UNIT REPORT

Chemistry MS - Assessment Plan Summary

Chemistry MS

Deliver A Curriculum With Appropriate Discipline Specific Knowledge

Goal Description:

The program will address the discipline specific knowledge dictated by professional societies and/or professionals in the workforce.

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Advanced Biochemistry Knowledge And Skills

Learning Objective Description:

CHEM 5372 "Advanced Biochemistry I" addresses detailed biochemistry concepts from a chemical perspective. It covers all major macromolecules, but with a strong focus on enzymes using cytochrome P450s as the model enzyme to explore in detail. Students are expected to understand enzymes and how they are studied at a level that allows critical analysis of primary literature in this field.

RELATED ITEM LEVEL 2

Ability To Understand And Critically Analyze Primary Literature In Enzyme Biochemistry

Indicator Description:

Each student will present an appropriate literature article (selected by the student and approved by the instructor). On the final exam, each student will be required to answer questions on five (5) different papers discussed during the semester (out of 13 total). Each question will require the student to first summarize the paper's major findings, then to explain how a technique used in the paper works, then critically evaluate what the authors did not include in the paper that they should have or could have. The students will not know the nature of the questions before the exam, just that there will be one question for each article.

Criterion Description:

Mastery As Demonstrated On Final Exam Questions.

80% of students will score at least 80% (10, 11, or 12 of 12 points) on 80% of the exam questions (4 out of 5 questions each student answered on this section of the final exam). Scoring will be done by the instructor.

Findings Description:

Observed Mastery Of Advanced Biochemistry Of Enzymes.

During the Spring 2017 semester, 100% of students (13) met the criteria.

RELATED ITEM LEVEL 3

Add Take-Home Exam Evaluation

Action Description:

This is the second offering where 100% of the students met the criteria. A review of the questions themselves supports that the questions are detailed and rigorous. Further, students are picking diverse questions (they are not doing well as a result of picking a few easier questions). This semester, each exam including the final exam was split into an in-class portion and a take-home portion to allow more in-depth questions to be included (some of which test literature-searching skills as well). In the next offering, I plan to assess the take-home portion as well, as students spend much more time on it and the questions are more in-depth.

RELATED ITEM LEVEL 1

Demonstrate Knowledge of the Electronic Structure of Metal Complexes

Learning Objective Description:

CHEM 5374 "Chemistry of Coordination Compounds" is a course about transition metal complexes. An understanding of the nature of the metal-ligand bond is essential for students to address the rest of the material in the course.

RELATED ITEM LEVEL 2

Mastery of the MO Diagram for Octahedral Metal Complexes

Indicator Description:

Graduate students in this course will demonstrate their mastery of the sigma only molecular orbital energy diagram for an octahedral metal complex by constructing such a diagram on an examination given the group theory character tables and the appropriate symmetries of the ligand orbitals.

Criterion Description:

Over 90% of the students will score over 3 on a 5 point scale on the question "Draw a full molecular orbital energy diagram for $M(NH_3)_6^{n+}$ where M^{n+} is a transition metal. The symmetries of the lone pairs of ammonia are a_{1g}, e_g and t_{1u}."

Findings Description:

There were six students in the course, and all six scored 5 on this question. Thus 6/6 = 100% scored above a 3.. Thus the criterion was met.

RELATED ITEM LEVEL 3

Monitor Student Preparation and Progress

Action Description:

With the offering of CHEM 5374 during the fall of 2015, the criterion was not met. Consequently, I gave a "placement" exam on the first day of the offering of CHEM 5374 during the spring of 2017 to assess the students' background. Some were quite weak in this area, so I provided supplemental materials and spent more lecture time on the fundamentals. This approach seems to have worked quite well given the results, so I will do the same again the next time the course is offered.

RELATED ITEM LEVEL 1

Demonstrate understanding of organometallic bonding and reaction chemistry

Learning Objective Description:

CHEM 5375 “Organometallic Chemistry” addresses the principles of bonding and reactivity in organotransition metal compounds and their use in a variety of catalytic transformations. A key objective is to evaluate the mechanisms of complex catalytic reactions in terms of fundamental principles of bonding, and how the reactivity of a catalyst can be understood and controlled using these principles. The relevant principles are the molecular orbitals formed between the transition metal center and organic ligand; the assignment of oxidation states and electron counts; and the relationship between these factors and molecular stability or reactivity.

RELATED ITEM LEVEL 2

Organometallic Chemistry

Indicator Description:

During the final examination, all students in the course will demonstrate their level of mastery of the concepts of organotransition metal bonding by identifying a key bond-forming and bond-breaking reaction step within the complex mechanism for the catalytic hydrodehalogenation of alkenes.

Criterion Description:

Over 90% of the students will correctly: identify the oxidative addition step within the multi-step catalytic mechanism and assign the change in oxidation state, electron count, and coordination number that the transition metal center undergoes during this transformation.

Findings Description:

100% (10/10) students correctly: identified the oxidative addition step; assigned the change in oxidation state; assigned the change in electron count; and assigned the change in coordination number.

RELATED ITEM LEVEL 3

Organometallic

Action Description:

In future offerings of this course, similar assessment indicators will be used, prompting students to identify a key reaction step within a complex catalytic cycle taken from the literature, and students will be required to evaluate changes in the properties of the transition metal complex that result from this step.

To increase the level of rigor, the criteria will be made more specific, evaluating students’ ability to assign the specific values for these properties prior to and after the reaction step, rather than simply the change in these values.

RELATED ITEM LEVEL 1

Demonstration of quantitative proficiency in the calibration and validation of chemical sensors

Learning Objective Description:

CHEM 5385, “Nanoscience and nanosensing” provides an introduction to calibrated measurements of concentration within the context of nanoscience and nanosensing. The course begins by setting up a framework for calibrated measurements of concentration and then examines how the fabrication, design, function, and applications of nanosensors fit into and influence that framework. Readings are assigned from both textbooks and the primary literature. A key objective of the course is that students be able to quantitatively analyze raw sensor data for the purpose of making calibrated measurements of concentration, and that they be able to validate these measurements.

RELATED ITEM LEVEL 2

Mastery of sensor calibration and validation concepts

Indicator Description:

All students in the course will demonstrate their level of mastery of the concepts of sensor calibration and validation by their performance on a midterm examination devoted to these topics.

Criterion Description:

80% of the students will score within 20% of the number of points of the highest scoring student on the relevant midterm exam, provided that the highest score is at least 85% of the available points on the relevant midterm exam. If the highest score is less than 85% of the

available points on the relevant midterm exam then the criterion will be that 80% of the students will score greater than 68% of the points on the exam.

Findings Description:

The high score was 95% on the fall 2016 relevant midterm. 100% of the students had scores within 20% of this score and thus met the criterion.

RELATED ITEM LEVEL 3

Nano action

Action Description:

An additional exercise discussing the potential pitfall matrix effects was added to the course, along with a discussion of how a matrix effect could be identified in the validation procedure. Extra problems from the primary literature were added. This was reflected on midterm exams.

In the next iteration of the course, we will work on developing one or more additional datasets for the students to work up related to ongoing research in nanosensing.

Develop Presentation Skills

Goal Description:

The ability to communicate research and knowledge are fundamental presentation skills in chemistry.

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Presentation Skills

Learning Objective Description:

Students completing CHEM 5100 will, at least once during their tenure as graduate students, demonstrate the ability to make a research presentation.

RELATED ITEM LEVEL 2

Acceptable Student Seminar Peer-Reviewed Presentation

Indicator Description:

During their tenure as graduate students, all students will present at least one departmental seminar. The faculty, with the assistance of the peer-review evaluation rubric, will determine the presentation's acceptability.

Criterion Description:

All graduate students in chemistry are required to take CHEM 5100 at least once during their tenure as graduate students. To pass CHEM 5100, students are required to receive an acceptable peer-rating on a required research presentation. Within the course, each student evaluates all other student presentations. The rubric is the last page of the syllabus.

Attached Files

5100 syllabus hainesS2017

Findings Description:

All students gave presentations that were deemed at least acceptable (100% of 10 in Fall 2016 and 100% of 8 in Spring 2017). Presentations were deemed suitable by the student peer evaluators (as determined by a median score of at least 21 out of 30 points) and by the course professor (assigned score of at least 70 out of 100). The new action, addition of student names to review rubrics that were removed prior to distributing comments to the speakers with a portion of the student grade assigned for review quality (note: grading was changed to rubric grading instead of point-based grading as shown in the syllabus), was a very beneficial change, as comments were observed to be more detailed (the desired outcome) as a result of this change. The post-presentation discussion was enhanced to include discussion of presentation style in addition to research discussions, and this also stimulated additional student interaction and comments and was beneficial.

RELATED ITEM LEVEL 3

Self-evaluation

Action Description:

The changes made to CHEM 5100 over the past couple of years should be kept, and presentation and review quality are both good. Future improvement/assessment should focus on incorporating student self-evaluation.

Update to Previous Cycle's Plan for Continuous Improvement

Previous Cycle's Plan For Continuous Improvement (Do Not Modify):

As pointed out previously, the master's program is different than our undergraduate programs in a variety of ways. Most importantly for assessment purposes, with the exception of our seminar class (CHEM 5100), graduate research (CHEM 6398) and thesis (CHEM 6099), our courses are not offered every year. They aren't necessarily offered every other year--the frequency varies based on the instructors' other demands and the needs of the students in the program.

For the seminar, providing a set time period at the end of the presentation to give the students enough time to provide thoughtful critiques proved to be a problem. The instructor added post-presentation discussion and plans to expand it. He will also make critique-writing a portion of the students' grade.

For CHEM 5381 "Advanced Physical Chemistry: Thermodynamics", the next time the course is offered, the instructor will provide additional tutorial material for students who are struggling with the material or who fall behind. about spectroscopic methods used in enzymatic studies, and the criterion will be raised.

For CHEM 5374 "Chemistry of Coordination Compounds", in the next offering of the course an attempt will be made to assess students' background in this area and will provide supplemental materials for those with weak backgrounds.

For CHEM 5373 "Drug and Toxin Biochemistry" additional graded exercises will be offered. The next time polymer chemistry is offered the students will be required to evaluate and summarize the key points of their peers' presentations.

Update of Progress to the Previous Cycle's PCI:
As pointed out previously, the master's program is different from our undergraduate programs in a variety of ways. Most importantly for assessment purposes, with the exception of our seminar class (CHEM 5100), graduate research (CHEM 6398) and thesis (CHEM 6099), our courses are typically not offered every year. They aren't necessarily offered every other year--the frequency varies based on the instructors' other demands and the needs of the students in the program.

Having said that, remarkably one of the courses taught last year was also taught this year: CHEM 5374 "Chemistry of Coordination Compounds". It was determined that some of the students were lacking proper preparation for the course, so additional materials were provided that improved student performance.

Plan for Continuous Improvement

Closing Summary:
As pointed out previously, the master's program is different than our undergraduate programs in a variety of ways. Most importantly for assessment purposes, with the exception of our seminar class (CHEM 5100), graduate research (CHEM 6398) and thesis (CHEM 6099), our courses are not typically offered every year. They aren't necessarily offered every other year--the frequency varies based on the instructors' other demands and the need of the students in the program. There are 5 areas of chemistry covered in our program (biochemistry, analytical, inorganic, organic and physical chemistry) and students are required to take at least one course in at least four different areas.

This past year was unusual due to retirements and being short-handed (due to a medical leave of absence) in the sense that CHEM 5374 "Chemistry of Coordination Compounds" was offered during the spring 2017 term (and had been offered in the fall 2015 term). In its next offering, the placement exam will be used again and adjustments made to the course based thereon.

For CHEM 5375 "Organometallic Chemistry", a key reaction step in a complex catalytic cycle will be identified and the level of analysis of this step will be refined in the next offering of the course.

For CHEM 5385 "Nanoscience and nano sensing", the next time this course is offered the instructor will develop one or more additional datasets related to ongoing research in nano sensing.

For CHEM 5372 "Advanced Biochemistry I", in the next offering the instructor will assess the take-home portion of the exams.

For seminar, student self-evaluation will be incorporated.