End of Year Assessment Report for Programs

Program: Chemistry	year: 2018-19
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Program Mission Statement

The Department of Chemistry is committed to excellence in chemical science education. It assumes that through the study of chemistry one can understand unique aspects concerning the nature of God and His creation. The following quote from Johannes Kepler exemplifies the Department's position and teaching philosophy concerning the motivation for the pursuit of scientific knowledge.

"Scientists are the priests of the highest God in regard to the book of nature. It befits us to be thoughtful not for ourselves but for the glory of God."

Consequently, chemistry becomes a part of the College's concept of Christian education.

Program Objectives

1. Demonstrate an understanding of major concepts, theoretical principles and experimental findings in chemistry. SLO 1.2, 1.3, 1,4,
2. Demonstrate a knowledge and understanding of the proper procedures and regulations for safe handling and use of chemicals . SLO 1.2, 1.4, 4.2, 4.4
3. Understand how to properly carry out experiments, and appropriately record and analyze the results. SLO 1.1, 1.2, 1.4, 2.1, 3.2
4. Demonstrate an ability to solve problems in chemistry using the tools, techniques, and data available. SLO 1.3, 1.4
5. Demonstrate effective writing and oral communication of concepts and experimental results. SLO 2.1
6. Discuss development of major scientific ideas and relate chemistry to and integrate chemistry with other areas of knowledge including issues of public concern. SLO 3.1, 4.2

Assessment Methods and Benchmarks – SPRING SEMESTER

Program Objective	Introducing	Developing	Mastering
PO1	CHEM 111 Lab Quiz Benchmark: >=75% 27% of students met the objective 100% of the chemistry majors met the objective	CHEM 112 ACS Final Exam Benchmark: >=75% 34% of the students met the objective 83% of the chemistry majors met the objective	Not taught this year
PO2	CHEM 111 Final Exam Benchmark: >=75%	CHEM 112 ACS Final Exam Benchmark: >=75%	Not taught this year

	34 % of students met the objective 100% of the chemistry majors met the objective	38% of the students met the objective 83% of the chemistry majors met the objective	
PO3	CHEM 112 Lab Notebook Benchmark: >=75% 91% of students met the objective 100% of chemistry major students met the objective	CHEM 112 Spectroscopy Labs Benchmark: >=80% 77% of students met the objective 100% of chemistry major students met the objective	CHEM 321 ACS P-Chem I Final Exam Benchmark: >=75% 80% of the students met the objective
PO4	CHEM 111 Line Spectra Lab Report Benchmark: >=75% 86% of students met the objective 100% of chemistry major students met the objective	*Not taught this year*	CHEM 314 Bioinformatics Project Benchmark: 70% 100% of the students met the objective
PO5	CHEM 112 NMR lab 2 Benchmark: >=75% 88% of students met the objective 100% of chemistry major students met the objective	*Not taught this year*	CHEM 321 Vapor Pressure Lab Report Benchmark: >=75% 100% of the students met the objective
PO6	CHEM 112 Lead Analysis Lab Benchmark: >=75% 91% of students met the objective 100% of chemistry major students met the objective	*Not taught this year*	CHEM 321 Student Presentation Benchmark: >=75% 100% of the students met the objective

Assessment Findings – SPRING SEMESTER

PO1.

A. Introducing: CHEM 111 Lab Quiz: The quiz requires students to demonstrate their basic lab theory, technique, and safety knowledge. 12 of 44 students (27%) met the objective with a score of 75% or better. But 6 of the 6 (100%)of chemistry majors met the objective.
B. Development: ACS Final Exam: The National Standardized American Chemical Society test requires students to demonstrate their knowledge of theory and problem solving ability at the first year chemistry level. 11 of 44 students (34%) met the objective with a score of 75% or better. But 5 of the 6 (83%) of chemistry majors met the objective. This full year, two semester, comprehensive exam allows us to identify areas of strength and weakness in our students understanding of and ability to problem solve using General Chemistry principles. Analysis of the exam results show that students are very strong with respect to basic thermodynamic and

electrochemistry principles but need some strengthening in the areas of stoichiometry, chemical kinetics, Lewis acid-base theory, and solution concentration calculations.

C. Mastery: Not taught this year

PO2. Introducing: CHEM 111 Final Exam. The comprehensive test requires students to demonstrate their knowledge of theory and problem solving ability after one semester of College General Chemistry. 27% of students met the objective
100% of the chemistry majors met the objective.

D. Development: ACS Final Exam: The National Standardized American Chemical Society test requires students to demonstrate their knowledge of theory and problem solving ability at the first year chemistry level. 38% of the students met the objective
83% of the chemistry majors met the objective. This full year, two semester, comprehensive exam allows us to identify areas of strength and weakness in our students understanding of and ability to problem solve using General Chemistry principles. Analysis of the exam results show that students are very strong with respect to basic thermodynamic and electrochemistry principles but need some strengthening in the areas of stoichiometry, chemical kinetics, Lewis acid-base theory, and solution concentration calculations.

E. Mastery: Not taught this year

PO3

A. Introductory: CHEM 112 Lab Notebook: Maintaining a complete and accurate record of your laboratory work in a notebook is foundational to doing good science. It is critical to learn and apply good notebook recording practices early in your science education so that those practices become habits that will serve you well throughout your career as a scientist. 88% of students met the objective
100% of chemistry major students met the objective

B. Developing: CHEM 112 Spectroscopy Labs: One of the goals of the Chemistry Department is to provide significant theoretical and practical, hands-on experience with advanced instrumentation across their four year undergraduate education. The three episode set of Spectroscopy labs provides freshmen level students this kind of experience with Nuclear Magnetic Resonance Spectroscopy and Infrared Spectroscopy. I was pleased to see that 77% of students met the objective and 100% of chemistry major students met the objective.

C. Mastering: CHEM 321 ACS P-Chem I Final Exam: The National Standardized American Chemical Society Thermodynamics test requires students to demonstrate their knowledge of theory and problem solving ability at the senior year chemistry level. 80% of the students met the objective. This is very typical for our Physical Chemistry program.

PO4

A. Introductory: CHEM 111 Line Spectra Lab: This lab gives students valuable experience of collecting data and using quantum theory and equations to calculate properties of the hydrogen atom. It also provides a historical context to the development of quantum mechanical theory. 86% of students met the objective, 100% of chemistry major students met the objective

B. Developing: *Not taught this year*

B. Mastering: CHEM 314 Biochemistry I, Bioinformatics Project,

C. Benchmark: 70%, 100% of the students met the objective

PO5

A. Introducing: CHEM 112 NMR lab 2: One of the goals of the Chemistry Department is to provide significant theoretical and practical, hands-on experience with advanced instrumentation across their four year undergraduate education. This three hour laboratory exercise introduces freshmen level students to the theory of Carbon 13 Nuclear Magnetic Resonance (NMR) Spectroscopy through an inquiry based learning

approach. The unique inquiry based approach is based upon a Journal of Chemical Education article that I wrote six years ago. We have been running the lab for the past six years. This lab prepares students for the NMR theory and analysis they will do in their sophomore year. Thus, this lab satisfies one of the CHEM111 General Chemistry course goals91% of students met the objective

B. Developing: *Not taught this year*
A. Mastery: CHEM 321 Physical Chemistry I: Vapor Pressure lab report : The vapor pressure lab is one of the most challenging labs in terms of getting good data. The experiment demands absolute care, attention to detail and extreme precision in data collection. I believe this is one of the Chemistry Department's most important laboratory experiences for students. The foundational theory and follow-up data analysis are complex and again require care and attention to detail. The quality of the linearity of results are used to evaluate the quality of the students' work. 66% of the students met the objective

PO6

A. Introducing: CHEM 112 Lead Analysis Lab: One of the goals of the Chemistry Department is to provide significant theoretical and practical, hands-on experience with advanced instrumentation across their four year undergraduate education. This lead analysis lab provides freshmen level students this kind of experience with Inductively Coupled Plasma Emission Spectroscopy. It also provides a significant experience related to the health impact associated with contaminated drinking water. 91% of students met the objective, 100% of chemistry major students met the objective
B. Developing: *Not taught this year*.
C. Mastery: CHEM 342 Instrumental Analysis: Student Presentation Each student will give a 10-20 minute oral report on one of a laboratory exercise, a special problem, test or homework problem. The oral report will communicate the basic theory associated with the problem, the approach for solving the problem, the results and their validity. The report will end with a more personal, spiritual reflection on what the science used in the problem says to you about the world (creation). Perhaps address questions such as: "Why can we even do science?" " What does the fact that we can discover the world (cosmos, creation) say about the nature of the world and our relationship to it?" Student must apply their experiences from the required GU general education course Science and Christianity. Benchmark: >=75% 100% of the students met the objective.
D. CHEM 321 Physical Chemistry I: ACS P-Chem I Final Exam Benchmark: >=75% 80% of the students met the objective

Sharing and Discussion of Assessment Findings – SPRING SEMESTER

Describe how assessment findings are typically shared and discussed among program faculty and other stakeholders. In particular, make clear the process for analyzing assessment findings and using them to make improvements in the program and/or the assessment process.

Use of Assessment Findings for Program Improvement (Action Plan) – SPRING SEMSTER

The analysis are summarized above. One area of analysis that was exceptionally beneficial was associated with the ACS National Standardized exams. We found the questions most frequently correctly and those most frequently answered incorrectly. This allowed us to determine how to handle particular topics next year. For example only 4% of the General Chemistry students answered a question concerning Lewis Bases. This is not a topic that is covered deeply in General Chemistry but is an important concept used in Organic Chemistry (the next course after General Chemistry). After consulting with Dr. Cox the GU Organic instructor, we decided to expand the level of coverage of Lewis acids and bases in General Chemistry. One nice outcome of the ACS test analysis is that one of the areas of greatest

strength for the students was electrochemistry and electrochemical cells. The ACS test was on the heels of a Gen Chem lab I designed that requires to construct a series of electrochemical cells, measure their voltage, and from that calculate properties of a chemical system. It appears that the lab experience helped the student with this area of chemistry.

Full Year Reflection – FALL/INTERTERM/SPRING TERMS

The student evaluations indicate that Chemistry majors feel that they are receiving an excellent undergraduate chemistry education. Their course evaluation quantitative responses and comments and their performance on national standardized exams demonstrate this to not only be a student perception but a reality.

CHEM 111 Overall Summative Rating: 4.5/5.0 , Challenge and Engagement Index: 5.7/7.0
CHEM 112 Overall Summative Rating: 4.8/5.0 , Challenge and Engagement Index: 5.6/7.0
CHEM 201 Overall Summative Rating: 4.1/5.0 Challenge and Engagement Index: 5.4/7.0
CHEM 314 Overall Summative Rating: 4.9/5.0 Challenge and Engagement Index: 6.6/7.0
CHEM 321 Overall Summative Rating: 4.9/5.0 Challenge and Engagement Index: 6.5/7.0
CHEM 342 Overall Summative Rating: 4.8/5.0 Challenge and Engagement Index: 6.7/7.0

Gen Chem ACS Exam: Mean National Ranking All Students = 40% Mean National Ranking Chem Majors = 71%
Physical Chem I ACS Exam: Mean National Ranking All Students = 67% the class average was better than 2/3 of all students taking the test.

Supporting Documents