UNIT REPORT

Chemistry BS - Assessment Plan Summary

Chemistry BS

(1) Deliver A Curriculum Appropriate For Understanding Fundamentals Of Chemistry

Goal Description:

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

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Understanding Of Fundamentals

Learning Objective Description:

Chemistry is an intensely sequential discipline. Students must master the material at an average level of understanding in the first semester course (general chemistry I) before they are allowed to attempt the second semester course (general chemistry II). The same is true for each of the first five semester courses in the sequence (general chemistry I, general chemistry II, organic chemistry I, organic chemistry II and physical chemistry I).

The fundamental concepts covered in general chemistry I and II include:
uncertainty in measurement, dimensional analysis, atomic and electronic structure, ionic and molecular formulas, nomenclature, stoichiometry, thermochemistry, bonding theories, valence shell electron pair repulsion theory, properties of gases, intermolecular forces, properties of solutions, kinetics, equilibrium, acid-base chemistry, oxidation-reduction chemistry, chemical thermodynamics and electrochemistry.

RELATED ITEM LEVEL 2

American Chemical Society (ACS) General Chemistry Test

Indicator Description:

All chemistry majors will be invited to take a nationally standardized test over general chemistry (written by the American Chemical Society Division of Chemical Education Examinations Institute) near their completion of general chemistry II. In order to encourage participation, the highest individual score is guaranteed scholarship money for a future semester, and additional scholarship monies will be scaled to percentile performance on the examination.

Criterion Description:

Sixty percent of chemistry majors are expected to score within one standard deviation of the mean or higher than one standard deviation above the mean on the ACS standardized general chemistry examination. In past years, the major weakness has been the low number of majors who took the exam. We continue to work to motivate more students to take the exam since the biggest problem is the number of takers.

Findings Description:

Of the 17 students that took the exam (62 were invited to do so), 14 (82%) scored within one standard deviation of the mean or higher on the ACS standardized general chemistry examination. The criterion was met and exceeded overall. For chemistry majors (excluding forensic chemistry majors), 4 students took the exam (22 were invited to do so) and all 4 of them (100%) scored within one standard deviation of the mean or higher. Thus the criterion was met for the chemistry majors. Overall, the participation rate for the academic year was 17/62 = 27% (and 4/22 = 18% for chemistry majors and 13/40 = 33% for forensic chemistry majors).

We still need to find ways to increase the participation rate.

Attached Files

ACSGeneralExam17

GenChemRecord

RELATED ITEM LEVEL 3

Fundamental Knowledge

Action Description:

We think that sitting for the ACS General Chemistry exam for chemistry and forensic chemistry majors as they finish CHEM 1412 (General Chemistry II) is important. We think that the scholarship money should be a reasonable incentive. This year participation is down slightly for the spring semester (24% overall for spring 2017 compared to 27% for spring 2016) and up for the fall (38% which is one of the highest participation rates we have had). It is difficult to generalize and some historical data can be found in the General Chemistry folder (in the file entitled GenChemRecord). While one might expect that multiple offerings of the exam would lead to increased participation, the data don't support it, and there is little to suggest that sending out multiple emails to the students is

effective. We will again offer the exam in both the fall and spring semesters, and we will ask all of the CHEM 1412 instructors to encourage the chemistry and forensic chemistry majors in their class to participate.

(2) Deliver A Curriculum Appropriate For Understanding Organic Chemistry

Goal Description:

The curriculum will provide students with opportunities to develop the skills typically required of professionals in the area of organic chemistry.

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Understanding Of Organic Chemistry

Learning Objective Description:

Organic chemistry is covered in the second year of a chemistry degree. It follows a year of general chemistry and precedes physical chemistry.

Students will demonstrate competent knowledge of the topics covered in organic chemistry I and II which include: hydrocarbons (alkanes, alkenes and alkynes), aromatic systems, functional group chemistry (including the chemistry of alkyl halides, ethers and various carbonyl compounds), stereochemistry, and carbohydrate chemistry.

RELATED ITEM LEVEL 2

ACS Organic Chemistry Test

Indicator Description:

A nationally standardized test over organic chemistry (written by the American Chemical Society Division of Chemical Education Examinations Institute) will be given to all chemistry majors who take organic chemistry II at Sam Houston State University. This test is given as the final examination for the course.

Criterion Description:

Seventy-five percent of chemistry majors are expected to score within one standard deviation of the mean or higher than one standard deviation above the mean on the ACS standardized organic chemistry examination.

Findings Description:

In the fall semester, two chemistry majors and ten forensic chemistry majors took the exam. Neither of the chemistry majors (0/2 = 0%) and four of the ten forensic chemistry majors (4/10 = 40%), for a total of four of twelve (33%) overall scored within one standard deviation from the mean or higher for the exam. In the spring semester, twelve chemistry majors and eighteen forensic chemistry majors took the exam. Seven of the chemistry majors (7/12 = 58%) and twelve of the forensic chemistry majors (12/18 = 67%) for a total of 19 of 30 (63%) scored within 1 standard deviation from the mean or higher than one standard deviation above the mean. In total, for these students 7/14 = 50% of the chemistry majors and 16/28 = 57% of the forensic chemistry majors, or 23/42 = 55% overall, met the criterion.

The criterion was not met for either group.

Attached Files

ACSOrganicExam17

OrgChemRecord

RELATED ITEM LEVEL 3

Organic Chemistry

Action Description:

For the fifth year in a row, we have data for all of the sections of CHEM 2325 (organic chemistry II) that were taught. Surprisingly, the biggest correlation with low performance on the standardized exam is no longer the section that fills most quickly when there are multiple sections. In general the fall semester performance is worse than the spring semester performance. This is to be expected since students who are on sequence (and never had to repeat any course) would take this course in the spring. Within the spring offerings, two of the three sections filled at the same time, and the third section filled last. The two that filled fastest had the same instructor, and the section that filled more slowly had a different instructor.

The approaches of these two instructors is different. The instructor teaching two sections used a "flipped classroom" approach and the other instructor did not. For the flipped classroom, 5/8 of the chemistry majors and 11/14 of the forensic chemistry majors met the criteria. In contrast, 2/4 of the chemistry majors and 1/4 of the forensic chemistry majors met the criteria in the traditional class.

We will continue to monitor the situation to see if there are real differences in the approaches. Last year we didn't observe any difference in flipped vs traditional. All of the students who fail to meet the criterion either repeat the course (and subsequently meet the criterion) or they change their majors. We will continue to assess student performance.

(3) Deliver A Curriculum Appropriate For Mastery Of Advanced Chemistry Topics

Goal Description:

The curriculum will provide students with opportunities to develop the skills typically required of professionals in the area of advanced chemistry topics.

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Mastery Of Advanced Topics In Chemistry

Learning Objective Description:

The material learned by the third year in the chemistry curriculum is refined and supported theoretically in Physical Chemistry I (CHEM 4448). The successful student will demonstrate a mastery of the advanced topics presented in this course. These topics include quantum theory, wave functions, the dipole approximation, electronic configuration, molecular structure, molecular orbital diagrams, symmetry, group theory, and the application of these topics to X-ray, ultraviolet, visible, infrared, Raman, and magnetic resonance spectroscopy. All sections of CHEM 4448 have been taught by Dr. Darren Williams since his arrival at SHSU in 2004.

RELATED ITEM LEVEL 2

CHEM 4448 Final Examination

Indicator Description:

CHEM 4448 is required of all chemistry majors. The final examination in Physical Chemistry I (CHEM 4448), written by Dr. Darren Williams, is recognized by the faculty of the Department of Chemistry as being comprehensive and covers all of the advanced topics listed in the objective statement. Dr. Williams is the sole instructor of CHEM 4448 at SHSU having taught all sections of CHEM 4448 since his arrival on campus in 2004. All students are required to complete the final examination. Examples of final exams are on file and secured within the Department of Chemistry and may be viewed by contacting Dr. Williams directly at williams@shsu.edu.

Criterion Description:

Seventy-five percent of chemistry majors are expected to demonstrate a mastery of at least sixty percent of the material (score 60%) on the comprehensive final examination.

Findings Description:

The criterion was met with 76% (32/42) of chemistry majors scoring at least 60% on the comprehensive final exam. The full statistics for all semesters since 2004 are attached as well as a box plot of the performance.

Of the 10 who did not make at least 60%, 7 received a grade of F in the course. Their final exam performance was similar to their performance on other exams in the course.

The ten pages of homework per week was not an issue now that the students have come to expect it.

Attached Files

FinalExamGradeTrends

CHEM 4448 Performance 2004-2016a

RELATED ITEM LEVEL 3

Physical Chemistry Action

Action Description:

A Lab Manual for CHEM 4448 was successfully completed with the help of two laboratory assistants. It was not published or bound, but the individual chapters/labs were posted on Blackboard each week.

We will continue to move toward publication of the manual in bound form.

(4) Deliver A Curriculum Appropriate For Understanding Instrumental Analytical Methods In Chemistry

Goal Description:

The curriculum will provide students with opportunities to develop the skills typically required of professionals in the area of instrumental analytical methods in chemistry.

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Understanding Of Instrumental Analytical Methods In Chemistry

Learning Objective Description:

The modern analytical laboratory makes extensive use of electronic instrumentation for the analysis of chemical samples. Our Instrumental Analytical Chemistry course (CHEM 4440) is designed to introduce students to and have them learn the importance and use of spectrophotometric, chromatographic, and mass spectrometric analytical instrumental methods and computers in analytical laboratories. The course's laboratory component includes a focus on complex technical writing and use of the scientific literature. Students must master this material to meet the objective. While Dr. Thomas Chasteen had been the instructor for all sections of CHEM 4440 for more than a decade, Dr. David Thompson has taken over the class.

RELATED ITEM LEVEL 2

Examinations In Instrumental Analytical Chemistry

Indicator Description:

All students in Instrumental Analytical Chemistry (CHEM 4440) are required to master the electronic, sampling, schematic, and computational fundamentals of modern analytical instrumentation as evaluated by 80-minute written tests requiring essays, laboratory data evaluation, and calculator-based computation. There are three tests and a final examination in this course. The testing of this knowledge and its application is standardized within the department across all sections.

Criterion Description:

Eighty two and one half percent of chemistry majors are expected to score within one standard deviation of the mean or higher than one standard deviation above the mean on the four examinations in this class. We expect statistical variability from test to test and from year to year.

Findings Description:

On the first exam, 29 of the the 35 students (83%) scored within one standard deviation of the mean or higher. On the second exam, 30 of the 35 students (86%) scored within one standard deviation of the mean or higher. On the third exam, 28 of the 35 students (80%) scored within one standard deviation of the mean or higher. On the final exam, 29 of the 35 students (83%) scored within one standard deviation of the mean or higher. The criterion was met for each exam except the third (which was 2.5% or 1 student short). Clearly intervention is not needed.

Attached Files

Copy of CHEM4440 F2016 SACS data

RELATED ITEM LEVEL 3

Instrumental Analysis Action

Action Description:

Dr. Thompson took over the course on short notice, and with good support from Dr. Chasteen began to familiarize himself with how this course has been taught in the past, to develop a vision for its future.

The action for this year will be to begin planning changes in the laboratory that will eventually increase individual student time on the instruments, by running several instruments in parallel during the same lab period. Currently all labs are run serially. This is a major change and the goal this year will be to draw up a strategic plan for making this change, and to recruit one or more students to work over the summer of 2018 testing and developing new labs for this model.

(5) Deliver A Curriculum With Appropriate Written And Oral Communication Skills Developed

Goal Description:

The curriculum will provide opportunities for mastery of written and oral skills.

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Adequate Written And Oral Communication

Learning Objective Description:

Students will demonstrate the ability to present to an audience of their peers a talk (seminar) based on their own research or research that has been reported in the scientific literature.

RELATED ITEM LEVEL 2

Chemistry Seminar Presentation

Indicator Description:

All chemistry majors are required to take CHEM 4100 "Chemical Literature Seminar". Students typically do so in their senior year. One of the requirements of this course is giving an oral PowerPoint presentation over either their own research, or research from the published chemical literature, to the other students in the class.

Criterion Description:

All chemistry majors are required to receive an acceptable peer-rating on a required research presentation. Presentations will be deemed suitable if deemed so 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). Within the course, each student evaluates all other student presentations. The rubric is the last page of the syllabus. Over the years, we have found that peers tended to rate presenters rather highly. We hope to see more helpful feedback after providing additional instruction in constructive feedback.

Attached Files

4100.01

CHEM4100 SyllabusS2017

Findings Description:

All students gave presentations that were deemed at least acceptable (100% of 18 in Fall 2016 and 100% of 15 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). (Note: Not all students received the highest grade in the course, as other aspects of the grading rubric were sometimes deficient for an individual student, especially meeting the deadlines for abstract submission).

RELATED ITEM LEVEL 3

Seminar Action

Action Description:

Student presentation quality is acceptable. The professor has transferred some of the techniques used in CHEM5100 to improve student outcomes (rubric-based grading, including review comments on grading rubric, attaching student names to reviews for professor to view then remove) with similar benefits. For the coming year, assessment should focus on the use of literature by the students in their presentations, which has been observed to be weak. Will try requiring students to reference a specific number of related articles in their presentation while still meeting minimum presentation quality standards.

Update to Previous Cycle's Plan for Continuous Improvement

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

As stated previously, we assess the same courses year after year for our B.S. programs because the courses, the material, and the requirements of the American Chemical Society do not change. This means that our plans from year to year end up being remarkably similar.

This coming year we will again offer two opportunities to take the ACS exam over general chemistry each semester, but we will endeavor to better advertise it to the students through multiple emails and instructor announcement(s).

In the area of organic chemistry, we will continue to monitor student performance on the standardized final and check instructor and time correlations. This may be a consequence of the registration process--more senior students register first which means that students who did poorly and are repeating the class register first and they may show up disproportionately in the class that fills fastest. As mentioned above, in tracking students who failed to meet the criteria, they do better on repetition. However, not all of them rose to the challenge, and will either have to repeat the course once more, or they will change their major.

In the area of physical chemistry, Dr. Williams will continue to stress issues related to time management through required homework assignments. Difficulties in the laboratory will be addressed through the creation of a Physical Chemistry Laboratory Manual.

In the area of instrumental analysis, there will be a major change in the coming year since the long-time instructor for the course will be taking a medical leave of absence.

For the seminar, there will also be a change in the coming year since the long-time instructor for the course will be taking a medical leave of absence.

I will address one last point. In the meta assessment for this past year, it was implied that the Chemistry Department should set some goal--"to be the best Chemistry Department in some specific area of student performance". The curriculum is set by an outside agency. B.S. chemistry majors have exactly one elective course in chemistry. The department is so resource limited that we cannot create and offer new courses. In this environment, we do an incredibly good job at producing students who get jobs in their field or go on to graduate school.

Update of Progress to the Previous Cycle's PCI:

Participation rates on the ACS general chemistry exam are up somewhat.

This year saw a shift in student performance in organic chemistry, but one year is anecdotal.

Dr. Thompson took over instrumental analysis and ran the course as Dr. Chasteen would have done.

Dr. Haines took over the undergraduate seminar, and since he has been running the graduate seminar for quite some time, the transition was smooth.

Plan for Continuous Improvement

Closing Summary:

As stated previously, we assess the same courses year after year for our B.S. programs because the courses, the material, and the requirements of the American Chemical Society do not change. This means that our plans from year to year end up being remarkably similar.

This coming year we will again offer two opportunities to take the ACS exam over general chemistry each semester, but we will endeavor to better advertise it to the students through instructor announcement(s). Multiple emails appear to have no effect on participation rates.

In the area of organic chemistry, we will continue to monitor student performance on the standardized final and check instructor and time correlations. As previously noted, this may be a consequence of the registration process--more senior students register first which means that students who did poorly and are repeating the class register first and they may show up disproportionately in the class that fills fastest. Demand for the course has increased, and two sections "filled fastest". We hired a new organic chemist this past year, and I expect things will shift as students' opinions shift. Organic chemistry is often the course that convinces some students to change their majors away from chemistry.

In the area of physical chemistry, students are now expecting the required homework, so some of the previous problems have abated. A laboratory manual has been created, but is currently only available online. Dr. Williams will work towards publication of the manual.

In the area of instrumental analysis, now that Dr. Thompson has taught the class once, he will work towards trying to get students to spend more time on specific instruments through creation of a rotating laboratory schedule. This may require more experienced laboratory instructors than we have available.

For the seminar, Dr. Haines has taken over the course and has determined that the students need to pay more attention to proper citation of the primary literature and will focus on improving this area in the next year.

As mentioned previously, there has been a suggestion that the Chemistry Department should set some goal--"to be the best Chemistry Department in some specific area of student performance". The curriculum is set by an outside agency. B.S. chemistry majors have exactly one elective course in chemistry. The department is so resource-limited that we cannot create and offer new courses. If we were to strive, for example, to be the best department in Texas in teaching physical chemistry, it means that we would have to hire several new faculty to do so and buy a lot of expensive laboratory equipment, which isn't going to happen. We don't have the resources to hire even one additional faculty member. In this environment, we do an incredibly good job at producing students who get jobs in their field or go on to graduate school.