2021-2022

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. Students are required to take courses in at least four major areas of chemistry to complete their degree (typically over the course of two years), each year four lectures in three to four areas are offered. This year courses were in Organic Chemistry, Physical Chemistry, and Biochemistry.

A description of the degree plan and course requirements can be found at <u>http://catalog.shsu.edu/graduate-and-professional/college-departments/science-and-engineering-technology/chemistry/chemistry-ms/#curriculumtext</u>.

Providing Department: Chemistry MS

Progress: Completed

RELATED ITEMS/ELEMENTS -----

RELATED ITEM LEVEL 1

Be Able to Apply Advanced Level Chemistry Knowledge In the Chemistry Subfield Physical Chemistry

Learning Objective Description:

Students take courses in at least four subfields of chemistry, but the curriculum has more courses in Organic Chemistry than other areas so it is treated separately. In the subfields of Physical Chemistry (covered this year), Biochemistry (covered this year), Analytical Chemistry (not offered this year), and Inorganic Chemistry (not offered this year), students will be able to apply knowledge to analyze and solve detailed problems at a high level of difficulty.

Upon completion of CHEM 5382 students will demonstrate advanced application of quantum theory and symmetry to the interpretation and prediction of spectroscopic data. Radio-frequency, microwave, infrared, Raman, UV-visible, and X-ray methods will be covered.

RELATED ITEM LEVEL 2

Advanced Application of Quantum Theory to the Interpretation of Spectroscopic Data Indicator Description:

The students will:

- Demonstrate competence in the mathematics associated with quantum theory.
- Interpret molecular structure through the lens of molecular symmetry and group theory.
- Synthesize symmetry-based arguments for the interpretation of spectroscopic data.
- Create spectral simulations using computational chemistry programs and Microsoft Excel.

Criterion Description:

Over 80% of the students will correctly predict the quantum trends in various spectra resulting from changes in system size, mass, temperature, and molecular symmetry. These same students will also successfully complete spectral simulation projects combining the major course concepts.

Findings Description:

In Fall 2021, 11/12 (92%) of the students met the criteria as judged by the instructor of CHEM 5382. The criteria is met.

RELATED ITEM LEVEL 2

Assessment of Understanding of Physical Organic Concepts

Indicator Description:

Pre- and post-test scores are used to assess student understanding of the fundamental concepts of organic chemistry. All students in the class are given a pretest on the first day of class. The same exam is administered on the last day of class. In addition to regular lectures, students are assigned problem sets to strengthen their understanding of physical aspects of organic chemistry, and they are evaluated by written examination.

Criterion Description:

100 percent of the students will have an improved score on the post-test compared to the pre-test. In addition, at least half of the students will reduce their number of incorrect answers by one half.

Findings Description:

During the Fall 2021 semester, 100% of the students showed improved performance on the post-test compared to the pre-test. However, only 33% of the students were able to reduce their number of incorrect answers by one half. On average, the students reduced their number of incorrect answers by 33%. this number is quite low due to having a fairly low class average on the initial pre-test.

RELATED ITEM LEVEL 3

Action Item for Physical Organic

Action Description:

The same indicator will be used the next time the course is taught (\sim 3 years). The criterion will be modified to include those that double the number of correct answers along with those that reduce their number of incorrect answers by one half.

RELATED ITEM LEVEL 2

Student Self-Assessment of Gain of Understanding of Physical Chemistry (Symmetry and Spectroscopy) Indicator Description:

Students will take a course CHEM 5382 Symmetry and Spectroscopy. In the course evaluation at the end of the course, students will be asked to rate their "Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, generalizations, theories)" on a scale of 1 (No progress) to 5 (Exceptional Progress).

Criterion Description:

At least 70% of students responding will rate their progress as "Substantial Progress" or "Exceptional Progress".

Findings Description:

Of the students responding to the course evaluation, 1 rated their progress "Moderate, 2 "Substantial", and 5 "Exceptional". That is 88% giving one of the top two ratings, which significantly exceeds the criteria.

RELATED ITEM LEVEL 1

Demonstrate Graduate-Level Understanding of the Chemistry Subfield Organic Chemistry Learning Objective Description:

Organic Chemistry is a core subfield of Chemistry that students take multiple courses in over their careers. During this academic year, their ability to understand and work through physical aspects of organic chemistry and enzyme-catalyzed organic reactions was a focus (each the focus of a separate course). Students in those courses will be able to apply their knowledge of organic chemistry to analyze problems involving organic reactions.

Physical organic chemistry involves the physical aspects (heat, light, stereochemistry, bond strengths, acidity, etc.) within organic molecules (covalent interactions) and between molecules (noncovalent interactions). Understanding these topics is useful for the fields of organometallic chemistry, materials chemistry, bioorganic chemistry, and biochemistry.

RELATED ITEM LEVEL 2

Assessment of Understanding of Physical Organic Concepts Indicator Description:

Pre- and post-test scores are used to assess student understanding of the fundamental concepts of organic chemistry. All students in the class are given a pretest on the first day of class. The same exam is administered on the last day of class. In addition to regular lectures, students are assigned problem sets to strengthen their understanding of physical aspects of organic chemistry, and they are evaluated by written examination.

Criterion Description:

100 percent of the students will have an improved score on the post-test compared to the pre-test. In addition, at least half of the students will reduce their number of incorrect answers by one half.

Findings Description:

During the Fall 2021 semester, 100% of the students showed improved performance on the post-test compared to the pre-test. However, only 33% of the students were able to reduce their number of incorrect answers by one half. On average, the students reduced their number of incorrect answers by 33%. this number is quite low due to having a fairly low class average on the initial pre-test.

RELATED ITEM LEVEL 3

Action Item for Physical Organic

Action Description:

The same indicator will be used the next time the course is taught (\sim 3 years). The criterion will be modified to include those that double the number of correct answers along with those that reduce their number of incorrect answers by one half.

RELATED ITEM LEVEL 2

Student Self-Assessment of Gain of Understanding of Organic Reactions and Synthesis

Indicator Description:

Students will take a new course CHEM 5385 Selected Topics in Adv Chem: Organic Reactions & Synthesis, the first graduate offering by Dr. Hinze. In the course evaluation at the end of the course, students will be asked to rate their "Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, generalizations, theories)" on a scale of 1 (No progress) to 5 (Exceptional Progress).

Criterion Description:

At least 70% of students responding will rate their progress as "Substantial Progress" or "Exceptional Progress".

Findings Description:

Of the 9 students responding, 1 rated their progress "Moderate", 1 "Substantial", and 7 gave the top score "Exceptional". That means 89% chose the top two levels, far exceeding the criteria. The criteria is met.

RELATED ITEM LEVEL 2

Student Self-Assessment of Gain of Understanding of Physical Organic Chemistry Indicator Description:

Indicator Description:

Students will take a course CHEM 5361 Physical Organic Chemistry. In the course evaluation at the end of the course, students will be asked to rate their "Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, generalizations, theories)" on a scale of 1 (No progress) to 5 (Exceptional Progress).

Criterion Description:

At least 70% of students responding will rate their progress as "Substantial Progress" or "Exceptional Progress".

Findings Description:

At the end of the course, 1 student rated their progress "Moderate", 4 "Substantial", and 3 "Exceptional". That is 88% choosing the top two levels, which significantly exceeds the criteria.

RELATED ITEM LEVEL 1

Students Are Able to Apply Knowledge in the Subfield Biochemistry Learning Objective Description:

CHEM 5373 "Drug and Toxin Biochemistry" discusses biologically active molecules (mechanism of their action in the body, receptor theory, biotransformation, pharmacokinetics and antagonism) through the extrapolation of the state of the art in drug antidotal therapy that employs the addition of exogenous metabolizing enzymes to destroy toxic molecules in the body. As examples for the worst toxic molecules, the course also discusses chemical warfare agents (historical application, mode of action, and antidotal approaches). The phases of drug development process are also covered following the approach of "Molecules from the Research Labs to the Hands of Doctors to Treat Diseases and Chemical Intoxications".

Students should be able to apply this knowledge to solve problems involving drugs and toxins.

RELATED ITEM LEVEL 2

Application of Knowledge of Drug and Toxin Biochemistry to Problem-Solving

Indicator Description:

All students in the class are evaluated by two midterm exams and a final exam. The exams require them to apply the knowledge gained in the course to solving problems involving drugs and toxins.

Criterion Description:

80% of the students will score within one standard deviation of the mean or higher on each exam.

Findings Description:

[Note: It is hoped this data can be added in June 2022 but is not yet available due to emergencies during international travel by the faculty member in May/June.]

RELATED ITEM LEVEL 2

Student Self-Assessment of Gain of Understanding of Drug and Toxin Biochemistry

Indicator Description:

Students will take a new course CHEM 5373 Drug and Toxin Biochemistry. At the end of the course, students will be asked to rate their "Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, generalizations, theories)" on a scale of 1 (No progress) to 5 (Exceptional Progress).

Criterion Description:

At least 70% of students responding will rate their progress as "Substantial Progress" or "Exceptional Progress".

Findings Description:

Of the 9 students responding, 5 students rated their progress "Substantial", and 7 gave the top score "Exceptional". That means 100% chose the top two levels, far exceeding the criteria. The criteria is met.

Develop Oral and Written Presentation Skills

Goal Description:

The ability to communicate research and knowledge are fundamental presentation skills in chemistry. Students should have opportunities to develop those skills.

Providing Department: Chemistry MS

Progress: Completed

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 quality 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. Transformation of the presentation quality will be observed within the semester as a round of lightning talks will precede the actual seminar presentations at the beginning of the semester. It is expected that student feedback after the lightning talks will be incorporated and result in the improvement in greater than 90% of the full-length presentations.

Attached Files
Spring_2022_20821.pdf

Findings Description:

100% of students (7/7 in Spring 2022) improved their presentation (including both research and literature) based on feedback during the lightning presentations.

RELATED ITEM LEVEL 3

Action - Peer-Reviewed Student Seminar

Action Description:

Lightning presentations will continue to be used, however instead of allowing research-based lightning presentations, all students will be required to do a lightning presentation on one of their main supporting article. This will help student improve their background knowledge and presentation of the introduction section of the talk.

RELATED ITEM LEVEL 1

Students Will Demonstrate Skills In Conference Presentations Of Research

Performance Objective Description:

Presenting research is an important skill, and presenting at conferences provide networking opportunities and can lead to recruitment to jobs or graduate programs.

RELATED ITEM LEVEL 2

Student Presentations

KPI Description:

The number of presentations by graduate students at professional meetings will indicate the success of the department in preparing students to orally present their research results. We expect that every graduate student who completes their M.S. degree will have will have made one or more presentation at a regional or national professional meeting (typically American Chemical Society (ACS) Meetings, but some groups attend Society of Toxicology and other related or specialized meetings).

Results Description:

Every graduate had presented their research at an external meeting, the criteria is met. During COVID this was a challenge, but the return of meetings is making this easier.

RELATED ITEM LEVEL 1

Students Will Demonstrate Skills In Publishing Research

Performance Objective Description:

Students will demonstrate the research skills to coauthor publications on their research findings.

RELATED ITEM LEVEL 2

Research Publications Coauthored by Undergraduate Students KPI Description:

Although only a smaller fraction of undergraduate students will typically get coauthorship on publications as a result of their research efforts, this is still an important measure of research mentorship success for this population of students.

It is anticipated that at least 5 undergraduate students each year will appear as coauthors on published papers.

Results Description:

Although only three papers were published with undergraduate students as coauthors, one had multiple undergraduates on it so five undergraduates did appear as coauthors on papers. The criteria is technically met.

Faculty will be encouraged to try to include contributing undergraduates as coauthors where reasonable.

RELATED ITEM LEVEL 3

Student Publications Action Description:

Student authorship on publications is lagging. This should be discussed at a fall Faculty and Staff meeting and both the rate of publication examined and the appropriateness of this assessment measure examined.

RELATED ITEM LEVEL 2

Research Publications by Graduate Students

KPI Description:

The number of research publications with graduate student authors or co-authors will indicate departmental success in preparing students to report research findings in written form. We expect that all graduate students who complete their M.S. degrees will have one or more publications (and most will have more than one presentation).

Results Description:

Only one of the five graduating students had a publication (though most had presentations and did research that may yet lead to publication). The criteria is not met.

Due to the timelines of research publication, this assessment tool may need to be revised. Faculty should discuss what a reasonable expectation for assessment would actually be before next assessment cycle, and whether the failure to meet this one represents an issue to be addressed. That is not clear at this time.

RELATED ITEM LEVEL 3

Student Publications

Action Description:

Student authorship on publications is lagging. This should be discussed at a fall Faculty and Staff meeting and both the rate of publication examined and the appropriateness of this assessment measure examined.

Update to Previous Cycle's Plan for Continuous Improvement Item

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

Closing Summary

In general criteria were met, and changes to specific courses will not occur in the next year as they are on a 2 to 3 year course rotation so will not be taught this next year. However, in general there did appear to be a common theme that students were struggling a bit to recall undergraduate knowledge effectively and apply it to learn graduate-level content. The faculty of courses taught in the coming year will be informed of this so that they can a) watch for similar issues, as they might be related to COVID-disruptions lowering student knowledge and/or recall of pre-requisite knowledge and b) can make adjustments to their courses during the year to try to offset this.

Update of Progress to the Previous Cycle's PCI:

Although this was discussed, it also got worse this year. A record number of students lost 'good standing' and their assistantship due to low graduate course grades. This appears to be due to a combination of factors, including the lack of pre-req knowledge, COVID-related issues that are dragging on, and some unique medical circumstances. As a result of the discussions that took place and these events, we are discussing adding a new course the first semester to capture all of the adjustment and background issues earlier in a graduate student's career. Further discussions of this course and potentially its development will be part of the Plan for Continuous Improvement.

New Plan for Continuous Improvement (MS Chemistry)

Closing Summary:

Although this year all or nearly all criteria were met, there were several observations that lead to changes that could improve the MS Chemistry program or its assessment:

- CHEM 5100 "lightning talks" will have a more constrained topic selection to better support other presentations in the course as indicated in its Action Item.
- The assessment of Physical Organic Chemistry (not taught every year, so next time it is offered) will be extended to include additional performance measures as indicated in its Action Item.
- Measure of student self-assessment on course evaluations in general were greatly exceeded at the 70% (for top two ratings) level. If used for assessment in the future, a more stringent criteria is likely desired.

In addition to the above items, it is observed that student performance was not as strong as the assessment items might suggest. This is indicated by:

- For the first time ever, an MS student took three attempts to pass their oral comprehensive exam.
- For the first time ever, three different students lost good academic standing their first semester for falling below a 3.0 GPA and were terminated at the end of the second semester for remaining below a 3.0 (although all had single-semester GPAs above 3.0 in the spring term). All three were readmitted to continue after extensive discussion.

Because of those issues, it will be important for the faculty to

- discuss assessment measures that align better with grades given in courses, or to discuss whether grades are accurately capturing student performance and
- discuss whether course offerings need to be modified in the fall semester to better support the transition of students into graduate school, especially for international students who make a major adjustment culturally and academically when arriving. This may include an early warning system of some kind for students whose background knowledge is found to be less aligned with our program than evaluation of their application suggested.