



## Chemistry | 2013-2014 Assessment Report

The independent project performed by students in Chem 413, Instrumental Analysis was used to assess student performance in a number of learning outcomes identified in the Chemistry Program Self Study document. This course, usually taken by chemistry majors in the fall of their senior year, requires all students to perform a multi-week independent project during the last third of the semester. Due to the place this course is taken in the chemistry major's program of study and the nature of the independent project, student performance on this project allows for the assessment of a number of learning outcomes identified by the chemistry program.

Each project was assessed in six different areas that measured performance in four different learning outcomes based upon a common rubric. The rubric was based on a 1 to 5 scale and tuned to have a score of 3 being at the level of expectation for the assessed component of the project.

Of the learning outcomes assessed in this exercise, three of the four were scored above our level of expectation and one was scored below our level of expectation.

### Use of Assessment Data

The learning outcome that was scored below our level of expectation deals with the ability to retrieve information from the primary and secondary chemistry literature. Based upon the information collected in this assessment exercise, it is not known if the students do not know how to access and identify appropriate literature sources or if they do not know how to appropriately document the literature used in support of their independent project. Faculty teaching upper level chemistry courses will discuss this situation in during the summer of 2014 and develop a plan to address both of these perceived weaknesses. Exercises designed to develop these two skills will be incorporated into one or more upper level chemistry courses starting in the fall of 2014 and we will reassess this learning outcome in the future.

### Instrumental Analysis Project

#### Items Assessed

1. Design an instrumental based analysis project
2. Research the literature in support of the project using primary or secondary literature
3. Design data collection using appropriate standards and sample preparation
4. Collect a representative body of data
5. Analyze the data using an appropriate statistical model
6. Documentation of the work

Element Assessed

Learning  
outcome

Scale

Goal

Identified an appropriate question	13	1 to 5	
Used Appropriate Literature Sources to support the design of the experiment	14	1 to 5	3
Appropriate Experimental Design addressing the matching of sample to instrumental technique	13	1 to 5	3
Performed the Experiment with sufficient skill to produce useful data	9	1 to 5	3
Performed an appropriate statistical analysis of the data	12, 9	1 to 5	3
Presented a well written report	12	1 to 5	3

### Scoring Rubric for Instrumental Analysis Project

Score	1. Identified an appropriate question	2. Used Appropriate Literature Sources to support the design of the experiment	3. Appropriate Experimental Design addressing the matching of sample to instrumental technique	4. Performed the Experiment with sufficient skill to produce useful data	5. Performed an appropriate statistical analysis of the data	6. Presented a well written report	
<b>1</b>	Question was not sufficiently developed to permit a successful project	No literature used	Instrument was not capable to address the question of the project	inappropriate sample preparation and data collection	Used an inappropriate statistical analysis	Report incomplete. More than component below level of expectation	
<b>2</b>	Identified a routine question to be addressed using a technique learned in other course	Only textbook or online literature used.	Appropriate instrument was identified by standards were not appropriate	Sample preparation or data collection inappropriate	Used an appropriate statistical analysis incorrectly, or interpreted the results incorrectly	Report incomplete.	Only one component below level of expectation
<b>3</b>	Identified a new question, but	At least one primary or	Routine sample preparation	Report complete.	Each part at level of		

	not novel, that was able to be addressed with available instrumentation	secondary literature source presented Calibration of technique done with appropriate standards.	and data collection was appropriate for project Used an appropriate statistical analysis correctly, but had multiple minor errors in analysis		expectation		
4	Identified a novel question to be addressed but did not develop the experiment sufficiently for success	More than one appropriate literature source used.	Creative experimental design, but unexpected result compromised success of project.	Challenging sample preparation or instrumental data collections that was somewhat successful in producing results	Used an appropriate statistical analysis correctly, and had few minor errors in analysis Report complete.	One component above the level of expectation	
5	Identified a novel question that was able to be addressed with the available instrumentation	Primary and Secondary literature used appropriately	Creative and appropriate use of instrumentation to address the question of the project	Very challenging sample preparation or instrumental data collections that was successful in producing results	Used an appropriate statistical analysis and correctly interpreted the results	Report complete. Multiple components above the level of expectation	

### Student Learning Outcomes

1. Have knowledge of inorganic chemistry
2. Have knowledge of chemical analysis and instrumental analysis
3. Have knowledge of organic chemistry
4. Have knowledge of atomic and molecular structure, thermodynamics, kinetics, quantum mechanics and spectroscopy
5. Have knowledge of applications of Chemistry to environmental, industrial and health issues

6. Have the ability to synthesize and characterize, by chemical or physical means, both organic and inorganic compounds
7. Have the ability to perform both qualitative and quantitative analysis by chemical and instrumental methods.
8. Have the ability to perform experiments to obtain fundamental thermodynamic and kinetic data on chemical systems.
9. Have the ability to operate scientific instruments that provide basic spectroscopic and electrochemical information and to interpret the data obtained.
10. Have the ability to perform separations of materials, including chromatographic techniques, with both manual and instrumental methods.
11. Have the ability to collect and analyze data using computerized methods.
12. Have the ability to write and present formal laboratory reports on the results of chemical experiments. This includes computation, error analysis, and graphic data displays. This should include skills with computer based simulations and computational models.
13. Have the ability to design experiments to collect information on a specific chemical problem or process.
14. Have the ability to access the primary and secondary chemical literature as well as other chemical data sources by both written copy and computer database methods.
15. Have the ability to work safely and with confidence in a chemical laboratory.