Chemistry BS

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. These topics, which include Physical Chemistry and Instrumental Analytical Chemistry, can only be understood after at least four semesters of undergraduate chemistry coursework and in some cases Calculus I, Calculus II, and a year of Physics with laboratory (all with C's or higher).

Attached Files

2015-acs-guidelines-for-bachelors-degree-programs.pdf

Providing Department: Chemistry BS

Progress: Completed

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Mastery Of Physical 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:

33/38 students (87%) scored at least 60% on the comprehensive exam, which exceeds the criteria of 75% of students. The criteria is met/exceeded.

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.

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:

The averages and standard deviations of the four exams were:

Exam 1: 95.6 +/- 13.1 (so one std dev below the mean was 82.5, 33 out of 36 exceeded so 91.7% exceeded with meets criteria)

Exam 2: 80.1 +/- 9.4 (70.7, all 36 students exceeded this so the criteria is met)

[Exam 3 was not given]

Final Exam: 97.6 +/- 18.5 (79.1, 30 of 35 students exceeded so 86% which meets criteria)

For all three exams given, the criteria was met, so the overall criteria is met.

RELATED ITEM LEVEL 1

Demonstrate Understanding of Biochemistry

Learning Objective Description:

Biochemistry is basically the study of the chemistry of living things. Fundamental knowledge in Biochemistry (as taught in the required first semester course) includes understanding the differences between the various classes of biological molecules, understanding the structure and function of proteins (especially enzymes), understanding how enzymes catalyze chemical reactions and how they are regulated. Students should also understand how the molecules of biochemistry are studied.

RELATED ITEM LEVEL 2

Students Can Accurately Represent The Structure Of A Simple Protein

Indicator Description:

Students who understand biochemistry and specifically protein structure should be able to draw an accurate chemical structure of a peptide given a sequence. This will be measured by asking the following question (the sequence given may change in different semesters) on the final exam of CHEM 3438 sections:

"Your friend in class are so happy to be finished that they decide to get a tattoo of the peptide FINISHED on their back. They have asked you to draw the structure of the peptide correctly as it would exist at pH 7.4 (showing all the correct ionization states). Please do so below, and remember, your friend will have this tattoo pretty much forever, so please get it right. (Note: You may use the back of the page for more space if needed, and feel free to draw a dangling bond on the right side of the page and continue the structure on another line if it helps.)"

Note: "FINISHED" is the amino acid sequence (using one-letter amino acid abbreviations) for the peptide they are asked to draw.

Criterion Description:

The question will be scored out of six points. The criteria will be met if at least 80% of students score at least 5/6 on the question, which is scored by the instructor of record. Points are deducted for having wrong termini or backbone (3 points, students are warned in class this is considered a major error on this kind of question), wrong amino acid side-chains (credit/deduction varies by how different the answer is from the correct structure), and for showing the correct structure in the wrong ionization state for the stated pH (1 pt).

Findings Description:

In fall 2021 in CHEM 3438.02 the question was given to 32 students with the following results:

6/6	8 students
5/6	7 students
4/6	4 students
3/6	4 students
2/6	2 students
1/6	6 students
0/6	1 student

Since 15/32 students scored 5/6 or higher which is 47% of students, this was well below the 80% criterion and the criterion was not met. The question was not used in Spring 2022.

The criteria is not met. Learning peptide structure depends heavily on prerequisite knowledge from Organic Chemistry and some from General Chemistry. In classroom discussions, it is apparent that students are remembering surprisingly little from their prerequisite courses, and that is likely contributing. In the future, a better attempt to measure that knowledge and hone it in class through discussions and assignments will be made.

RELATED ITEM LEVEL 3

Organic Chemistry Knowledge

Action Description:

Although the ACS Organic Exam results were borderline (failed to meet the criteria technically, but within rounding expectations), the measure of student ability to represent the chemical structure of a simple protein failed and it is believed based on interactions in later courses that students are not learning or retaining knowledge in the area sufficiently to handle content that builds on it. Therefore, we will increase the utilization of Organic Chemistry in in-class activities in the flipped course CHEM 3438 Biochemistry I. This will allow students to review Organic and practice it as part of that course, for which this knowledge is pre-requisite.

RELATED ITEM LEVEL 2

Students Can Explain What An Enzyme Is And How It Works

Indicator Description:

Students who demonstrate an understanding of biochemistry, and more specifically the nature of enzymes, will be able to answer the question "Explain what an enzyme is and how it works to a student finishing Organic Chemistry II class." This question will be asked on the final exam in a section of CHEM 3438 Biochemistry I as a free-response question.

Criterion Description:

The question will be scored out of four points. If at least 90% of students (set high as this knowledge is very fundamental to understanding of biochemistry) can achieve a score of at least three out of four points on the question, than the criterion has been met.

Findings Description:

Out of 32 exams in CHEM 3438.02 in Fall 2021, 28 scored 4/4, 3 scored 3/4, and 1 scored 1/4. Based on these results, 97% of students could answer the question correctly (as defined by getting at least 3/4) and the criterion is met. The question was not asked again in Spring 2022.

[Note: Unlike the peptide structure question used in another indicator/criterion/findings, this question does not depend very deeply on pre-requisite knowledge other than a basic understanding of what a catalyst is. This likely explains why the other question failed by a significant margin and this question succeeded by a wide margin.]

RELATED ITEM LEVEL 2

Students Will Self-Report That They Learned A Lot in CHEM 3438 Biochemistry I

Indicator Description:

As a complement to exam question assessments, students will be asked to self-assess how much they learned in CHEM 3438 Biochemistry I on a post-course Qualtrics survey. The survey instrument is given to students at the end of the semester (distributed approximately one week before the last day of class).

Students are asked to evaluate "On a scale of 1 to 100, how much do you agree with each statement" and a statement "I learned a lot this semester." is rated. The question defaults to a neutral score of 50.

Criterion Description:

If 80% of students give an agreement rating of 75% or more, this will be deemed successful.

Findings Description:

Of the 32 students in fall CHEM 3438.02 Biochemistry I, 16 responded to the survey. Here are the responses:

Rating	Number of Students
100	10
94	1
93	1
90	1
86	1
80	1
79	1

As can be seen, 100% of responding students agreed at a score of 75 or higher, exceeding the criteria. Ten students (63%) gave a perfect rating of 100.

The survey results from Spring 2022 are attached as a PDF file. In the spring semester, 25/28 people agreed at a level of 75 or higher (89%) with 17 of the students (612) giving a perfect rating of 100. The lowest score was 50, followed by 71 as the second-lowest.

Overall, then, 41/44 students agreed at a level of 75 or higher, which is 93%. This greatly exceeds the criteria of 80% so the criteria is met.

Attached Files

CHEM3438 Spring 2022 Learning Self-Assessment.pdf

Deliver A Curriculum Appropriate for Understanding Basic Chemistry

Goal Description:

Deliver an education in foundational and organic in-depth coursework (chemistry coursework from the first half of a BS degree) that provides knowledge and skills aligned with professional expectations, for example those described in the attached American Chemical Society Guidelines for Bachelors Degree Programs.

Attached Files

2015-acs-guidelines-for-bachelors-degree-programs.pdf

Providing Department: Chemistry BS

Progress: Completed

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Understanding Of Chemistry 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.

Note: We cannot legally reproduce these exams, but the normalization data is available and is attached (this is the 2006 ACS General Chemistry 2nd Term Form).

Attached Files

General-Chemistry-Brief-Year-Form-2006.pdf

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:

In Fall 2022, the exam was not given. Due to an error, the Spring 2022 exam proctor went to the wrong room and the exam had to be rescheduled, likely reducing turnout. Two students took the exam, so we are not breaking them out by major (CHEM and FCHM)..

Of those two students, one scored 27/50 (52nd percentile) and one scored 30/50 (64th percentile).

The test national standardization mean was 28/50 with a standard deviation of 8, so one standard deviation below the mean was 20/50 (representing 20th percentile). Both students scored higher than this, so the criteria is technically met but with such low turnout that this measure likely doesn't mean that much.

RELATED ITEM LEVEL 3

Action - ACS Exams in a Later Course

Action Description:

As the turnout for the scholarship exam at the end of General Chemistry, which uses the standardized ACS exam, is too low, we will pilot giving tests to students at the beginning of CHEM 3438 Biochemistry I. CHEM 1411 and 1412 General Chemistry I & II are both pre-requisites for CHEM 3438 as are CHEM 2323, 2123, 2325, and 2125 Organic Chemistry I & II lecture and labs. All chemistry undergraduate majors take this course. The exams will be given at the beginning of CHEM 3438 in lab time.

This will produce a slightly different measurement, as students are expected to lose knowledge post-course but the measure of retention may be useful and this way we can capture all majors for comparison. For Organic Chemistry, we will be able to compare scores for the ACS exam given at the end of Organic II lecture and beginning of Biochemistry I.

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 national mean on the ACS standardized organic chemistry examination.

Note: We are not legally allowed to reproduce these exams, so a sample is not attached. However, the normalization data is available and is attached.

Attached Files

OR16_Norm_Sheet_Final_post.pdf

Findings Description:

The mean and standard deviation in the national norming data are 36.6 and 11.4, respectively, as noted in the attached Norm Sheet. Thus the criteria of scoring within one standard deviation of the mean requires a score of 25.2 or higher. A score of 26 corresponds to a percentile ranking of (bottom) 20th percentile. In Dr. Arney's class, 17 students took the ACS final exam and all but 2 met the criteria (88% met the criteria). The average score in his class was 38.5 correct, which corresponds to (interpolating) 58th percentile. In Dr. Hobbs' sections, the average number of correct answers was 30 (32nd percentile), 29 (29th percentile), and 26 (20th percentile) correct. In those sections 9/13 (69%), 16/20 (80%), and 12/24 (50%) exceeded 25.2 questions correct for a total of 37/57 (64.9%). All together for all sections, 52 out of 74 students exceeded 25.2 questions correct for 70.3% meeting the threshold. The criteria therefore was not met.

[Note: If the 25.2 threshold was rounded to 25, a slightly different outcome of 55/74 students scored 25 or higher as 3 students scored 25. This is 74.3% of students meeting the threshold with this alternate rounding, but is still slightly below the threshold).

The criteria was not met.

RELATED ITEM LEVEL 3

Action - ACS Exams in a Later Course

Action Description:

As the turnout for the scholarship exam at the end of General Chemistry, which uses the standardized ACS exam, is too low, we will pilot giving tests to students at the beginning of CHEM 3438 Biochemistry I. CHEM 1411 and 1412 General Chemistry I & II are both pre-requisites for CHEM 3438 as are CHEM 2323, 2123, 2325, and 2125 Organic Chemistry I & II lecture and labs. All chemistry undergraduate majors take this

course. The exams will be given at the beginning of CHEM 3438 in lab time.

This will produce a slightly different measurement, as students are expected to lose knowledge post-course but the measure of retention may be useful and this way we can capture all majors for comparison. For Organic Chemistry, we will be able to compare scores for the ACS exam given at the end of Organic II lecture and beginning of Biochemistry I.

RELATED ITEM LEVEL 3

Organic Chemistry Knowledge

Action Description:

Although the ACS Organic Exam results were borderline (failed to meet the criteria technically, but within rounding expectations), the measure of student ability to represent the chemical structure of a simple protein failed and it is believed based on interactions in later courses that students are not learning or retaining knowledge in the area sufficiently to handle content that builds on it. Therefore, we will increase the utilization of Organic Chemistry in in-class activities in the flipped course CHEM 3438 Biochemistry I. This will allow students to review Organic and practice it as part of that course, for which this knowledge is pre-requisite.

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.

Providing Department: Chemistry BS

Progress: Completed

RELATED ITEMS/ELEMENTS

RELATED ITEM LEVEL 1

Demonstrate Adequate 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. As part of the Fall 2021 and Spring 2022 semesters students were tasked with completing a seminar topic form and include two supporting references and a reason why they were chosen.

Attached Files

Syllabus CHEM 4100 Spring 2022.pdf

Criterion Description:

Success was defined by submission of two supporting references by at least 80% of students and overall improvement in introductory and background slides as evaluated by the instructor.

Findings Description:

All students were required to submit topic selection forms with two supporting references. Over 95% of students (32/33) either included their supporting references in their seminar presentations or they found more relevant references to include. Therefore the criteria is met.

RELATED ITEM LEVEL 3

Action - Chemistry Seminar Presentation

Action Description:

The seminar topic selection forms will continue to be used, as they helped the student go beyond their selected research article and be able to present a broader background in their introductions. Moving forward separate forms will be created for those doing literature and research presentations.

RELATED ITEM LEVEL 1

Develop Effective Written Communication Skills

Learning Objective Description:

Students will learn to write effectively to a professional audience following accepted professional standards in the field.

These standards are best documented in the publication "The ACS Guide to Scholarly Communication" available at https://pubs.acs.org/doi/book/10.1021/acsguide.

RELATED ITEM LEVEL 2

Chemistry Majors Will Self-evaluate That Their Writing Has Improved as a Result of Their Writing-Enhanced Courses

Indicator Description:

A survey will be developed and sent to Chemistry majors (and others, but the results for this ICF will be filtered for just Chemistry majors) in which they will be asked to score whether they agree with the statement "Based on your writing enhanced chemistry courses, how much do you agree with each statement" followed by the statement "My writing has improved as a result of those courses.". The respondents will score their agreement from 0 (strongly disagree) to 100 (strongly agree).

Criterion Description:

At least 80% of Chemistry majors responding will give agree with a score of 51 or higher (since 51 would be minimal agreement).

Findings Description:

The survey findings for Chemistry Majors are attached. Of 9 Chemistry majors responding, 8 gave a score of 60 or higher and one gave a score of 50. That is 89% giving a score of 51 or higher which significantly exceeds the criteria.

Attached Files

CHEMwriting.pdf

RELATED ITEM LEVEL 2

Lab-Assistant Assessment of Student Writing Will Demonstrate Student Improvement to a Passing Level

Indicator Description:

In CHEM 3438W Biochemistry I Laboratory, which is writing-enhanced, students write multiple large 'Formal Reports' which are research reports written to an audience of professional scientists as well as 'Results and Discussion' sections that are drafts of these parts of the Formal Reports. Thus students turn in the Results and Discussion first, get feedback, and use this to build the much larger Formal Report. Writing artifacts are evaluated by the undergraduate and graduate lab assistants, who also provide the feedback.

The description of the Formal Report assignment excerpted from the lab manual is attached. A two-part picture of the rubric from Blackboard/Turn-it-In used by the lab assistants to evaluate the reports is also attached (the rubric cannot be exported as a text table to include here, unfortunately).

Attached Files

Report Pages from Biochemistry Lab Manual 2021-22.pdf

Rubric1.JPG

Rubric2.JPG

Criterion Description:

At least 90% of students will be evaluated to write an acceptable final Formal Report as indicated by a score of 70% or higher in the evaluation of the report.

Findings Description:

The results obtained for all majors in the course were:

Fall 2021

Section 11 - 8 out of 11 students scored 70% or higher (73% of students)

Section 12 - 14/16 (88%)

Section 13 - 14/15 (93%)

Section 14 - 12/13 (92%)

Spring 2022

Section 11 - 22/22 (100%)

Section 12 - 13/17 (76%)

Overall, 83 of 94 students scored 70% or higher, which is 88%. Therefore, the criteria was not quite met.

Evaluation of the papers that earned less than 70% suggests that the underlying problem is not a lack of writing skill as much as a lack of time invested. The writing portion of CHEM 3438 lab is an extremely high workload, and requires constant management. Between Fall 2021 and Spring 2022, the last formal report was changed from an individual assignment to a group assignment in order to reduce the workload (and help teach team skills).

This means the 4 grades in Spring 2022 that were below 70% were really one paper by four students earning 68% on their paper. With the number of students evaluated this means the assessment criteria needs to be re-evaluated if this is re-used as really the whole data set if all students were submitted as groups would just be around 25 papers, so each paper is around 4% of papers overall and around 25% of the papers in a give section and rounding to the nearest 1% for the criteria does not make sense. Therefore 88% is exactly at the criteria within reasonable rounding error.

In the classroom, additional thought into how to tweak the overall set of writing assignments to reduce workload and increase time students can put into the final formal report would be considered but a solution has not been found at this time.

RELATED ITEM LEVEL 2

Students Will Self-Assess That Their Writing Improved at the End of a Writing-Enhanced Course

Indicator Description:

In a post-course survey in the writing-enhanced course CHEM 3438W Biochemistry I taught by Dr. Haines, a question will ask students to self-evaluate whether they agree with the statement "My writing has improved as a result of taking this course". Their responses will be on a scale of 0 (disagree strongly) to 100 (agree strongly).

Criterion Description:

At least 80% of students responding will agree that their writing improved at a level of 51 or higher on the scale of 0-100.

Findings Description:

In Fall 2021, 36 students responded with an average response of 79 +/- 21. All but 3 student responded with a 51 or higher, with 12 rating it at 100.

In Spring 2022, 18 students responded with an average score of 65 +/-39. All but 3 responded with a 51 or higher, with 6 rating it at 100.

Overall, then, 48/54 students rate that they agreed that their writing improved at a level of 51 or higher, 89% of students responding. This exceeds the criteria of 80%, the criteria is met.

Data for both semesters in the form of Qualtrics report PDFs is attached.

Although the criteria is met, the apparent lower score may be significant given that more writing was moved to group writing in Spring 2022 versus Fall 2021. That reduced workload that was straining students, but at the expense of less writing for each student and less feedback on their individual writing, so this decrease is not unexpected but is contrary to the goal of improving writing. At this time a solution that both reduces workload and increases writing development is not apparent, but more thought will be put into how to manage these competing goals.

Attached Files

Fall 2021 CHEM3438 Writing Self-assessment.pdf

Spring 2022 CHEM3438 Writing Self-assessment.pdf

Update to Previous Cycle's Plan for Continuous Improvement Item

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

Closing Summary

The plan for the coming year is dominated by the return to 'normal' courses (assuming that continues to be the plan despite the current huge spike in COVID cases). Although it would seem returning to normal would be easier, COVID heavily disrupted teaching styles and courses for the coming year will be taught using some of the tools generated during COVID-alterations, so in a way this means we will be teaching in the four format in under two years (old normal, pure online/remote, hybrid, new normal) and are doing so under a new schedule (fall starts earlier than ever and starts on a Monday not a Wednesday) than we have in the past.

Specific things to be done to improve:

- Return to using the standardized ACS organic exam, which must be taken in-person. This will give us valuable comparative data to pre-COVID student performance.
- Better advertise and communicate about the benefits of taking the ACS General Chemistry exam to increase the fraction of eligible students that take it
- Increase student writing in CHEM 3438 to further improve skill development for writing professional research reports according to professional standards
- Navigate the return to 'normal' courses during a completely abnormal time. Extensive accommodations will still be necessary for students who are quarantined or isolated due to COVID, and campus-wide policies were still changing as the semester started.
- Assess the major problems resulting from COVID-disruptions that will continue to plague us even if COVID-disruptions in attendance immediately stopped. For example, some of our transfer students now come in with a transcript that says they have two years worth of chemistry (CHEM 1411, 1412, 2323+2123, 2325+2125) but when advised indicate that they have never been in a lab or handled chemicals before. This creates a major safety and skill-deficit issue. It is unclear how to solve this while simultaneously moving forward with normal class loads that take 110% of faculty and staff time, but solutions (internal and external, for example the American Chemical Society is working on providing small workshop materials to help solve this problem) must be explored.
- Improve lab assistant expertise. The students in the previous pool are also our pool of lab assistants to supervise students working with hazardous chemicals in the lab. We have also failed to secure budget increases to increase pay for our students workers, even though most competing jobs have increases pay over the years, and as a result our number of applicants has not kept pace with our increased number of lab sections and we have had to use lab assistants with extremely low qualifications to fill positions (for example, they may have taken the lab they supervise only one semester before and earned a C). Since budget increases to increase pay have been systematically denied, one of the few strategies available on the department side is to try to increase communications. [Note: This is complicated a great deal by the fact that Fall 2021 will start earlier than we have ever started before and starts on a Monday, so assignments will be needed earlier than ever before.]

Update of Progress to the Previous Cycle's PCI:

The year ended up being a partial return to normal, but with challenges posed by COVID disruptions that will reverberate for years to come.

For the specific things to be done to improve:

- Return to using the standardized ACS organic exam, which must be taken in-person. This will give us valuable comparative data to pre-COVID student performance.
  - This was accomplished.
- Better advertise and communicate about the benefits of taking the ACS General Chemistry exam to increase the fraction of eligible students that take it
  - Although it was planned and communicated better in Spring 2022, an error (the wrong room number was given to a proctor) disrupted the exam.
  - We will start testing with this exam in CHEM 3438 to catch more majors, though at a later step of the degree.
  - The scholarship exam will continue, but we will need to continue to improve logistics of getting students in to take it.
- Increase student writing in CHEM 3438 to further improve skill development for writing professional research reports according to professional standards
  - Because of concerns about workload based on constant student feedback, we actually reduced the amount of individual student writing (but not number of assignments, just more were group assignments). This may be impacting student writing development in a negative way, but at this time appears to be necessary for student mental health.
- Navigate the return to 'normal' courses during a completely abnormal time. Extensive accommodations will still be necessary for students who are quarantined or isolated due to COVID, and campus-wide policies were still changing as the semester started.
  - Although there were minor issues here and there, overall instructors did an excellent job navigating the transition from pandemic-high-flexibility to a post-pandemic-lower-flexibility mode of teaching. Accommodations were made were needed, but not to the extent that students circumvented features of courses designed to help them learn content.
- Assess the major problems resulting from COVID-disruptions that will continue to plague us even if COVID-disruptions in attendance immediately stopped. For example, some of our transfer students now come in with a transcript that says they have two years worth of chemistry (CHEM 1411, 1412, 2323+2123, 2325+2125) but when advised indicate that they have never been in a lab or handled chemicals before. This creates a major safety and skill-deficit issue. It is unclear how to solve this while simultaneously moving forward with normal class loads that take 110% of faculty and staff time, but solutions (internal and external, for example the American Chemical Society is working on providing small workshop materials to help solve this problem) must be explored.
  - This will remain an issue for some time. We did not implement the ACS min-workshop, which was very limited in scope. Lab instructors are aware of the low-experience problem for incoming students and for our lab assistants.

- Improve lab assistant expertise. The students in the previous pool are also our pool of lab assistants to supervise students working with hazardous chemicals in the lab. We have also failed to secure budget increases to increase pay for our students workers, even though most competing jobs have increases pay over the years, and as a result our number of applicants has not kept pace with our increased number of lab sections and we have had to use lab assistants with extremely low qualifications to fill positions (for example, they may have taken the lab they supervise only one semester before and earned a C). Since budget increases to increase pay have been systematically denied, one of the few strategies available on the department side is to try to increase communications. [Note: This is complicated a great deal by the fact that Fall 2021 will start earlier than we have ever started before and starts on a Monday, so assignments will be needed earlier than ever before.]
    - This issue has gotten much more complicated as pay for competing jobs increased since last year, but the university has not approved budget requests to raise student worker pay about $8/hr. The result is that we are extremely stretched in our teaching pool. For summer 2022, for example, nearly 1/3rd of lab sections are being direct-instructed by a staff instructor due to low number of applications for student workers in the summer.
    - We did reach out to a much wider audience of potential workers, sending applications for Fall 2021 and Spring 2022 to all students that had a chemistry course in the previous year. This offset application loss somewhat, but not completely.

New Plan for Continuous Improvement (BS Chem)

Closing Summary:

This year represented a partial return to normal, and allowed a better perspective to see the aftermath of COVID and what challenges will linger form the limits of teaching during the pandemic.

- A specific area to target for improvement is student knowledge of Organic Chemistry. Sophomore-level Organic Chemistry (CHEM 2323/2123/2325/2125) is widely held to be the most difficult set of courses in college regardless of major, so a challenge for it is not new. To increase student knowledge and retention and better measure it we will
    - Start giving American Chemical Society Organic Chemistry standardized exams at the start of CHEM 3438 Biochemistry I during lab time, to measure knowledge that is pre-requisite to that course. [Carried out by Dr. Donovan Haines.]
    - Spend more time during in-class activities in CHEM 3438 Biochemistry I lecture on practicing writing organic structures and using organic concepts. These concepts are very central to Biochemistry I, and already activity-based assignments exist that involve peptide and metabolite structure. These will be expanded to increase practice and discussion (class time in the course is largely discussion and practice, it is a flipped format where content presentation happens outside of class time). [Carried out by Dr. Donovan Haines]
- Our assessment of General Chemistry knowledge didn't work very well, but success rates in the General Chemistry courses have separately been observed to be quite low. To address these issues, we will
    - Start giving American Chemical Society General Chemistry standardized exams at the start of CHEM 3438 Biochemistry I during lab time, to measure knowledge that is pre-requisite to that course. [Carried out by Dr. Donovan Haines.]
    - As part of a Provost and COSET Dean's Office initiative, a working group was formed to address low CHEM 1411 and 1412 success (grades of C or higher) rates. These efforts are leading to a lot of additional student supports being developed for Fall 2022 (primarily for the first step, CHEM 1411), ranging from mentored study groups to learning frameworks (study skills etc.) presentations during lab time the first two weeks of classes, and additional advisor and instructor resources being developed to support student success. This effort will also produced detailed success data, some of which was generated Fall 2021 but the full extended dataset will be produced in Summer 2022. [This is carried out by a team composed of chemistry personnel Dr. Adrian Villalta-Cerdas, Dr. Dustin Gross, Dr. Christopher Zall, Dr. David Thompson, Steve Hegwood, and Dr. Donovan Haines along with input from the entire chemistry faculty and staff and collaboration/coordination with the Academic Success Center led by Dr. Mary Catharine Breen, the STEM Center led by Dr. Taylor Martin, and the COSET Dean's Office led by Associate Deans Dr. Melinda Holt and Dr. Li-Jen Lester along with input from the campus PACE Center.]
- We always strive to improve writing and presentation skills. Although all criteria were met in these areas, we will continue to
    - Improve undergraduate seminar (CHEM 4100) by honing the research topic selection process to help student broaden their background. [Dr. Dustin Gross]
    - Collect more specific feedback from students about how to balance the excessive workload that comes with a high level of writing practice with the low level of writing improvement that comes with a low level of writing practice. We will interview teaching assistants of CHEM 3438 and ask students about this specific issue on post-course surveys for the course in the coming year. [Dr. Donovan Haines]