College of San Mateo — Program Review Submission

2014-2015 Instructional Program Review

Program Name: **Chemistry**
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1. Description of Program

Provide a brief description of the program and how it supports the college's **College Mission and Diversity Statements**, **Institutional Priorities, 2013/14-2015/16**, **5 in 5 College Strategies, Spring 2011**, and other **Institutional Program Planning** as appropriate.

The Chemistry program offers the first two years of chemistry courses to serve two major tracks:

1)The first two years of chemistry are required for a baccalaureate in various majors such as biology, chemistry, and engineering.

2)Various chemical courses are required for certificate or two year programs such as nursing, dental assisting, and lab technologist.

Which track a student will take depends on their educational goals. Both tracks align with the Board of Trustees' Core Value of a Student-Centered Mission, as well as College of San Mateo's Mission Statements.

The chemistry program supports the College Priorities as identified in the mission statement.

1. Improve Student Success and
2. Promote Academic Excellence

The faculty are continually engaged in developing and utilizing new teaching methodologies to improve student success and promote academic excellence. Examples of efforts in these areas include but are not limited to introduction of Reading Apprenticeship, efforts to seek funding and other resources to introduce supplemental instruction, team evaluation of laboratory manuals and development of new laboratory experiments, introduction of teaching videos for key organic chemistry techniques, active involvement in the integrated learning center to provide tutoring help to students and overhauling the data acquisition system in our laboratories. The faculty have been working closely with third party providers such as Sapling learning, McGraw Hill and Pearson publishing to identify and try out online homework support/learning systems for our students. We also work with the CSM learning center in identifying and supporting tutors there.

3. Promote Integrated Planning, fiscal stability and efficient use of resources

Efficient use of resources is another area we focused on this past year. Recognizing the increasing demand on our laboratory technician, we are reviewing all experiments offered and are aiming to narrow them down to a standard set of experiments which instructors may choose from. This makes technical support more efficient and provides more consistency to different sections of the same course. One outcome of the streamlining of the technical support turns out to be the need to secure additional funds for glassware and equipment as multiple sections will be conducting the same experiments at the same time. The department plans well. Working closely with the division dean, course offerings fill and, overall, meet student demand quite well. The load for chemistry always exceeds 500.

4. Enhance Institutional Dialogue

Faculty from the department participate in institutional dialogue by participating in student success initiatives such as reading Apprenticeship (RA) and outreach (Family Science Day). Department faculty are also members of College committees such as CSM Scholarship Committee, Reading Apprenticeship (RA) Committee and the Division Technology Committee.

Courses offered in chemistry include:

Chem 192 Elementary Chemistry – a first introductory course in chemistry for non-science majors, remedial preparation or some certificate programs. Prereq: Math 110 or one semester algebra. Recommended: enroll concurrently in MATH 115 or MATH 120 or 122.

Chem 210 General Chemistry I – first semester general chemistry for science majors. Prereq: MATH 120 with a grade of C or higher and CHEM 192 with a grade of C or better or equivalent; eligibility for ENGL 838/848 and one course in physics.

Chem 220 General Chemistry II – second semester general chemistry for science majors. Prereq: Chem 210 with a grade of C or higher.

Chem 231 Organic Chemistry I – first semester organic chemistry for science majors. Prereq: Chem 220 or 225 with a grade of C or higher.

Chem 232 Organic Chemistry II – second semester organic chemistry for science majors. Prereq: Chem 231 with a grade of C or higher.

Chem 250 Analytical Chemistry Quantitative Analysis – Introduction to chemical analytical procedures. Prereq: Chem 220 with a grade of C or higher.

Chem 410 Health Science Chemistry I – a first introductory course in general chemistry for some health professions. Prereq: None Recommended: MATH 110 or one semester course of algebra, eligibility for ENGL 848.

Chem 420 Health Science Chemistry II – a first introductory course in organic/biochem for some health professionals. Prereq: Chem 410 with a grade of C or higher.

Chem 680 MA (will be taught as Chem 100 starting Fall 2015) – Survey of Chemistry - an experiment online course; one of the first two XLO online courses offered at CSM. There are no prerequisites for this course, which is recommended for non-science majors or as an exploratory course for further studies in chemistry. (AA)

2. Student Learning and Program Data

A. Discuss Student Learning Outcomes Assessment

1. Reflect on recent SLO assessment results for courses offered by the program. Identify trends and discuss areas in need of improvement.

The Chemistry department is current with our SLO assessments in all courses. There is close coordination and collaboration between fulltime and part-time faculty in designing, implementing and reviewing our SLO process. In addition, our SLO assessment schedule master plan, SLO statements as well as assessment resources and data are all centrally stored and accessible on our departmental WebAccess.

Below is our results and reflections on SLO assessments on all chemistry courses.

Chem 210 - This course's SLO's were assessed in fall 2014. SLO 1 was the final exam question "Carbon obeys the octet rule". The student had to score at least a C on the question to consider it as meeting the SLO criterion. 78% of the 45 students assessed answered this question correctly thus meeting the success criterion. SLO 2 was the Hess's Law day 2 lab report grade. The student had to score at least a C on the lab report to consider it as meeting the SLO criterion. All of the 45 students assessed earned at least a C on this lab report thus meeting the success criterion. SLO 3 was the final exam question "Methane has a 90 degree bond angle." The student had to score at least a C on the question to consider it as meeting the SLO criterion. 84% of the 45 students assessed answered this question correctly thus meeting the success criterion. SLO 4 was the final grade in the lab portion of the course. The student had to score at least a C in the lab portion of the course in order to consider it as meeting the SLO criterion. All of the 45 students assessed earned at least a C in the lab portion of this course thus meeting the success criterion. The chemistry department feels that no action is required at the present time. It should be noted that this course will be assessed again in fall 2017. As of fall 2014 Chem 192 was reinstated as a prerequisite for the Chem 210 course.

Chem 220 - This course's SLO's were assessed in spring 2014 using the performance on three questions on the final exam. The student had to score at least a C on the question to consider it as meeting the SLO criterion. The question for SLO 1 had 73.9 % of the 88 students taking the final exam scoring at least a C. The question for SLO 2 had 85.2% of the 88 students taking the final exam scoring at least a C. The question for SLO 3 had four parts. Part A had 90.9% of the 88 students taking the final exam scoring at least a C. Part B had 93.2% of the 88 students taking the final exam scoring at least a C. Part C had 96.6% of the 88 students taking the final exam scoring at least a C. Part D had 89.8% of the 88 students taking the final exam scoring at least a C. The chemistry department feels that no action is required at the present time. It should be noted that this course will be assessed again in spring 2017.

Chem 250 This course's SLO's were assessed in fall 2009. The student had to score at least a C on the lab report for SLO 1 and 4, questions on the final exam for SLO 2 and 3, lab notebook for SLO 5 and received at last a C on all of the written lab reports for SLO 6 to consider the assessment as meeting the SLO criterion. For SLO 1, all 15 students received an A on the lab report. For SLO 2 and SLO 3, all 15 students scored at least a B on these questions on the final exam. For SLO 4, 14 out of the 15 students received an A on this lab report indicating that they were capable of preparing standards and using a calibration curve. The 15th student was absent on day 1 of the lab but on day 2 of the lab received an A for that portion of the lab indicating the student was also were capable of preparing standards and using a calibration curve. For SLO 5, all 15 students earned an A on their lab notebook. For SLO 6, All of the students received at least a C on all on the written lab reports and by the second half of the semester all of the students were earning at least a B on the written lab reports. All 6 of the SLO's met the criterion. The chemistry department feels that no action is required at the present time. It should be noted that this course will be assessed again in fall 2014. This course was not assessed in Fall 2014 as it has been cancelled. It is being offered in Spring 2015.

CHEM 192 was assessed in Fall 2014. Students' attitudes and perceptions were assessed using a Likert-type scale applied to quick write responses. 90% or more of students agreed or strongly agreed that requirements for SLO1, SLO2, and SLO3 were met or exceeded. The chemistry department feels that no action is required at the present time. This course will be assessed again in Fall 2017.

CHEM 231 was assessed in Fall 2014 and is due for assessment again Fall 2017. SLO statement 3 was assessed - "Demonstrate understanding of theories of stereochemistry and relate theories to structure and properties (Comprehension/analysis). Assessment is based on question on final exam given on 12/17/14. In summary: success criteria was set at 75% of students passing with a grade C or better. In all, there were 33% grade A's; 51% AB's, 86% ABC's. Therefore, 86% of the class passed with a grade C or better. Criterion is met and no modification needed for this SLO.

CHEM 232: All 6 SLO's were assessed during Spring 2013 on multiple dates: 5/22/13 – SLO 1 & SLO3; 4/17/13 – SLO2; 2/22/13 – SLO 4;

1/25/13 – SLO 5. Assessment methods included multiple choice questions, short answers and questions involving mathematical analysis. All assessments were instructor graded. In all cases, proportion of student ranged from 80 – 86%). Therefore, all SLO goals were met and no modification recommended to the SLO's.

CHEM 410 assessment will continue to use a student attitudes and perceptions' instrument using a Likert-type scale. SLOs were assessed for all chemistry 410 courses in 2014 and will be reassessed 2017. Here are the SLOs for CHEM 410:

Students agreed/highly agreed (94%) that they were better able to understand the nanoscale particle nature of matter (SLO 1).

Students indicated that they were better able to represent the chemical elements and chemical compounds after having taken this class: 94% agreeing/highly agreeing (SLO 2).

Students indicating that they are more able to work quantitative problems involving concentrations, and other chemical calculations after having taken this class: 87% agreeing/highly agreeing (SLO 3).

We are pleased that each of these three SLOs' of CHEM 410 demonstrated such high success rates. Efforts are ongoing to ensure that the materials taught in these classes align with student needs across all three campuses of the district. Because the content need and intended audience varies at each of the sister colleges, efforts are underway to rename and renumber this course at the three colleges. CSM Chemistry is in close communication with the interested parties at our sister colleges as well as counseling.

CHEM 420 assessment will continue to use a student attitudes and perceptions' instrument using a Likert-type scale. SLOs were assessed for all chemistry 420 courses in 2014 and will be reassessed in 2017. Here are the SLOs for CHEM 420:

Students indicating that they are better able to represent chemical reactions and biochemical mechanisms: 94% agreeing/highly agreeing.

Students indicating that they are better able to solve quantitative problems involving behavior and reactions of various chemical substances: 78% agreeing/highly agreeing.

Students indicating that they are more familiar with organic functional groups and their reactive behaviors as well as the complex biologically relevant chemical systems: 89% agreeing/highly agreeing.

We are pleased that each of CHEM 420's three SLOs demonstrated such high success rates. Still greater care in the presentation of labs is needed. CSM Chemistry are in the process of expanding our online WebAccess course specific pages that will provide our students with greater information to help them succeed.

2. Comment on the success rates in the program SLOs that are aligned with specific course SLOs. What do the program SLO and course data reveal about students completing the program? Identify trends and discuss areas in need of improvement. Is the alignment between course and program SLOs appropriate and informative? See **course-to-program SLO alignment mapping**.

CSM Chemistry Program SLOs are:

- Demonstrate preparedness to transfer to a 4 year institution.

- Critically analyze and apply general chemistry and organic chemistry concepts (Critical Thinking.)
- Perform quantitative analysis relating but not limited to graphical and numerical data obtained from laboratory experiments, and apply general chemistry and organic chemistry theories to solve problems (Quantitative Skill.)
- Effectivity explain general chemistry and organic chemistry theories and concepts (Effective Communication.)

After reviewing individual course SLOs of the chemistry classes offered at CSM, all assessed SLOs demonstrated varying degrees of success. Each course has its own set of SLOs as well as assessment instruments used.

The department has demonstrated a high success in the course SLO's and it can be assumed that this will translate into success in the program. It is difficult to predict trends as the sample size for the program over the past two years has been 8 students. It is likely that the sample size will remain small. CSM Chemistry will continue to take in data as it becomes available.

3. Evaluate the program SLOs in relation to survey data from the degree and certificate award earners survey. What does the survey data reveal about the effectiveness of the program SLOs? Identify trends and discuss areas in need of improvement.

There are four program SLOs for chemistry. In summary, they require that students analyze and apply chemical principles, demonstrate preparation for transfer, understand concepts and demonstrate analytical and laboratory skills. The SLO Survey of Degree Applicants shows that 100% of the students agree, or strongly agree that they are successful in all four program SLOs. In fact, for three out of 4, 75% of the students strongly agree that they have met the SLO. The data demonstrates that the combination of instructional techniques used by the chemistry faculty are successful.

While this is gratifying, the student sample was small (8 students) and continued tracking of the date will be needed to ensure success. Also, 75% leaves room for improvement and suggest a continued focus on student success. Finally, it should be expected that the sample size will probably always be small for chemistry as students are usually taking chemistry to satisfy another major like biology or engineering.

4. Describe any additional methods used to assess program SLOs and reflect on the results of those assessments.

The 4th program SLO states "Perform quantitative analysis relating graphical and numerical data obtained from laboratory experiments, and apply chemistry theories to solve problems". It might be possible, for the more advanced courses, to design a laboratory practical in order to test this SLO more specifically. In essence, after a student has moved into the more advanced chemistry courses, create a context for them to actually demonstrate accomplishment of this SLO. This idea is being tested out in organic chemistry to see its applicability.

Practical sessions are held in the organic chemistry laboratory where students are tasked with establishing the identity of an unknown compound based on various sources of qualitative and quantitative analysis. These exercises require the student to utilize a broad range of acquired skill and knowledge. These exercises are carried out in a workshop setting and are too long and involved to qualify as an examination. In future a rubric to assess the success of the students could be developed.

In the meantime CSM Chemistry will remain using Student Attitudes and Perceptions, vetted questions from quizzes/tests, and/or written work as our primary assessment instrument, selecting those that are deemed most appropriate for the situation at hand.

5. For any courses in the program that satisfy a GE requirement, which GE SLOs are supported or reinforced by the course SLOs? What do assessment results for the course SLOs reveal about student attainment of the GE SLOs? See **GE SLO Alignment Summary Report** or **All Courses GE SLO Alignment Data**.

Every chemistry course has a minimum of 3 SLOs that support quantitative skills and critical thinking. Chemistry 220 (second semester general chemistry) and chemistry 232 (second semester organic chemistry) have 4 SLOs supporting reinforcing these General education

(GE) SLOs and chemistry 250 (analytical chemistry) and chemistry 231 have 6 SLOs reinforcing these two GE SLOs. Every chemistry course has at least 1 SLO that supports effective communication. Chemistry 250 and chemistry 410 (health sciences chemistry) have 2 SLOs reinforcing this GE SLO and chemistry 210 and 232 each have 3 SLOs reinforcing this GE SLO.

As discussed in section II, A 1, assessment of students demonstrates very positive outcomes for course SLO success. It is reasonable to infer that the successes of these course level SLOs will translate to success with their GE SLOs.

B. Student Success Indicators

1. Review **Student Success and Core Program Indicators** and discuss any differences in student success indicators across demographic variables. Also refer to the **College Index** and other relevant sections of the **Educational Master Plan: Update, 2012**, e.g., Student Outcomes and Student Outcomes: Transfer. Basic Skills programs should also refer to **ARCC** data.

The student success indicators for the 2013-2014 academic year were 74.4% success and retention of 85.1%. These numbers were comparable to values from the previous year values for the chemistry department with a very slight downward trend.

The success value of 74.4% was higher than the division value at 65.5% and in line with the overall college value of 70.2%. The retention values for the chemistry department held relatively steady from 86.9% in 2012-2013 to 85.1% in 2013-2014. The retention value of 85.1% is in line with the retention value for the division at 80.8% and the overall college retention rate of 84.1%.

Overall our retention rates for our all demographics either increased or remained stable. Across all of the demographics there was a marked increase in the success indicators.

For the demographic identifying as black the percent success in 2013-2014 for the chemistry department was 26.3% (19 students). This value is significantly lower than 81.3% (16 students) in 2012-2013 and lower than the value for the division 51.7% (408 students) and college overall, 61.2% (1772 students).

The retention rate in the chemistry department for the black demographic dropped from 87.5% for the 2012-2013 academic year to 63.2 % 2013-2014.

No individuals identifying as Native American enrolled in the Chemistry course in the year 2013-2014.

The retention rate of the demographic identifying as Hispanic remained stable with a retention rate of 80.0% for 2013-2014 which is in line with the division retention rate of 75. % and the overall college retention rate of 81.3%. For the demographic identifying as Hispanic the percent success in 2013-2014 for the chemistry department was 64.7% which is a slight increase from the value of 59.2% in 2012-2013 for the chemistry department. The success rate was slightly higher than the division success rate at 55.2% and the college success rate of 62.9%.

The enrollment identifying as Pacific Islanders saw a drop in enrollment from 14 students in 2012-2013 to 7 students in 2013-2014. The retention rate of the demographic improved giving a rate of 86.7% in 2013-14 with a retention rate of 71.4% for 2012-2013. The retention rate for 2013-2014 was in line with the division retention rate of 76.5% and the overall college retention rate of 82.7%. For the demographic identifying as Pacific Islander the percent success in 2013-2014 for the chemistry department was 14.3%, which is a drop from the value 57.1% in 2012-2013 for the chemistry department. The success rate was lower than the division success rate at 49.6% and the college success rate of 60.6%.

There has been a significant drop in the percent success of both groups identifying as black and pacific islanders (26.3% and 14.3 % respectively. This drop in success is reflected in a lower retention rate for students identifying as black (63.2% retention) whereas the group identifying as Hispanic show an upward trend to increased retention ((80% retention).

2. Discuss any differences in student success indicators across modes of delivery (on-campus versus distance education). Refer to **Delivery Mode Course Comparison**.

CSM Chemistry courses are, almost exclusively, offered on campus. Every class, except one (chemistry 680/ Chem 100 from Fall 15) has a laboratory component, which must be done on campus. As chemistry 680 (Chem 100) was previously a television course, and has not been offered in many years, there really is no comparative data for student success in face-to-face vs online.

However, with some courses (chemistry 231 and 232) faculty began increasing the use of WebACCESS in 2012. We anticipate having enough annual data from chemistry 231 and 232 to perform meaningful descriptive statistics by 2016. At this time, every chemistry course is using WebACCESS in addition to other web-assisted technologies. Faculty are increasingly using online technologies to enhance their classes: video recording of live lectures, pre-recorded laboratory demos for lab experiments, online homework systems and use of WebAccess for posting lecture materials, assessment, communication and grading.

No quantitative assessment is available thus far, but there is a definite cultural change in the way students expect and sometimes directly request such resources. One faculty member is working to make these online resources into a library for use by all faculty, full time and part time.

C. Program Efficiency Indicators. Do we deliver programs efficiently given our resources?

Summarize trends in program efficiency as indicated in the **Student Success and Core Program Indicators** (LOAD, Full-time and Part-time FTEF, etc.)

The three-year average LOAD using Fall, Spring, and Summer sessions has soared in recent years and is now at 635.5 (WSCH/FTEF) with the latest year available (Summer 2014) showing a net increase of 5% from this composite average value.

Adjunct FTEF has remained steady around its three-year averages. A new chemistry adjunct instructor was added to the department in this year.

Overall, these measures of program efficiency suggests that the CSM Chemistry department has seen a greater demand, as demonstrated using LOAD (averaging above 620) compared to a college LOAD of 533 and FTEF (averaging 100). The high load places stress on all our available resources.

The Biology, Chemistry and Physics departments have coordinated the scheduling of the major courses so that students have a clear path to scheduling their required classes efficiently. This is an essential consideration for students who are transferring which are the majority of our students in Chemistry.

3. Additional Factors

Discuss additional factors as applicable that impact the program, including changes in student populations, state-wide initiatives, transfer requirements, advisory committee recommendations, legal mandates, workforce development and employment opportunities, community needs. See **Institutional Research** as needed.

After studying the information on the Institutional Research web-page a number of interesting factors can be identified:

- 0.3% of CSM students declared chemistry as a major in fall 2012, but greater than 50% of CSM students identify transfer as a goal. This confirms faculty observation that, while there are not many chemistry majors, sections fill quickly and so load is high
- CSM's percent of total district enrollment has declined from 50% in fall of 1985 to 37.1% in 2012. Faculty have observed anecdotally that more students are taking classes at 2 or more colleges. CSM is not their sole educational choice.
- Among the top 50 county employers you find companies like Tesla, Applied Materials Inc., and Lawrence Livermore Laboratories. Among the top 50 occupations in the county you find nursing and healthcare (job increase projection of 22% from 2011 to 2017), healthcare technicians (job increase projection of 14%) and life scientists (job increase projection of 7%). While there are many other examples, all these employers and each of the job categories require knowledge of chemistry, though not necessarily a chemistry degree.
- The 4th and 5th most popular majors declared by incoming students are nursing and biology. A strong background in chemistry is required for both of these majors.
- Better than 50% of students taking the placement exams place into basic skills mathematics. An interesting thing about chemistry is, chemistry homework problems are actually a very prescribed set of word problems in mathematics. As students struggle with traditional mathematics courses, their struggles are also reflected in chemistry.

4. Planning

A. Results of Program Plans and Actions

Describe results, including measurable outcomes, from plans and actions in recent program reviews.

Plans to improve the health and safety of the stock room and the laboratories are currently in progress. An environmental assessment has been carried out and we are waiting on the recommendations of the engineers to determine how to install chemistry storage cabinets with better ventilation. In addition, the engineers are examining options to install additional hoods in two of the chemistry laboratories. This will increase both safety and success for students in chemistry laboratories. More hoods mean more student work in a safer environment. More hoods also means more students working at one time and not sitting at benches awaiting their turn and possibly disrupting experimental results.

A new Infrared spectrometer will be purchased before the end of the 2015 academic year. The acquisition of a new instrument will help with student throughput efficiency in the laboratory. The new instrument is designed to be robust and require minimal maintenance which will satisfy our intention to optimise or efficiency and resources.

SI has been introduced into general chemistry 210 classrooms and the OChem 231 classroom. Plans to continue the SI program and expand it into the Chemistry 410 classroom offering are underway and will be implemented in the Fall of 2015.

The Chemistry 250 class offering will be banked and Spring 2015 is the last semester it will be taught for the foreseeable future.

The Chemistry 680 XLO (Chem 100 Fall 2015) class is live and currently has 17 students enrolled and 2 tutors. This is the first semester of it being offered and it is still in the testing phase. Efforts are being made to increase awareness of the class within the community to increase enrollment. The course aims to have enrollment of up to 100 students with a tutors: student ratio of 1: 25. The balance of tutors: student is important in maintaining the balance between class size and effective teaching contact time. The tutors primary duty is to assist the instructor in Web Access management so that the instructor can focus on the teaching and assessment portions of the class.

The purchase of 40+ google chromebooks have been a smashing success. These computers provide near instant access to our students to such web assets like WebAccess. Furthermore, due to these devices being thin clients (i.e. no software/OS/hardware) that may become damaged or in need of expert configuration – these units have had 100% uptime. These units have permitted our students to not worry about "learn about…using a computer" instead our students "use a computer…to learn". Instructors also love these units due to their lightweight design, 10 hour battery life, and connecting students to cloud resources already provided by the college. The introduction of this technology has increased access to on-line tools that would normally be used as out of class resources such as homework and study packages. It is now possible to use these powerful tools in a classroom setting as all students can have access to the technology at one time.

The MeasureNet laboratory system has had three new computers to replace failing ones. These new computers have helped to stabilize the system. Also, the department received factory training on the system's newest capabilities. This day long training was greatly appreciated and well received. Further refurbishment of the systems individual components will take place this coming year.

In response to the college's documented need for a focus on student success faculty are involved in programs designed to directly improve student success. Catherine Ciesla is continuing to use tools learned from district-wide Reading Apprenticeship (RA) program in her classes as well as participating at the state level in a Science, Technology, Engineering, and Math (STEM) Think Tank working on the development of curriculum for the training of science faculty. A qualitative assessment has shown that when RA techniques are employed in the classroom that students are more engaged in classroom discussions and take more ownership of their own learning process. Yin Mei has begun to introduce elements from the "flipped-classroom" approach to a 410 class. No data is yet available, but student feedback is highly encouraging of this method of content delivery. Chemistry faculty are actively involved in the Integrated Science center with two full time faculty members and three part time faculty holding their regular office hours in the center.

B. Program Vision

What is the program's *vision* for sustaining and improving student learning and success over the next three years? Make connections to the **College Mission and Diversity Statements**, **Institutional Priorities, 2013/14-2015/16**, and other **Institutional Program Planning** as appropriate. Address discussion in the Student Learning and Program Data section: SLO assessment results and trends in student success indicators.
[**Note**: Specific plans to be implemented in the next year should be entered in C of the Planning section.
CTE programs must address changes in the context of completion and employment rates, anticipated labor demand, and any overlap with similar programs in the area as noted in D1 and D2 of the Career Technical Education section.]

As a department, our vision for the program over the next three years is in line and supportive of the college mission statements and institutional priorities. Faculty members are in the process of reviewing and modifying existing general chemistry 210 laboratories so that they are reflective of our students needs and learning modalities. The laboratory program will be more representative of the technological and informational demands placed on our students in a global economy (IP3: Develop responsive, high quality programs and services). Over the next three years we intend to expand the review of laboratory classes to other courses offered. The review of the teaching materials used in the laboratory classes will be carried out by working closely with adjuncts who are often the main users and implementers of the material(IP3: Develop responsive, high quality programs and services).

Our improvement in teaching materials has started to extend beyond the laboratory and will continue to do so over the next three years. The improvements are guided by the principles that they have to meet student needs and increase accessibility to the material. This works to benefit all of our students and is in line with our student equity plan. For example, the Chem 680 online course developed by Yin Mei Lawrence is in the process of translating videos into mandarin for overseas students, this could be expanded to other video materials to increase accessibility for ESL students. Faculty members will continue the research and implementation of text and online resources such as effective online homework systems that have been shown to improve student success (IP1:Improve student success). For example Catherine Ciesla has been working closely with publishers to identify new skills based texts that better facilitate the learning of our students as well as researching on-line homework based programs that can test critical thinking and give immediate feedback to the student. These are invaluable teaching tools and over the next three years we plan to assess and adopt other materials that will improve and support our students learning (IP1:Improve student success).

One of our aims as a department is to establish a catalogue of the highest quality teaching materials that cover the foundation concepts for individual courses. These materials will cover a range of teaching modalities that will meet students diverse needs based on their availability of time, learning preferences and need for multiple exposures to the same concept. This catalogue of materials, be it video resources, lecture images or subject lesson plans, will be available to all faculty via WebAccess. The need for this resource is based on the reality that a significant proportion of our general chemistry classes are taught by adjunct faculty who are working at multiple schools. Having resources available on a centralized location leads to a faculty who are efficiently prepared with materials that we as a department have approved as being of the highest quality and responsive to the needs of our varied and diverse group of students(IP1, IP2, IP3). It also moves us towards providing a consistent experience for our students so that they can expect a similar high quality experience with all of our instructors.

The development of a centralized catalogue of course material is also to support the professional development of our adjunct faculty who play a critical role in the department. As a department we are adopting methodologies such as reading apprenticeship (RA) and flipped classrooms as a way of engaging and stimulating critical thinking in our students. This style of teaching requires teaching materials and resources and having them available to all faculty members removes barriers to faculty who may not have used the methodologies but are interested in implementing them in their classrooms (IP4). Two faculty members are already involved in professional development (Reading Apprenticeship) that aims to develop pedagogies that facilitate learning as opposed to simple consumption of information.

Training that is less content focused and more students learning focused, allows us to prepare better teaching materials and better serve our students in how we communicate with them within our virtual and physical classroom. In the next three years our aim is to increase the number of faculty members who participate in student focused training programs with a view to incorporating methods into their teaching. There is a distinct need to provide access to this training to our adjunct faculty so a further aim is to increase awareness within our adjuncts of the availability of these professional development opportunities.

The department currently has a group of adjuncts that are very committed and experienced and are very self-sufficient. As a result of reviewing and implementing changes to our curriculum it has become clear that our adjuncts require more communication and support of these changes and new expectations. Going forward we envision greater communication and input from our adjunct faculty with regards to the effectiveness of changes implemented and their views on what issues need to be addressed to benefit our students. This will be implemented in the form of more regular meetings which up until now have been infrequent and disjointed. The development of effective communication between full time and part time faculty is proving to be essential as our people are our most valuable resource and it is important that they are employed effectively and their time used efficiently (IP5).

Increasingly the chemistry faculty are contributing to college wide efforts to improve student learning support. In addition to working with the Learning Center in recommending tutors, we are also offering to work more closely with tutors to better serve students. Faculty are involved in crafting proposals to include collaborative workspaces within the new Emerging/Innovative Technologies Building. Students would benefit from such workspaces – a “design space” equipped with whiteboards, multi-purpose computer labs, and a “tech shop” to support prototyping – would allow students to work in interdisciplinary teams and extend what they learn in the classroom to more advanced projects. Students would gain hands-on experience as they prepare for internships and transfer. Projects could go beyond what is currently possible in a single course – and limited by our lab facilities - making it easier to attract support from local businesses and industry. The faculty is keen to offer special projects to interested and able students. These projects benefits students not just in content learning, but also promote deeper supervised-but-independent learning as well as providing research opportunities. Currently, our ability to offer these special projects is limited by availability of resources. We would therefore greatly enhance our ability to offer special projects and other student-success centered activities if there are more learning spaces available. We therefore very much look forward to working with faculty in other

disciplines to develop the physical and curricular infrastructure for this effort.

Chemistry department faculty have been key members of the division technology committee. As such, they have taken the lead with other science faculty on professional development of science faculty and other faculty across the college. For example, the technology committee has offered more than one workshop on the use of WA as flex activity. Workshops were well attended and we will continue with identify faculty technology needs and provide leadership and assistance as necessary. (IP6 – institution dialog; IP5: promoting integrated planning). Over the next three years the faculty will continue to take a lead role on campus and within the district with respect to the introduction of and the support of new technology training for faculty.Chemistry faculty are also involved in a statewide initiative to develop professional development curriculum for instructors in the STEM disciplines. The development of these materials is to equip faculty with the tools to effectively teach students reading skills and strategies in their specific discipline (IP4: Support Professional Development). Catherine Ciesla will act as a mentor in July of this year as part of the West Ed. run 3 day STEM institute.

If we are to continue teaching effectively, as well as to develop our programs in line with College vision and institutional planning, we need additional resources and support from college administration. While reviewing testing of new Chem 210 laboratory procedures it became clear that the time available to commit to this endeavour was limited due to faculty teaching load and college commitments. For the efficient development of high quality teaching materials, the full time faculty need to have release time to focus on these projects so that they can be done thoroughly and in a time efficient manner.

1. To guide future faculty and staff development initiatives, describe the professional activities that would be most effective in carrying out the program's vision to improve student learning and success.

A large part of our program vision is the development of new teaching materials, initially the updating of laboratory practical lessons. In the Fall of 2014 we worked to identify 4 labs that would be good replacements for the Chem 210 general lab. It is clear, after carrying out that exercise, for the department to identify, select, try out and then introduce new labs in a time efficient manner, it is essential that the faculty have the opportunity to have release time to focus on these projects.

It has been noted that the introduction of the fully online distance education course Chem 680 (Chem 100 from Fall 2015) is particularly appealing to overseas students many of whom are mandarin speakers. The faculty have been working to make videos accessible to these students by captioning videos in mandarin. For the instructor of the Chem 680 course there is a desire to learn mandarin in order to better communicate with these students.

The introduction of new teaching materials and a desire to focus on more student learning focused methods of content delivery requires that we have trained faculty that understand how to create these materials and how to effectively use them. With this in mind, the faculty would like to be able to attend conferences focused on new teaching methods and the use of technology in the classroom.

2. To guide future collaboration across student services, learning support centers, and instructional programs, describe the interactions that would help the program to improve student success.

We would like to extend our collaboration with the learning center by not merely recommending tutors but working with their tutors in devising actions plans to make then a more effective resource for the students. For example, all tutors for say CHEM 210 could have regular meeting to exchange information such as tutor availability, and any content questions tutors may have.

It has been observed that incoming international students are choosing classes that are not necessarily the best fit for them given their preparation and language skills. Increased discussion with the Center for International Students with respect to course assignment for incoming students would help set the students up for success.

Increased discussion with counsellors to better understand the academic road map that is designed for students would help design efficient and effective paths to success for our students. These discussions could be in the form of faculty receiving training in how the students are advised in course choices.

The introduction and continued implementation of the SI program has been shown to have a direct impact on student success. The expansion of this program will lead to better integration of student support services and instructional services which is a direct path to student success.

Textbooks are a significant burden on our students. With textbook costing more than 200 dollars, the department could benefit from working with other divisions and student support services as to assuaging this large expense. Some instructors have reached out to the Library, Learning Center, ISC; placing books on reserve. This practice though needs to be more formalized.

Chemistry faculty continue to volunteer their time in the Integrated Science Center as a resource and continue their dialogue with the Learning Support staff in a Reading Apprenticeship (RA) Focused Enquiry Group.

3. To guide the **Institutional Planning Budget Committee** (IPBC) in long-range planning, identify any major changes in resource needs anticipated during the next three years. Examples: faculty retirements, equipment obsolescence, space allocation.

See the Resource Requests section below to enter itemized resource requests for next year.
Leave sections blank if no major changes are anticipated.

Faculty

We are requesting one full time chemistry faculty position. At the present time full time faculty must do overloads to cover all of the classes. At the present time there are 7 adjunct professors and only 4 full time professors. A member of the full time faculty is no longer able to do an overload due to the development of the new course Chem 680. For the department vision, the development of online classes, curriculum development for face to face classes and STEM reading apprenticeship, the faculty need release time to work on these things. Also, it is highly likely that one of the full time faculty members will retire within the next 2 years so plans to replace the position and integrate the person into the department before that time is essential for a smooth transition.

Equipment and Technology

In addition to incorporating online technology and teaching methodology into our courses for greater student success, we are also using technology to enhance intra- and interdepartmental collaborations. In the short term, fulltime and part-time faculty need better laptops to facilitate their work. In the medium to long term, we would welcome a college-wide program to provide additional equipment, training and support of use of technology in all STEM programs for students and faculty. The STOT1 and STOT2 courses are excellent and if they could be offered at times that were during the summer then the ability of full time and part time faculty to take advantage of them would be increased.

As online homework systems and WebAccess become more widely used in our courses, we need to ensure there is a sufficient number of work stations for students in the ISC/Learning center; and these centers should be open at hours that fully accommodate students'

schedules. For faculty, learning new technology is time-consuming and costly in terms of equipment (software and hardware), a centralized and well-equipped location (such as a STEM technology support lab) would maximize our efforts to learn and apply new technology into our teaching.

Our Chemistry supply budget of $10,500 for equipment and supply and various consumables have not changed over the past 8 years. The cost of many chemicals and supply has gone up ranging from 5-15% along with increase in shipping cost. For our students to remain competitive for transfer and in the current job market, it is essential for them to be exposed to a broad range of experimental methods and experience of handling hazardous materials. These experiments require the use of expensive glassware and chemicals. We need to have a gradual increase in supply budget in order to cope with higher material cost and inflation.

Equipment

1. The pH electrodes are reaching their lifespan and need to be replaced. We will need to purchase a minimum of 60 pH electrodes.
2. We may need to replace the data acquisition system with another type of data acquisition system. This will require at least 40 stations and 40 each of the corresponding probes that go with the new system.
3. We need to buy at least three more centrifuges.
4. We need to buy at least four more milligram balances.
5. We need to replace the DI water filters.
6. We need to buy at least 4 more UV/VIS spectrophotometers.
7. The GC/MS instrument can be used for demo purposes. This instrument requires preventative maintenance.
8. MeasureNet stations have been failing and require 10 replacements.
9. We need to replace 10 colorimeter probes for the MeasureNet stations.
10. Hoods require inspection and necessary repairs.

Glassware and other miscellaneous items

1. There is a high turnover of glassware as a result of student usage. It is essential to replace this glassware.
2. The last time we purchased full organic microkits (sets of equipment essential for organic labs) was in 2005. More glassware is needed: 20 more microkits.

3. We need to buy at least 20 silicone rubber hand protectors.

4. We need to buy 20 desiccant cartridges

Instructional Materials

1. Our s, p, d and f atomic orbital model sets are over 50 years old and are falling apart.. Having physical models available in the classroom allows us to introduce concepts through modalities that appeal to kinesthetic and 3D visual spatial learners. These models help bring alive a concept of atomic orbitals that is challenging but fundamental to the understanding of chemistry.

2. Water electrolysis and gas law demo kits. Large scale models of sodium chloride, water, graphite and diamond.

3. Replacement ACS exams.

4. Replacement calculators.

5. All of the equipment, glassware and miscellaneous items fall into this category as well as we need them to teach our classes.

Classified Staff

We would like to hire a part time person to help with the increased demands of the preparations for the chemistry labs. As we develop more intensive laboratory practicals, the complexity of the setup and logistics of preparation of these experiments are increasing. An alternative to having a part time person would be to have 2 student workers that work 10 hours per week.

Facilities

The volatile organic compounds are currently being stored in cabinets that are not vented. To maintain a safe working environment it is necessary that these chemicals are stored in a suitable cabinet that has appropriate venting. Two new cabinets are needed in the stock room and retrofitting of the vents in existing cabinets is required.

A Demonstration of the problem is shown in the following youTube link:

http://bit.ly/1GvGnFQ

In the general chemistry laboratories there are only single fume hoods in each laboratory. This leads to significant logistical and safety issues during teaching sessions. To effectively prepare our students for the workplace and their next academic institution they must receive rigorous laboratory training. Currently the fume hoods in the laboratories cannot adequately provide the right balance between efficiency and safety. The laboratory sessions require complicated logistical planning by the teacher. For example, a typical class has 30 students. Each fume hood can safely accommodate a maximum of 2 students at a time. If each student spends 3 minutes dispensing chemicals at the fume hood that amounts to 90 minutes spent only getting their chemicals. This can be further complicated if the students are working with chemicals that cannot be dispensed at the same time. It can take up to 45 minutes just to get the class equipped and ready to do their experiment. This is not efficient use of time or beneficial for their learning. It also poses real safety risks when working in the lab.

Plans are being developed to add more hood space to rooms 36-321 and 36-329. Following on from recommendations resulting from an

environmental assessment carried out by the Denali group in March 2014, it has been established that there is a need for one new fume hood in each of the two of the general chemistry laboratories. Currently there is no official timeline for the installation of these units and the project is on going.

C. Program Plans and Actions to Improve Student Success

Prioritize the plans to be carried out next year to sustain and improve student success. Briefly describe each plan and how it supports the **Institutional Priorities, 2013/14-2015/16**. For each plan, list actions and measurable outcomes. (Plans may extend beyond a single year.)

Plan 1

Increased Enrollment in New Course Offering

Starting this current semester (Spring 2015), we are offering an online chemistry class as an experimental course CHEM 680 MA (CHEM 100 from Fall 2015). The plan is to increase the visibility of the course and expand enrollment. This satisfies requirement of our Institutional Priorities (IP3: development of responsive high quality services, IP2: Promote academic excellence, IP1: Improve student success.)

Action(s)	Completion Date	Measurable Outcome(s)
In conjunction with the marketing department, increase promote the Chem 680 Class to the community. Chemistry debrief as to best practices at engaging and communicating with others	Spring 2016	Increased enrollment of the class.

Plan 2

Title:

Targeted Curriculum Development

Description

The faculty plan to continue the development of general chemistry materials primarily for the laboratory classes of Chem 210 and 220. Assessment of the laboratory offerings for Chem 410 and Chem 192 are also planned. This satisfies requirements of our Institutional Priorities (IP3:development of responsive high quality services, IP2: Promote academic excellence, IP1: Improve student success)

The faculty will create model courses of each course offering that will be placed on WebAccess as a centralized resource. This resource satisfies requirements of our Institutional Priorities (IP3:development of responsive high quality services, IP5:

efficient use of resources)

Action(s)	Completion Date	Measurable Outcome(s)
Create model courses for Chemistry courses that are available to all faculty.	Spring 2016	All Labs and supplementary lecture materials are available online.
Replace and/or adapt Laboratory procedures for Chem 210/220	Spring 2016	Identification of 4 labs per course that can be assessed and integrated into the curriculum.

Plan 3

Title:

Intra-department communication.

Description

The introduction of new teaching materials and methods of delivery and organization of those materials requires our adjuncts, those most affected by these changes, to be effectively trained and supported through the transition. A plan of the department is to increase the communication between adjunct and full time faculty and to use their experience of working at other institutions as a resource when designing and implementing curriculum changes.

This effort to incorporate adjuncts into the discussion of how best to realize the vision of the department is a newer approach but an important step towards making the department effective. This satisfies Institutional priorities; IP2: Promote academic excellence,IP5: Efficient use of resources and IP1: Improve student success.

Action(s)	Completion Date	Measurable Outcome(s)
Work collaboratively with adjunct faculty to discuss proposed curriculum changes and obtain feedback from adjunct faculty on the effectiveness of those changes.	Fall 2015 and Spring 2016	The introduction of new laboratory and class material that has been rigorously assessed and approved by the chemistry department faculty.

Plan 4

Title:

SI Instruction

Description

Supplemental instruction (SI) has been introduced into Chem 210 (first semester general chemistry) and Chem 231 (first semester organic chemistry). The inclusion of SI was based on strong evidence that the inclusion of an SI leaders significantly improves student success in the students courses. We plan as a department to expand SI leaders to Chem 410 classes and continue in OChem 231 class.

This satisfies requirements of our Institutional Priorities (IP2:Promote academic excellence, IP1: Improve student success)

Action(s)	Completion Date	Measurable Outcome(s)
Continuation and expansion of SI within Chemistry	Spring 2016	Effectiveness of the program will be assessed by the Learning Center.

5. Resource Requests

Itemized Resource Requests

List the resources needed for ongoing program operation.

Faculty

NOTE: To make a faculty position request, complete **Full-time Faculty Position Request Form** and notify your Dean. This request is separate from the program review.

Full-time faculty requests	Number of positions
Chemistry professors	1

Equipment and Technology

Description	Cost
MeasureNet - replacement controller system	5,000
MeasureNet Probes - various (aging out of instrumentation)	6,000
MeasureNet Station Replacements (10)	20,000
MeasureNet Colorimeter Probes (10)	1,800
Lab Laser Printers - Replacement units	3,000
pH Electrodes replacements (60)	9,000
Centrifuges (3)	1,800

Milligram balances (4)	14,400
DI water filters (12)	7,200
UV/Vis Spectrophotometers (4)	14,400
Glassware and miscellaneous items	29,000

Instructional Material

Description	Cost
Various models, demo kits, ACS exams, Calculators and other miscellaneous items	9,000

Classified Staff

Description	Cost
Part-time stock room person	$35,000

Facilities
For immediate or routine facilities requests, submit a CSM Facility Project Request Form.

Description	Cost
2 x fumehoods and vented cabinets for general chemistry labs & stockroom	500,000

6. Program Maintenance

A. Course Outline Updates

Review the **course outline update record**. List the courses that will be updated in the next academic year. For each course that will be updated, provide a faculty contact and the planned submission month. See the **Committee on Instruction website** for **course submission instructions**. Contact your division's **COI representatives** if you have questions about submission deadlines.
Career and Technical Education courses must be updated every two years.

Courses to be updated	Faculty contact	Submission month
Chem 220	Kate Deline	Fall 2020
Chem 231	Yin Mei Lawrence	Spring 2015
Chem 232	Yin Mei Lawrence	Spring 2015

The TBAs will be removed from all chemistry courses.

B. Website Review

Review the program's website(s) annually and update as needed.

Faculty contact(s)	Date of next review/update
Jeff Flowers	December 2015

C. SLO Assessment Contacts

Faculty contact(s)	Date of next review/update
Chem 210 Kate Deline	Fall 2017
Chem 220 Kate Deline	Spring 2017
Chem 192 Catherine Ciesla	Fall 2017
Chem 231 Yin Mei Lawrence	Fall 2017
Chem 232 Yin Mei Lawrence	Spring 2016
Chem 410 Jeff Flowers	Fall 2017
Chem 420 Jeff Flowers	Spring 2017