING N/A	FALL N/A SPRING N/A	FALL N/A SPRING N/A	FALL N/A SPRING N/A
CHM 300 Independent Study	FALL N/A SPRING N/A	FALL N/A SPRING N/A	FALL N/A SPRING N/A	FALL N/A SPRING (1/1)
CHM 324 Organic Chemistry II	FALL N/A SPRING (2/2)	FALL N/A SPRING (26/40)	FALL N/A SPRING (8/20)	FALL N/A SPRING (13/20)
CHM 324 H Organic Chemistry II	FALL N/A SPRING N/A	FALL N/A SPRING (2/20)	FALL N/A SPRING (3/20)	FALL N/A SPRING (12/20)
CHM 325 Organic Chemistry II Lab	FALL N/A SPRING (2/2)	FALL N/A SPRING (26/40)	FALL N/A SPRING (8/20)	FALL N/A SPRING (13/20)
CHM 325 H Organic Chemistry II Lab	FALL N/A SPRING N/A	FALL N/A SPRING N/A	FALL N/A SPRING (3/20)	FALL N/A SPRING (12/20)
CHM 400 Advanced Projects	FALL (1/1) SPRING (1/1)	FALL N/A SPRING N/A	FALL N/A SPRIMG N/A	FALL N/A SPRING N/A
CHM 440 Biochemistry	FALL N/A SPRING (13/20)	FALL N/A SPRING N/A	FALL N/A SPRING (12/14)	FALL N/A SPRING (6/20)
CHM 441 Biochemistry Lab	FALL N/A SPRING (13/20)	FALL N/A SPRING N/A	FALL N/A SPRING (12/14)	FALL N/A SPRING (6/14)

Chart 1C: 2

Course offered	Supported Programs
CHM114/CHM115 General Chemistry I with Lab	Biology Education Biology BA/BS
CHM 125/CHM125 General Chemistry II with Lab	Biology BA/BS
CHM314/CHM315 Organic Chemistry I with Lab	Biology BA/BS
CHM324/CHM325 Organic Chemistry II with Lab	Biology BS (Elective) Pre Vet
CHM440/CHM441 Biochemistry with Lab	Biology BS (Elective) Pre Vet

Without a strong foundation in General, Organic, and Biochemistry, students who plan to have careers in medicine or other life sciences will not be able to understand many of the more complex aspects of their upper-level and graduate-level science classes. Additionally, chemistry is an essential component of exercise sciences, nutrition, and health sciences. The discipline of chemistry is also necessary in explaining both Physics and the Physical Sciences at the nanoscale level, making these classes indispensable to the William Woods curriculum.

Section 2. Faculty and Resources

A. Physical Facilities

1. There is a dedicated Chemistry Laboratory and Chemical Storage area.
2. Since the last report, the Chemistry program has acquired a Gas Chromatograph/Mass Spectrometer. This will allow students, with the professor's assistance, to conduct research on the composition of various organic materials. The University and professor are currently working to get the instrumentation operational.

B. William Woods University - Dulany Library

COLLECTION ANALYSIS

November 2014

In Support of the Following Academic Program: Chemistry

I. **MOBIUS Holdings** (Subject Search):
Chemistry – 16,603 catalog entries
Chemistry, Organic – 2,405 catalog entries
Chemistry, Inorganic – 1,020 catalog entries
Biochemistry – 3,004 catalog entries
Chemistry, Physical and theoretical – 2,137 catalog entries

II. **William Woods University Holdings**:

Journals

	2006	**2014**
Print	2	**2**
Electronic Full-text	10	**227**
Electronic Index Only	101	**639**

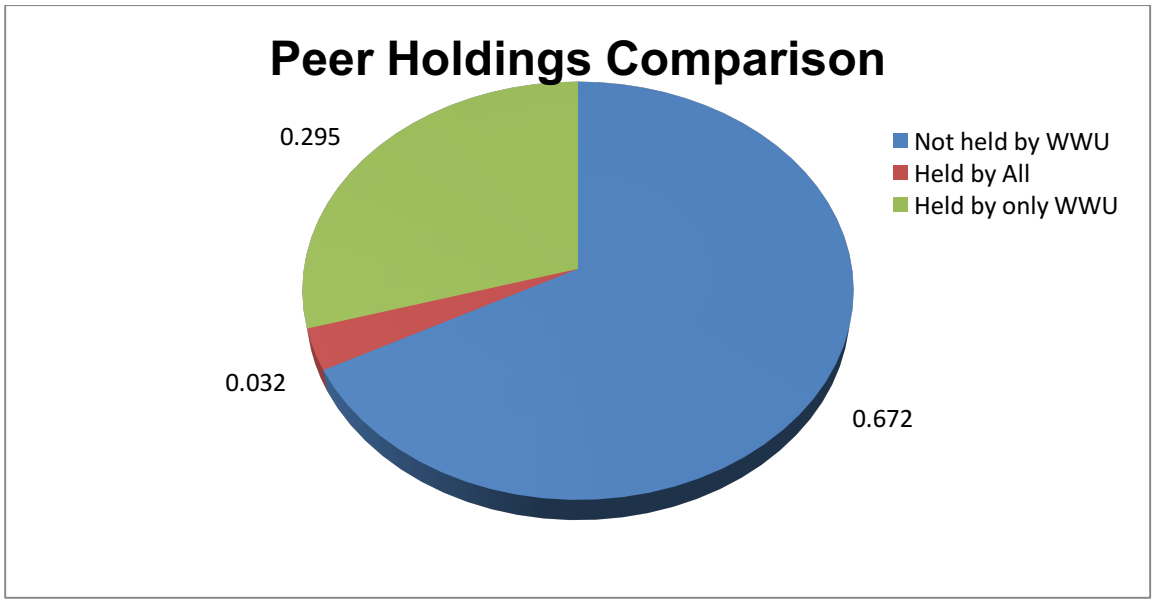
Books, Visual Materials, Electronic Books:

Subject	Totals	1920--1929	1930--1939	1940--1949	1950--1959	1960--1969	1970--1979	1980--1989	1990--1999	2000--2004	2005--2009	2010	2011	2012	2013	2014	Other
>> Chemistry Totals	228	1	3	5	7	84	6	24	50	28	18	0	0	1	0	0	1
Chemistry, General	77	0	1	3	4	21	3	7	22	9	6			1			0
Analytical Chemistry	17	0	1	0	0	3	0	2	6	3	2			0			0
Inorganic Chemistry, General	10	1	0	0	0	3	2	2	1	1	0			0			0
Organic Chemistry, General	52	0	0	2	1	17	1	3	14	6	8			0			0
Physical & Theoretical Chemistry	63	0	1	0	2	39	0	8	6	6	1			0			0
Crystallography	9	0	0	0	0	1	0	2	1	3	1			0			1

Subject	Totals	Books	Journals/Magazines	Videos
>> Chemistry Totals	238	135	101	2
Chemistry, General	84	50	33	1
Analytical Chemistry	17	4	12	1
Inorganic Chemistry, General	10	5	5	0
Organic Chemistry, General	55	28	27	0
Physical & Theoretical Chemistry	63	47	16	0
Crystallography	9	1	8	0

III. Comparison with Peer Institutions

Libraries Used For Comparison: Westminster College, Columbia College, Central Methodist University, Stephens College



The number of titles in the preceding chart are as follows:

Not held by WWU – 207 titles
Held by All – 10 titles
Held by only WWU - 91 titles

IV. Analysis

Chemistry as a discipline taught at the undergraduate level generally requires both up-to-date and basic library materials. Basic information is available in several print resources in the Library's Reference collection and in *Encyclopedia Britannica Online.* Like most scientific disciplines, research in chemistry is typically published in journal, rather than monograph form. In order to meet this need, the Library has acquired a significantly greater number of chemistry journals in electronic full-text form since 2006 as is indicated by the table in section II above. The library receives infrequent requests for chemistry materials from faculty or students. As a result, the acquisition of print materials is conducted by the library staff from reviews in library journals and is generally limited to new basic reference materials or books of general interest. The Library's collection of visual materials in chemistry is also limited for the same reasons.

As in all other disciplines, WWU faculty and students have access to the resources available in MOBIUS member libraries, which includes the superb collections at the large research institutions in the state of Missouri, i.e., the four campuses of the University of Missouri, Washington University, Missouri State University and St. Louis University. Beginning in 2014, access to the resources of the academic, public and special libraries in Colorado and Wyoming became possible through Prospector, a resources sharing partner of MOBIUS. Prospector provides access to an additional 30 million books, journals, DVDs, CDs, videos and other materials, and includes the collections of the libraries at the campuses of the University of Colorado, Colorado State University, University of Denver, and the University of Wyoming. Resources selected from both MOBIUS and Prospector are delivered by courier, thereby reducing the delivery time.

C. Faculty

Chart 2C: 1

Name of Faculty	***Highest Degree Earned (Concentration)***	***Degree Granting Institution***	***Years Full-time Teaching in Higher Ed***	***Contracted Course Load***
Joe Kyger	***Doctorate, Radioanalytical Chemistry***	***University of Missouri***	***10 years***	***Full***
Becky Treu	***Doctorate, Integrated & Applied Sciences***	***St. Louis University***	***Unknown***	***Adjunct***
Josh McCormick	***Doctorate, Radiochemistry***	***University of Missouri***	***N/A***	***Adjunct***
Nelli Muratova	***Doctorate, Natural Sciences***	***Ruhr-Universität Bochum***	***N/A***	***Adjunct***

The program is adequately staffed for its current size. If the program continues to grow as it has been in the last few years, then it will need another full-time faculty member. The full-time and adjunct faculty are very well-qualified to meet the needs of the students; they have shown they are doing an excellent job in educating them by the rate of employment within their field of study and/or acceptance into graduate school.

D. Internship Experiences

1. Samantha Berry ('14) completed an internship at Enginuity World Wide in Mexico, Missouri in order to gain hands-on laboratory experiences, including running tests, helping with research, cleaning the lab, and much more. She gained substantial experience in conducting literature research.

Section 3: Financial Analysis of Program (data from Academic Dean and Comptroller)

Chart 3A: 1

Program	Total Cost (Personnel, budget and special expenses)	Total Income (Course Fees, tickets, sales)	Number of majors (2013)	Cost per Minor
Chemistry	$ 47,500.00	$ 5280.00	26	$ 1623.00

Include courses that are provided for common study as well as required in other majors in represents a complete program. It is important for a universal approach to identifying the cost of programs. Additional explanation can be provided below if programs feel it is necessary.

1. Discussion of Additional expenses related to instruction. i.e. Internship, clinical, practicums…

2. Description of Non-Instructional Expenses: Expenses that are included in the budget but not part of the instructional aspect of the program, not all programs will have this.

Section 4: Objectives and Assessment

Chemistry Program Assessment Plan 2014-2015 Academic Year

Academic Year	2014-2015
Program	Chemistry
Faculty	Joe Kyger
Program Mission Statement	The Chemistry Minor at William Woods University exists both to supplement the Biology major and to create in the students a full understanding of the sciences, emphasizing the discipline of Chemistry, as they relate to the world at large.

Program Action Items

Action Item 1:	Increase student preparedness for class.
Action steps:	Increase quiz frequency
Timeline	Given weekly on Friday
Faculty Responsible	Joe Kyger
Evaluation	Measure effectiveness by evaluating overall class performance on exams relative to last year's.

Action Item 2:	Increase student classroom involvement.
Action steps:	Have additional small group activities during lectures.
Timeline	periodically
Faculty Responsible	Joe Kyger
Evaluation	Conduct student surveys.

Program Objectives

1. Demonstrate a fundamental understanding of chemical concepts relating to all branches of chemistry, including analytical, organic, physical, inorganic, and biochemistry.
2. Demonstrate a thorough understanding of the periodic table of elements and how it can be used to determine trends in chemical reactivity and stability.
3. Logically apply the scientific method to everyday situations in order to facilitate an understanding of the world around us.
4. Integrate empirical evidence with experimental data, such that solid conclusions can be formulated.

Program Objectives Matrix

	Objective 1	Objective 2	Objective 3	Objective 4
CHM114	I	I, R	I,A	
CHM115	R	R	R	I
CHM124	R, A	A	A	
CHM125	R			A
CHM314	R			
CHM315	M, A			M,A
CHM324				
CHM325				

I=Introduced R= Reinforced M=Mastered A=Assessed

Program Objectives and Assessment Strategies

Objective 1	Demonstrate a fundamental understanding of chemical concepts relating to all branches of chemistry, including analytical, organic, physical, inorganic, and biochemistry.
Methods	Course unit examinations with specific questions related to the objective Extra Credit assignments designed to promote understanding of the objective Lab instructor works with each lab group to visually or orally determine understanding of the objective Lab reports that require understanding of the objective to complete
Benchmark	Students will score above 70% on coursework related to the objective; homework and extra credit should be above 80%. Objective will be measured in lab through lab instructor/student interaction. Students are required to be 100% proficient.
Sample Information	All students in O-Chem. and Gen. Chem.
Who	Instructor will collect and interpret data
When	Spring every year

Objective 2	Demonstrate a thorough understanding of the periodic table of elements and how it can be used to determine trends in chemical reactivity and stability.
Methods	Course unit examinations with specific questions related to the objective Course final examinations have questions related to objective.
Benchmark	Students will score above 70% on coursework related to the objective; homework should be above 80%.
Sample Information	All students in Gen. Chem.
Who	Instructor will collect and interpret data
When	Spring every year

Objective 3	Logically apply the scientific method to everyday situations in order to facilitate an understanding of the world around us.
Methods	Quizzes in Lecture and Lab with questions related to the objective Lab Reports that require understanding of objective to complete Extra Credit Assignments designed to promote understanding of objective
Benchmark	Students will score above 70% on coursework related to the objective; homework and extra credit should be above 80%. Objective will be measured in lab through lab instructor/student interaction. Students are required to be 100% proficient.
Sample Information	All students in Gen. Chem.
Who	Instructor will collect and interpret data
When	Fall and Spring every year

Objective 4	Integrate empirical evidence with experimental data, such that solid conclusions can be formulated.
Methods	Lab reports, pre-lab/post-lab assignments that require understanding of the objective to complete Lab Instructor works with each lab group to visually or orally determine understanding of the objective
Benchmark	Students will score above 70% on coursework related to the objective. Objective will be measured in lab through lab instructor/student interaction. Students are required to be 100% proficient
Sample Information	All students in O-Chem. and Gen. Chem.
Who	Instructor will collect and interpret data
When	Spring every year (Gen. Chem) and Fall every year (O-Chem)

Section 5: External Review- Not Required for a Minor

1. Attach External Review Report
2. Every program review must include consultation with external reviewers unless accredited by a national association. If the program is accredited, the name of the accreditation agency and schedule for the accreditation process must be included.

Section 6: Conclusions and Recommendations

Chemistry	Excellent	Adequate	Needs Improvement	Comments
History, Mission and Vision	☒Overview is succinct (-300 words) ☒ Program's purpose/mission is clear, including relationship to the university's mission statement. ☐Clearly describes the approach to maintain or improve student retention and graduation rates. ☐ Provides detailed description of possible employment positions for graduated students.	☐Introduction describes the program with more detail than necessary (+300 words) ☐Introduction includes the program mission but it is unclear about it purpose within the university. ☒Summarizes the data on student retention and graduation rates. ☒Provides a short summary of employment placements for graduated students.	☐Introduction omits either program mission or the program purpose within the university. ☐Program description is absent, weak or lacked reflection of program data. ☐Description of student data lacks reflection. ☐Lists a few locations where graduated students are employed.	Are there any students who are minors in Chemistry but not involved in the biology program?
Course rotation-offerings	☐Course rotation is followed in the way courses are offered. ☐All cross-listed courses are identified. ☐Course offerings appear appropriate for the needs of the program.	☒Course rotation is followed with few exceptions of independent study/tutorial courses when needed.	☐Course rotation is not followed. Many instances of tutorial and/or independent study.	Is there a way to modify the rotation of upper level courses? Starting to use adjuncts for lower level courses due to enrollment
Faculty and Resources	☐Faculty qualifications and specific competencies are fully and accurately described ☐Provides a sound rationale for current staffing and/or future recommendations related	☒Faculty qualifications and competences are described. ☒Notes the adequacy or inadequacy of current staffing with little discussion on the impact to student learning.	☐Faculty qualifications and competencies are poorly described or absent. ☐Merely lists the faculty/staff positions in the department with no explanation how current	The space in the building is at max capacity. Almost to the point of diminishing returns for the sciences.

	to student learning. ☐Summarizes all physical equipment needs and supplies noting any deficiencies and the impact on student learning. ☒Provides summary analysis of library holdings, noting specifically how deficiencies, if any, affect student learning ☐Provides rationale and recommendations to improve resources that would address such deficiencies and link student learning.	☒Provides summary of current equipment, etc., but does not connect to student learning. ☐Provides a summary of library holdings. ☐Provides recommendations to improve resources but does not connect to student learning.	staffing impacts student learning. ☐Lists only perceived equipment deficiencies (no list of actual resources) ☐Omits library information. ☐Does not recommend any changes to resources for the program.	The discussion on resources will be the same for CHM, BIO, PHY.
Assessment of Program	☐Annual Assessment includes learning outcomes and assessment measures, which are clearly explained. ☐Problems involving curriculum clearly explained. ☐Standards for performance and gaps in student learning are clearly identified with action plans for improvement if needed. ☐Report includes collaboration from all program faculty, including adjunct, external constituents in the assessment of student learning. ☐Program's involvement in service, LEAD, and other university activities are clearly explained.	☒Annual Assessment includes learning outcome and/or assessment measures. ☐Problems involving curriculum are addressed. ☐Standards for performance and gaps in student learning are recognized. ☐Program report includes feedback from all on campus faculty in assessing student learning. ☐Program involvement in service, LEAD, and other university activities are listed.	☐Annual Assessment does not address learning outcomes and/or assessment measures. ☒Problems involving curriculum are omitted. ☒Standards for student performance and gaps in student learning are not identified. ☒Program report does not include feedback/input from all program faculty when assessing student learning. ☒Program involvement in service, LEAD, and other university activities are omitted.	Proper assessment report was not included. Annual Assessment report provided later. Cannot use Extra Credit for assessment assignments. Will review during the annual assessment process.

External Review	☐Program response to all criteria marked as "somewhat – not evident" on the External Review report is complete with specific strategies for improvement.	☐Program responded to some of the criteria marked as "somewhat-not evident" on the External Review report with ideas on how to improve.	☐Program did not respond to the areas of weakness marked on the report as "somewhat – not evident".	Not required for a minor .
Conclusion	☐Strengths and challenges include references to student learning. ☐Challenges exhibit more depth than resource shortages and include challenges for the program faculty. ☒Program response to external review and Academic Council is complete and thorough. ☐Action plan for the program is visionary, showing evidence that the program is aiming for a higher level of student learning.	☐Strengths and challenges are identified, but don't relate to student learning. ☐Challenges are little more than resource driven. ☐Action plan accommodates the program challenges but does not move it to a higher level. ☐Program responds to external review and Academic Council with little discussion.	☐Strengths and challenges are identified. ☐Challenges are all resource driven. ☒There is no action plan that addresses the challenges that face the program. ☐Program acknowledges the recommendations of external review and Academic Council with no discussion on changes.	Academic Council accepted report as modified. No concerns noted.

There was a lengthy discussion on the number of Chemistry minors and if there are any current minors who are not also Biology majors. From a quick glance, it appears that the Chemistry minor is part of obtaining the Biology major. Is that accurate, and are there any minors that are not also Biology majors?

It was discussed the need for more sections and identified adjunct faculty for the introductory chemistry courses. There was also discussion about the rotation for upper level courses. Are there ways to modify the rotation and continue to provide the courses when needed for student learning? Would it be possible to modify the rotation without making the courses too large? What are the limits to class sizes based on lab space? Are there problems with lab size/class sizes? Is the program losing students due to the available space?

Academic council would like to see the actual Assessment report. The one provided in the report was the Assessment plan from the fall and not the actual Assessment Report. This was incorrect and the responsibility of the Associate Dean of Academic Assessment. The correct report will be inserted for Academic Council review. Academic council was concerned that extra credit was mentioned as an assessment method. This is not a viable option for assessment as not all students are required to complete extra credit.

Once these comments are received, I will submit them to Academic Council for Review. After their final review, I will submit to the program their final comments and the rubric evaluating the program. I thank you for your time with this process and for the work you put into the report. If you have any questions please feel free to email me and ask for clarification.