Chemistry Program Review
October 2015

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1. Program/Discipline Overview

A. What are the educational goals or objectives of this program/discipline?

Chemistry is a central discipline for biology, physics, engineering, allied health, medicine, pharmacy and liberal arts. As such, our goal is to prepare students who are continuing their education at a four-year institution, and to introduce chemistry as a science to students who need to fulfill a science requirement for a liberal arts degree, a career, or a technical training certificate.

How do these compare with national or professional program/discipline trends or guidelines?

"Chemistry is central to the intellectual and technological advances in many areas of science. The traditional boundaries among chemistry sub-disciplines are blurring, and chemistry is increasingly intersecting with other sciences. Unchanged, however, is the atomic and molecular perspective that lies at the heart of chemistry. Chemistry programs have the responsibility to communicate this outlook to their students and to teach the skills their students need to apply it"[1]

Have they changed since the last review, or are they expected to change in the next five years?

Our goals are in accordance with PCC core outcomes and national affiliations (ACS) and the goals have not changed since the last program review. However, we regularly revise and update our curriculum based on evolving technology advances and/or development. In addition the chemistry faculty are continually working to apply innovative teaching methodologies to achieve our goals.

B. Briefly describe changes that were made <u>as a result of</u> SAC recommendations and/or administrative responses from the last program review.

The following changes were made as of a result of the administrative response to the last program review.

The instructor qualifications were updated and are detailed in Appendix 1. In addition, there were numerous SAC-specific requests in our previous program review. Requests are detailed below followed by actions taken.

Faculty

Additional Faculty were requested at the Cascade and Rock Creek campuses. The Rock Creek campus added a full-time position effective during the 2011-12 academic year. After a faculty resignation in the fall of 2014, the position was eliminated. The Cascade campus shared a temporary full-time chemistry position with the Southeast campus. That Cascade position has now been moved to the Southeast campus. The net effect in full time faculty staffing is a reduction of one full time faculty member.

Laboratory Resources

There were several requests for increased staffing levels of laboratory technicians, additional laboratory equipment, and improvements in facilities.

Additional Lab Support

Sylvania hired (with temporary funding) a part-time (40%) lab assistant for the Spring 2010 term, and was expanded to 50% temporary since the 2011-12 academic year. This position is essential when night chemistry labs are offered for the safety of students and faculty. If this position is cut in the future, we will not continue to offer night labs. It should be noted that there has been a high turnover in this temporary 50% position, adding workload to remaining staff and faculty positions responsible for training/support as well as decreasing the functional efficiency of the stockroom.

[1] *This excerpt taken from the 2009 ACS (American Chemical Society) "Guidelines for Chemistry in Two-Year College Programs". It exemplifies the goals of the Portland Community College Chemistry SAC.*

Southeast shares one FT Instructional Support Technician (IST) with microbiology and geology/general science. The Cascade campus requested another 50% IST for physical sciences for the 2011-12 academic year. A 50% temporary position was created, but was strictly for physics and geology. This position is not being renewed for the 2015-16 academic year.

Additional Lab Equipment

There has been a significant investment in equipment since the last program review.

Sylvania: Campus Green Initiative Funds[2] "Ground Beneath Our Feet" Grant funded research/teaching equipment: Scanning electron microscope, Atomic Absorption Spectrometer, Gas Chromatograph/Mass Spectrometer.

Campus Green Initiative Funds "Storm Water Project" Grant funded the purchase of a set of 12 LabQuests and sensors used in the field for CH 100 and CH 151.

Division Budget Funding: two rotary-evaporators, set of 12 Vernier Gas Lamps and 6 sets of Gas Tubes, and a set of 12 milligram benchtop balances.

Rock Creek: Updated licenses for molecular modeling (Odyssey), a vented solvent cabinet, new lab stools for chemistry lab, Rotary Evaporator & Flasks, Stirring Hot Plates, and Parr 1341 Plain Jacket Calorimeter were purchased.

Cascade: Vernier mini gas chromatographs (GCs), UV visible-plus, and Mel-Temp melting point equipment was purchased and integrated into a variety of the classes offered at Cascade.

Southeast: Southeast campus chemistry labs are in a new facility that was not in existence for the last Program Review. Therefore, purchases have been extensive, including basic glassware and equipment, Vernier data loggers, sensors and software, and a Fourier-Transform Infrared Spectrometer (FTIR).

Additional Support Resources

The SAC has requested a variety of additional supports which include release time, paid meeting time, and administrative assistant support. These resources were requested to enable the SAC to complete work on assessments, tracking outcomes, course development, and professional development activities. The Administrative response to these requests has been to acknowledge their need without committing the requested funds.

"Many SACs have raised similar issues, and we are unable to make across the board commitments of funds for these requests. "

"This (Increased Dedicated Travel funds) is not a resource that we have the ability to reallocate to Division Deans."

2. Outcomes and Assessment: Reflect on learning outcomes and assessment, teaching methodologies, and content in order to improve the quality of teaching, learning, and student success.

As a SAC we have worked to improve our assessment of outcomes in classes across the district. Our efforts notwithstanding, assessment has become a large focus and struggle for our SAC. In recent years we have developed assessment tools and collected and interpreted the data, only to conclude that our tool was too broad or open-ended to analyze the results. In addition, the assessment goals and requirements as handed down by the Assessment Council have been somewhat of a moving target over the past few years. As a result of these struggles and uncertainties, in Fall 2014 our SAC decided on the course of action described in part B.

[2] *Sylvania Green Initiative Funds are separate from The Green Initiative Fund passed by the ASPCC District Student Council in 2008.*

A. Course-Level Outcomes: The College has an expectation that course outcomes, as listed in the CCOG, are both assessable and assessed, with the intent that SACs will collaborate to develop a shared vision for course-level learning outcomes.

i. What is the SAC process for review of course outcomes in your CCOGs to ensure they are assessable?

We have incorporated grading rubrics to assess student projects and laboratory reports in some of our classes. The rubrics help to ensure that every student is assessed consistently in the same key areas. However, we have realized that we need to be more consistent in terms of evaluator training/norming and we need to add more outcome-specific assessment into our classes. To that extent, three SAC members full-time and part-time faculty attended the Learning Assessment Council class in the Fall of 2014. We are in the process of streamlining and revising our CCOGs to ensure that the intended course-specific outcomes are assessable and meaningful.

Three SAC members completed the Learning Assessment and Outcomes Course taught by Wayne Hooke. Information was shared in detail at subsequent SAC meetings with the full SAC.

We have rewritten our district-wide Intended Course Outcomes and received positive feedback from Sally Earll, the Coordinator for Curriculum Enrollment Services. The SAC has received extremely positive early feedback on these changes.

> "Everyone who has read the revisions is impressed with the SACs work to so clearly align the core outcomes to the course outcomes and to provide a mapping level indicator. This shows an incredible commitment on the part of the SAC to be transparent about the value of the core outcomes. We like what you've done and may consider it a model in the future…"

We are in the process of rewriting the Course-Specific Objectives for each of our courses with completion expected summer 2016. The new specific learning outcomes (objectives) clearly define the conditions, skills and knowledge students must demonstrate on exams, in the laboratory and in other course components as well as benchmarks to define the level of mastery students are expected to achieve as a result of successfully completing this course. These new learning objectives will enable the SAC to complete future Outcome Assessments more easily and in a manner that provides relevant feedback on instruction district-wide.

ii. Identify and give examples of changes made in instruction to improve students' attainment of course outcomes, or outcomes of requisite course sequences (such as are found in MTH, WR, ESOL, BI, CH, etc.) that were made as a result of assessment of student learning.

As a result of about 10 years of student surveys and math competency exams across the district we implemented the major changes detailed below.

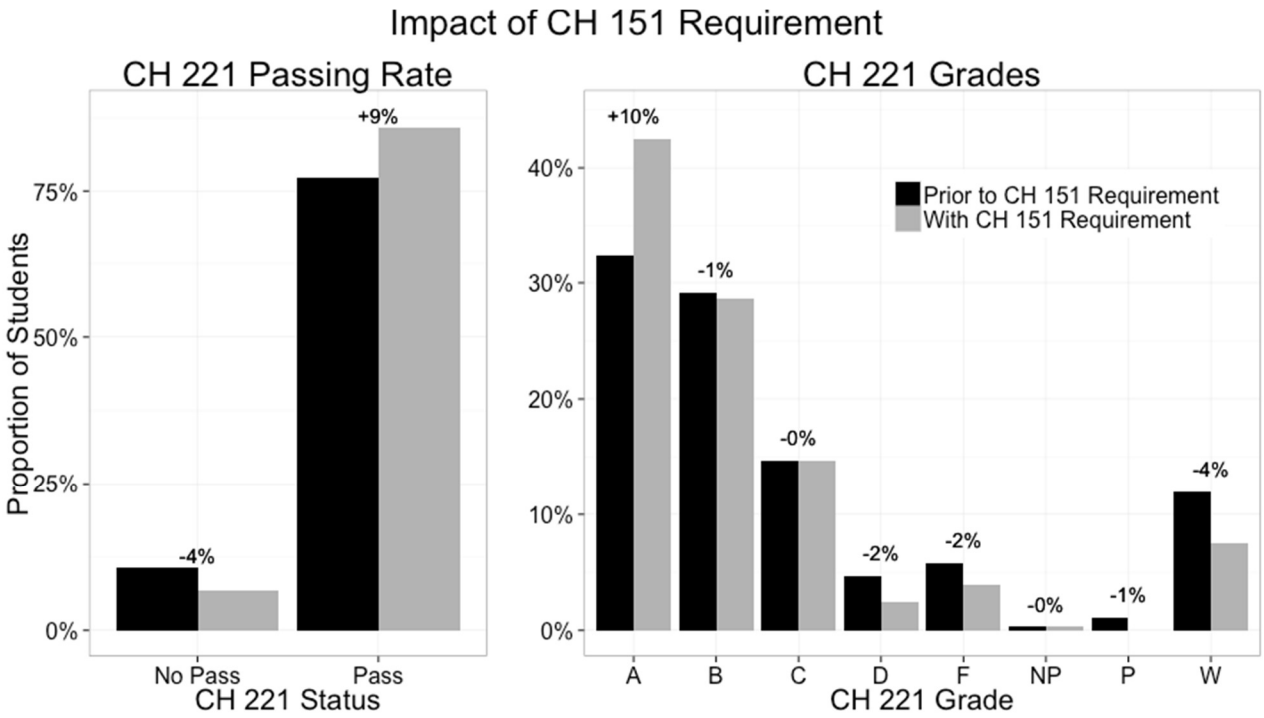
The most significant change to improve student outcomes was the development of a mandatory preparatory prerequisite course, CH 151, for our General Chemistry sequence. Chemistry at PCC is leading the way in the Pacific Northwest in this area, as nearly all 2- and 4-year colleges and universities still only have "recommended" prior courses for general chemistry. However, our discussions with other colleges and universities have indicated support for such a class. As of Fall 2014, CH 151 Preparatory Chemistry is a prerequisite for CH 221, the first course in the general chemistry sequence. This prerequisite is satisfied by attaining a C or higher in the new CH 151 course, or by passing a CH 151 Competency Exam with a score of at least 70%.

The SAC understands that students might have sufficient knowledge from a high school chemistry class or previous college chemistry class to enter directly in CH 221. In response to this a CH 151 competency exam was created by the SAC. Students are now able to take this exam every quarter at each campus to test out of taking CH 151 and go directly into CH 221. A website was created by the physical science

Instructional Administrative Assistant Madhu Narayan at Sylvania that has a study guide, times and dates for exams and general information about taking the exam. Administration of this exam is currently taken on by the SAC. Our expectation is that PCC will support this important prerequisite exam by moving this placement test to the Testing Center, in line with what is done in the Math and English departments.

Figure 1, shown below, demonstrates the impact of adding the CH 151 requirement on student success in CH 221. In the academic year prior to instituting the CH 151 requirement, 77% of students (979 of 1269) completed CH 221 with a passing grade. After implementing the CH 151 prerequisite in Fall 2014, the proportion of students earning a passing grade in CH 221 jumped to 85% (309 of 362). Further examination of the distribution of grades for CH 221 shows that students are not only more likely to pass CH 221, but they are poised to excel in this course. The proportion of students earning an A increased by 10 %, while the proportion of students receiving D, F, NP, or withdrawing from the course dropped by 4 %.

Figure 1*: Impact of the CH 151 Requirement. The chart on the left shows the proportion of students registered for CH 221 who completed the course with a passing grade before (black) and after (grey) instituting the CH 151 requirement. The chart on the right shows the distribution of actual grades earned. The change in percentage points of the proportion of students in each category is noted above each pair of bars.*



Increased student success in the first course of the general chemistry sequence can be attributed to increased preparedness of students. Previous difficulties in CH 221 resulted from an unacceptable range of student preparedness from students with no chemistry background and poor math skills to those exceptionally ready in both chemistry and math, all in the same class. Since mandating the preparatory course, faculty have reported a more cohesive and appropriate level of student preparedness.

In light of the increased student success in CH 221 and faculty observations about the level of preparedness of students as a whole, the SAC feels confident that introducing the mandatory preparatory course was the appropriate move. These results are early, and more data should be collected in future years to continue to evaluate the impact of introducing this new requirement.

For our CH 221 classes, MTH111 has become a prerequisite, rather than a co-requisite. This pre-req was added in response to analysis of MTH course outcomes and student preparedness in our courses.

B. Addressing College Core Outcomes

i. Update the Core Outcomes Mapping Matrix.

Updated Core Outcomes Mapping Matrix is attached in Appendix 2.

C. For Lower Division Collegiate (Transfer) and Developmental Education Disciplines: Assessment of College Core Outcomes

i. Reflecting on the last five years of assessment, provide a brief summary of one or two of your best assessment projects, highlighting efforts made to improve students' attainment of the Core Outcomes.

Project 1: Self Reflection

A particularly useful and successful assessment project was the assessment of self-reflection by our students. Many tools that encourage students to self-reflect were being used throughout the district already. For this assessment the SAC adapted a tool developed by an instructor which was being used at the Sylvania campus. Our assessment goal with this tool was as follows: *Can students effectively self-reflect about their performance in our courses?*

The tool had three distinct sections. Each section was presented to students in our introductory or first term of a sequence courses as noted below during a Winter quarter. The tool was in the form of a worksheet with the following sections:

- The first section was a pre-exam section. This encouraged the students to plan specifically for how to study for the first exam of the course and reflect on the concepts that the student finds unclear in their minds.
- The second was a self-reflection after the first exam of the quarter. This section encouraged students to reflect on their performance on the exam and discuss strategies for either changing or maintaining their performance on the next exam.
- The third was a self-reflection after the second exam asking how these assignments had changed or impacted the student's performance on the second exam. It also encouraged students to ponder the worth of self-reflection in other classes and aspects of their life.

The following are examples of what the SAC would consider exemplary attainment of the self-reflection outcome, which would be the goal of the SAC for most, if not all, students.

- The reflection is written in a clear and expressive manner utilizing proper grammar, spelling, and punctuation. In addition, good sentence and paragraph structure are employed to create clear and concise answers to the questions.
- The learning experience being reflected upon is relevant and meaningful to student and course learning goals.
- The reflection moves beyond simple description of the learning experience to an analysis of how the experience contributed to student understanding of self, others, and/or course concepts.
- The reflection clearly demonstrates connections to other classes/life experiences.
- The reflection clearly demonstrates the ability of the student to take responsibility for her/his own learning.

When applying the self-reflection rubric, the students scored very well on the assignment. We interpret this result to mean that in general, when given the opportunity to self-reflect, students complete the process well. Evaluation of the assessment using our rubric indicated the following general conclusions:

- Most of the students found the process meaningful/useful towards their attainment of the course outcomes and believed it was a worthwhile experience.
- Students were able to reflect on their experience in a way that the SAC felt was moving them toward the course outcomes.
- Students were able to analyze the experience on a metacognitive level. Students did not just describe what they had done or learned, but reflected on what they did that helped them learn and why it helped them learn.
- Most students were able to see how this self-reflection experience could transfer outside the discipline of chemistry and be useful in other classes as well as outside the classroom.
- Students were able to take ownership of their learning and be critical of themselves as to how well they were doing at attaining the course outcomes. They also were able to talk about how they might change their study habits in the future to attain greater learning.

Project 2: Communication

A communication assessment was introduced as part of a pilot program, recommended by the LAC, by one of our instructors.

Most students enrolled in the organic chemistry sequence are majoring in health-related fields such as pharmacy, medicine, nutrition, and physician assistant. To many students, organic chemistry appears merely as a collection of disconnected concepts and facts, where memorization is encouraged over understanding. Likewise many students fail to see how the underlying concepts apply to everyday issues in the health sciences.

Over the past five years one of our instructors has been introducing a 'Question of the Month' (QoM), activity that encourages students to come up with a challenging question on their own. We see this as a step toward a more comprehensive understanding of the material, broadening their view on organic chemistry principles stressing the interrelationships between organic chemistry and health sciences. The assignment was designed to help students make the connection of the material covered in class with everyday living chemistry principles. Students were expected to write a challenging question with the following instructions:

- Start by writing a paragraph using relevant background information introducing the reader to the question.
- Clearly communicate the question. This means that the question is constructed in such a way that it allows your fellow students to easily follow your thought process with clear and concise instructions.
- If necessary, provide an example of a worked problem, which helps understand exactly what is asked.
- Be sure to evaluate your own question in terms of correct information provided.

Eighteen of the twenty students enrolled in class participated in the writing assignment. All 18 students completed the QoM, each writing one question three times over the course of the term. The 3-week span between each assignment was chosen as it allowed the instructor to provide feedback after each question was turned in. The expectation was to see incremental improvement in the written communication after each task.

Each assignment was evaluated using a rubric. The rubric was adapted from Liberal Education and America's Promise (LEAP) and modified to fit the question of the month. Each written assignment was evaluated separately. Our SAC used three criteria to assess for written communication:

- Source and Evidence
- Content, Organization and Development
- Control of Syntax and Mechanics

In QoM I, 63% of the 18 students were at or above the benchmark level. That percentage rose to 69% for QoM II. In the final assessment, QoM III, 83% of the 18 students produced assignments at or above the benchmark level.

The Chemistry SAC was recognized by the LAC with a perfect score and awarded the Exemplary Assessment of Student Learning award (we got Smarties!).

ii. Do you have evidence that the changes made were effective (by having reassessed the same outcome)? If so, please describe briefly.

The Chemistry SAC recommended the assignments used for assessing self-reflection need to be consistent across the district. The results of our evaluations have shown that these assignments are helping our students develop their self-reflective skills. Due to the modified assessment schedule for the Chemistry SAC, Self-Reflection was not re-assessed prior to this Program Review.

iii. Evaluate your SAC's assessment cycle processes. What have you learned to improve your assessment practices and strategies?

We have discovered over the course of the assessment cycle process that the SAC members themselves need to learn how to write better assessment tools and objectives. Historically the SAC has attempted to create tools and strategies that, while having the potential to be highly informative, are nonetheless incredibly difficult to assess in a way that is meaningful, not incredibly time consuming and easy to implement consistently across the district.

Importantly, through this process and our own self-reflection, we have determined that at present most of our courses have learning outcomes that are not easily assessable. Many of our course outcomes lack clearly assessable benchmarks. Thus, during the 2014-2015 academic year, the Learning Assessment council approved a plan for our SAC to develop sets of course outcomes and learning objectives which, in future assessment cycles, will more directly map to college core outcomes and also lend themselves to be readily assessable across the district by defining clearly assessable benchmarks. Part of this revision included the pilot study in Winter 2015 described in Project 2: Communication above (See part C, i).

Completion and evaluation of this pilot study are intended to put the SAC on a more meaningful assessment cycle. We expect the improved outcomes and benchmarks to provide a more uniform student experience across the district, as well as better connecting our core course outcomes to those of the college as a whole.

iv. Are there any Core Outcomes that are particularly challenging for your SAC to assess? If yes, please identify and explain.

The SAC has found Cultural Awareness to be the most challenging core outcome to assess.

While of course the SAC recognizes that cultural awareness is an important outcome for any student or citizen, the rigor and subject matter of chemistry does not lend itself easily to ready inclusion of this outcome. In addition to the inclusion of the other core outcomes, chemistry courses must also focus on higher order thinking skills, process-oriented skills, competence in a laboratory/hands-on setting, and safety and environmental awareness, all within the context of conceptually and often mathematically challenging subject matter, merely as the course of the day. Our students must be ready to compete in challenging and highly competitive courses of study when they transfer to 4-year colleges and universities or other professional programs. The inclusion of cultural awareness to the extent that it could be given due diligence during most of our courses is simply very difficult in light of all the other critical thinking, content-specific and skill-based content that must be included in our courses to enable students to be successful beyond PCC.

However, we must note that the SAC recognizes that teaching and learning science are activities, which are strengthened with an understanding and practice of cultural awareness. We have developed an introductory course that incorporates a wider variety of outcomes that includes effects on environment and the community. Furthermore, a faculty member at Sylvania has worked with disciplines across the district to develop a new mural to be painted by a PCC student on the science floor of the ST building highlighting the achievements and accomplishments of underrepresented groups in science and technology.

3. Other Curricular Issues

A. Which of your courses are offered in a Distance Learning modality (online interactive television, etc.), and what is the proportion of on-campus and online? For courses offered both via distance learning and on-campus, are there differences in students success? (Contact the office of Institutional Effectiveness). If so, how will you address the differences? What significant revelations, concerns, or questions arise in the area of DL delivery?

The Chemistry SAC currently offers Everyday Chemistry (CH 100), the Allied Health Chemistry Series (CH 104-6) and the General Chemistry series (CH 221-3) in the distance learning modality. The General Chemistry series is a hybrid course that has mandatory on-campus exams and laboratory. All other courses have online exams and an at-home laboratory component.

The 100-level Chemistry courses offered in the distance learning modality compose 30% of the total 100-level courses on average district wide. The 200-level Chemistry courses offered in the distance learning modality compose 10% of the total 200-level courses on average district wide

Pass rates for both on-campus and DL courses are shown in Table 1 on the next page. The pass rates for the general Chemistry series (CH 221-3) are statistically the same. This is in contrast to the 100 level courses, which have a higher on-campus pass rate. Drop and pass rates for our online courses seems to be in line with at least one study by the Community College Research Center (Columbia University)[3]. This study shows students have significantly higher withdrawal rates in all subjects for online courses versus face-to-face. One possible reason that the 100 level DL courses have a lower pass rate is that the students registering for the 100 level courses have less math and science experience. This lack of experience precludes them from understanding the rigor of the subject and subsequently the time required to successfully complete the course. Students are attracted to all of the DL courses for their flexibility. Unfortunately, many of these students fail to comprehend the amount of time required to complete the course successfully.

To address the difference in the course pass rates we have reviewed each course information page (CIP) to verify that there is a clear statement of the required weekly activities and an estimate of the time necessary to complete them. CIPs for several courses were updated. Our SAC is discussing the addition of a math quiz to the CH 104-6 series CIPs to enable students to assess their math readiness to complete the courses successfully. Some DL instructors regularly send out emails to their classes 1-2 weeks before the class starts with the CIP information and a syllabus. We hope to implement this in all our DL courses.

[3] *Community College Research, Columbia University, 2013 - Website accessed April 10th, 2015 http://www.achievingthedream.org/sites/default/files/resources/Online-Learning-Practitioner-Packet.pdf*

***Table 1**. Percentage of chemistry courses online and district pass rates for On Campus vs. DL (2010-2014)*[4]

Course	CRNs Online (%)	On-Campus Pass Rate (%)	DL Pass Rate (%)
CH 100	33.0	78.4	61.1
CH 104	25.9	83.3	76.7
CH 105	27.3	90.9	82.2
CH 106	37.8	98.5	81.4
CH 221	7.7	74.7	77.9
CH 222	10.5	79.7	78.6
CH 223	9.2	76.9	81.8

The shells for the CH 104-6 series are now 7 years old. We have learned a great deal about how best to organize and present chemistry during this time period. Although the courses are continually updated in small ways by the faculty teaching DL, more intensive updates are needed. Updating DL courses is time consuming; however it is important to make changes to keep up with technology and pedagogical changes. To address this, a team of PT and FT faculty was chosen to review and update CH 104. This team has been awarded IIP and Media Camp funding for course upgrades. The SAC hopes to update the entire series in a timely fashion, but with summer being the only real time to make such significant changes we are looking at a slow process without extra support from administration. Disability Services is working with the SAC to ensure that these older courses are accessible.

A number of academic integrity issues have surfaced. These include submission of lab reports that are from students who were previously in the course, students paying others to take the course for them, not buying a lab kit and falsifying data and students working together on at-home exams. The SAC understands that these are issues in all DL classes at PCC. The SAC is looking to the administration and the DL department to provide support in dealing with and helping to prevent these issues. While we wait for the college to decide how to best handle these integrity issues we have made a few changes to improve the situation. Two mandatory on-campus exams in the CH 221-3 hybrid series at Rock Creek are given during the term and at Cascade and Sylvania most DL courses require students to send pictures of themselves completing the labs at home.

B. Has the SAC made any curricular changes as a result of exploring/adopting educational initiatives (e.g., Community-Based Learning, Internationalization of the Curriculum, Inquiry-Based Learning, Honors, etc.)? If so, please describe.

Through the enthusiasm, skills and interests of its full-time and part-time faculty, the Chemistry SAC focuses on the importance of incorporating pedagogically sound initiatives into the curriculum. Several of these initiatives are campus- or course-specific due to the interests of individual instructors or teams. The diversity of offerings provides many options for achieving course outcomes across the district. Curricular changes since our last program review include:

- Distance Learning
  - The CH 100 Everyday Chemistry course is fully online and ADA compliant for both lecture and lab components. This online course has been offered every term since Fall 2013.
  - The CH 104-106 series is in the process of updating the online courses to become ADA compliant.

[4] *Data found in PCC IE website, from file on DL and on-campus courses info: (DL and on campus course success rate file) at* http://www.pcc.edu/ir/program_profiles/

- Undergraduate research
  - The CH 298A research course has been approved by the EAC. While several faculty are interested in offering individual research opportunities to students, there is currently no system in place to compensate instructors or record FTE. The chemistry SAC voted not to offer the course until bargaining with the PCCFFAP is complete in 2015. Additionally work is being done to ensure the course transfers for chemistry major elective credit to PSU with the eventual goal of have these credits accepted throughout the Oregon University System.
  - Multiple-week field lab projects offered in some CH 100, 105 and 151 sections engage students in the process of scientific inquiry. With guidance, students develop a research question, propose an experimental plan, calibrate instruments and collect data in the streams around campus, analyze the data graphically, create a results statement, and draw conclusions relating to water quality in our watershed.
  - Organic Chemistry III students engage in a research project in which they study the literature, choose a project, complete the chosen experiment and present the results either through an oral presentation to the class and/or at the annual Chemistry Poster Fair at the Rock Creek Campus.
  - Guided-inquiry labs in some sections mimic the research experience by setting up a problem for students to investigate on a topic not yet covered in lecture. Students learn to analyze the empirical data obtained in the experiment and evaluate reliability of their data when no reference or "right answer" is available.
  - A key requirement for the "Honors" designation for the CH 221-223 General Chemistry course is a literature or experimental research component in which students must "apply chemistry-based scientific research methods to investigate questions relevant to student's individual interests and to make connections to other sciences and/or the humanities" (from the CH 221H-223H CCOGs).
  - Several students have worked on research projects under the guidance of some instructors at Sylvania. For example, one student in a science teaching program at PSU worked over the course of 2 summers and 2 academic years, both through work study and volunteer, to research nanotechnology-based labs at Sylvania. These labs have been implemented into the general chemistry curriculum. Other students have volunteered to work as lab assistants in the general chemistry labs as peer facilitators. These students reflect upon their experience, provide feedback and help to update and upgrade the laboratory experiences.

- Sustainability
  - Greener organic chemistry labs have been developed that utilize fewer hazardous substances in smaller quantities. Students in CH 241 and 242 synthesize compounds using green chemistry techniques and then reflect on the aspects of the experiment that made it green. The Rotary Evaporators purchased for the Rock Creek and Sylvania campus since last program review enable PCC to comply with EPA and OSHA standards by capturing organic solvents versus removing them through evaporation.
  - The newly-repurposed CH 100 course uses sustainability issues such as water and air quality, global climate change, and energy resources to frame chemistry learning for non-majors in several sections.
  - The field lab projects described in "Undergraduate Research" focus on the water quality of surface water on campus or in the local area. As part of the project, students research water quality concerns and standards and connect their data to those standards.

- Honors Program
  - CCOGs for Honors sections of the entire general chemistry sequence (CH 221H-223H) were approved. The CH 221H Honors General Chemistry course was developed and taught Fall 2013. Feedback and self-reflection indicated the need for further revision in light of the recent CH 221 prerequisite changes, as well as better alignment with the goals of the Honors program. The SAC plan for updating the Honors courses is to initiate a dialogue with the Honors Program to determine if a introductory level course such as CH 100 would better serve our students' needs.

- Nanotechnology
  - Engaging lab experiments focused on nanotechnology, such as growing nanoparticles and evaluating their physical attributes and properties, spectroscopy, organic solar cells and semiconductors, were developed and implemented initially in the honors general chemistry course. These labs have been adapted to the regular general chemistry curriculum at the Sylvania campus.

C. Are there any courses in the program offered as Dual Credit at area High Schools? If so, describe how the SAC develops and maintains relationships with the HS faculty in support of quality instruction.

During the Spring 2014 term PCC Sylvania offered CH 221 Dual Credit for the Lakeridge High School students who successfully completed the year-long advanced placement course. This agreement was established after Jennifer Brazier, one of the chemistry teachers from Lakeridge High, requested dual-credit for these high school students. Jennifer provided her resume, her course syllabi for her AP and Honors Chemistry classes and PCC provided Jennifer with the CCOGs for our CH 151, CH 221, 222 and 223 courses. In an effort to maintain the relationship with the HS faculty, Jennifer Brazier has maintained email contact and attended the Spring 2014 SAC Meeting to identify additional options for students to receive this dual-credit. In addition a one-year faculty assessment was completed during the Spring 2015 term, which included a campus visit, review of course materials, and follow-up discussion. With the input from Jennifer, the Chemistry SAC is working towards allowing students to obtain CH 151 Dual Credit for high school students who successfully complete a year-long high school honors or equivalent chemistry course. The largest barrier identified by the Chemistry SAC in allowing more high school students in the Portland area to receive dual credit, especially for CH 151, is the discrepancy between the high school chemistry teacher requirements and the PCC Chemistry Instructor Qualifications. The Chemistry SAC plans to work with the Dual Credit Office, additional High School Teachers who meet the qualifications for PCC Chemistry Instructors, and other SACs to increase the number of dual credit offerings in chemistry.

D. Please describe the use of Course Evaluations by the SAC. Have you developed SAC-specific questions? Has the information you have received been of use at the course/program/discipline level?

District-Wide/Program Use of Evaluations (SAC)

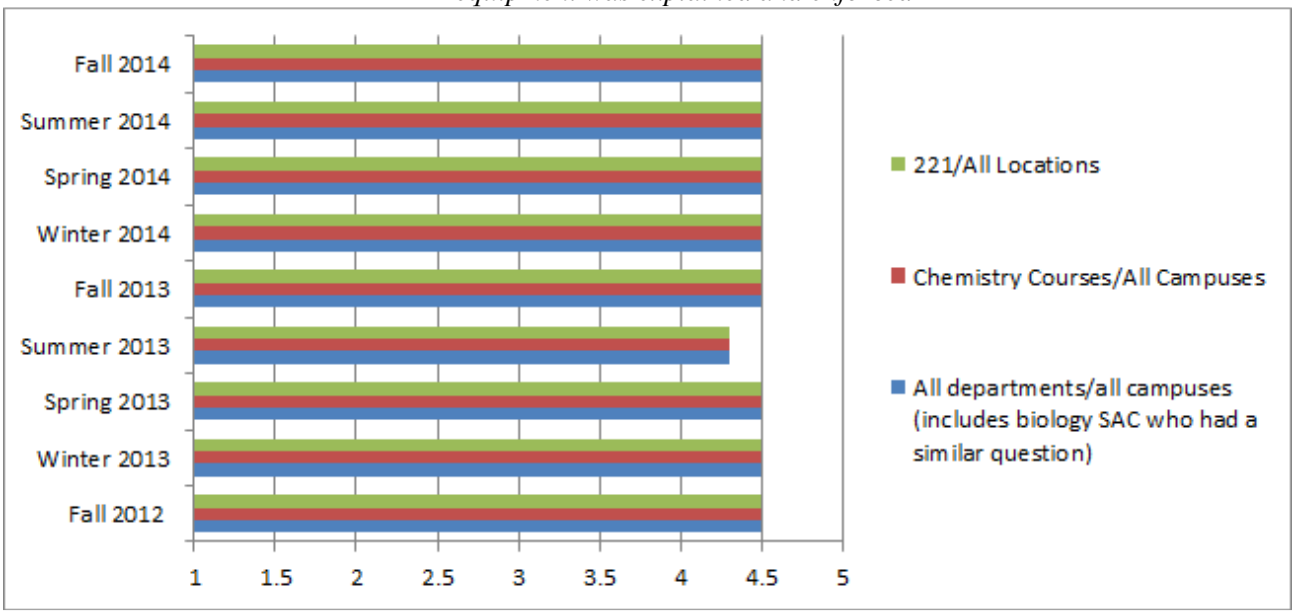
Upon initiation of the Course Evaluation (CE) district wide the SAC prepared and instituted a list of questions to be used for all chemistry courses. These questions were revised one time following their creation after individual instructors viewed their results.

Results from a SAC-wide question: "If a lab course, proper use and care of lab equipment was explained and enforced" are shown in Figure 2 on the following page. The results demonstrate the lack of detailed information gathered from this survey. Essentially the SAC concluded that the average value of 4.5 indicated that we met our objective. Additional access to the SAC-wide questions and their responses is necessary to improve the questions and gather information so that we can refine our CE.

Course Usage (Campus Specific)

In evaluating the responses to the PCC CE, a few instructors at PCC Sylvania noticed students were not able to link lecture and lab material easily to their daily life. During the Spring 2014 term the PCC Sylvania team implemented a new set of chemistry lab experiments which provided direct applications of lecture and lab material. The last question in each lab report asks the students to identify one application of the experiment to their life. For one instructor the scores for spring 2014 were >4.5/5 for this question.

***Figure 2**. Results of the district-wide Course Evaluation question: "If a lab course, proper use and care of lab equipment was explained and enforced"*



Drawbacks

1. A critical impediment to using the data from these SAC-wide questions is the lack of availability of both the graphed and raw data to SAC members. Only the deans have access to the SAC CE data, although our SAC administrative support (a division dean) could access easily it either. The Chemistry SAC is keen to use SAC-level questions in future course evaluations, but this lack of direct access creates an impediment that prevents the SAC from utilizing this tool. After the SAC is granted direct access to the SAC CE questions we plan to evaluate the questions and discuss any necessary modifications.

2. Due to the limited number of questions which can be created by instructors and low response rate prior to Fall 2014, many have found the use of CE considerably less valuable than previous tools used. We recognize that response rates have improved somewhat in the past year due to some PCC measures, but the limited number and format of instructor questions is still problematic.

Historically many chemistry instructors used a tool called SALG (Student Assessment of Learning Gains) which consistently provided a response rate >90% for those instructors. This student feedback form gave much greater flexibility and allowed assessment of The Class Overall, Specific Class Activities, Assignments and Graded Activities, Class Resources, Information Given to Students, Support as an Individual Learner, Understanding of Class Content, Increase in Skills, Class Impact on Attitudes (towards chemistry), and the Integration of Learning and Overall Classroom Experience. In addition, the SALG tool allows instructors to see which students responded, although individual responses were anonymous. While a complex tool of this nature may not be possible district wide, the instructors' use of their own end-of-term evaluations in addition to the PCC-mandated evaluation has been discouraged. Since more-informative feedback tools can't be used any later than the 8th week of the term, potentially valuable student summative feedback can no longer be obtained in the manner that is useful for curricular change.

The Chemistry SAC strongly desires a greater opportunity to use a more useful feedback tool.

E. Identify and explain any other significant curricular changes that have been made since the last review.
The CH 100 Fundamentals of Chemistry course offered prior to Fall 2013 served two populations of students: those who take the class for a General Education science class with a lab and those preparing to take the

majors-level general chemistry series. The Chemistry SAC decided to split these two populations into two different courses to better serve both populations of students. The new classes are CH 100 and CH 151.

CH 151, a new preparatory chemistry class, was developed to serve students entering our majors CH 221 sequence, the Veterinary Technology program, the Bioscience Technology program, and the Microelectronic Technology program. It has also become a prerequisite for BI211, a class designed for students majoring in biology and the sciences, including pre-medical, pre-dental, chiropractic, pharmacy, and related fields.

The new CH 100 class now serves primarily the GenEd Population. This class is a much better fit for our non-science majors who need a science class to fulfill their GenEd requirement.

CH 221H, an honors version of CH 221, was offered in Fall 2013 at the Sylvania campus as a pilot course. Students were expected to be math-ready and have had appropriate preparatory chemistry experience. Major deviations from the regular CH 221 curriculum included a term research project on nanotechnology with final oral presentation, omission of curricular units on background math, problem solving and introductory chemistry, and a new suite of 6 labs introducing nanotechnology and the synthesis and characterization of controlled-growth multi-sized silver nanoparticles. The labs related directly to the course content but focused on cutting-edge technology. Subsequent honors courses, although planned, were not taught after consideration of the general unpreparedness of most of the students for a laboratory science class at the general chemistry level. Discussions with the Honors Council ensues regarding future introduction of a general chemistry honors sequence in light of the new CH 151 prerequisite for CH 221 (see above).

CH 101 was developed at the Sylvania campus. This course was designed specifically for students enrolled in the Civil and Mechanical Engineering Technology (CMET) program at Sylvania, although it does meet general education transfer credit requirements for any student. The course was designed to better serve the needs of the CMET program students, and was created with much advice from a number of CMET faculty. The course was implemented in the Winter and Spring terms of 2012. Further discussions with the CMET faculty resulted in the CMET student class schedule being altered such that this course now directly precedes the one for which it is a pre-req, and therefore better integrated directly into their program. The course is now taught once per year in conjunction with the CMET program schedule.

For our CH 221 classes, MTH111 has become a prerequisite, rather than a co-requisite as previously discussed in question 2A.

4. Needs of Students and the Community

A. Have there been any notable changes in instruction due to changes in the student populations served?
We have not made any significant changes in instruction due to changes in the populations served since we have not observed any significant demographic changes. Student demographics in Chemistry courses are shown in Appendix 3.

B. What strategies are used within the program/discipline to facilitate success for students with disabilities? What does the SAC see as particularly challenging in serving these students?
Chemistry instructors provide assistance and resources for students with disabilities in accordance with The Americans With Disabilities Act. We work closely with students and Disability Services to meet the specific needs of students with disabilities.

As of academic year 2013-2014, all new PCC D2L courses were required to be accessible. The SAC found this to be extremely challenging for all DL courses. Enormous amounts of time have been spent and continue

to be spent making these courses ADA compliant. The compensation and release time for these activities is not on par with the required efforts.

During the creation of CH 100DL, SAC members worked closely with the publisher of the online homework for the course to create accessible assignments. We worked closely with disability services to ensure materials posted for the course were either accessible or that there was an alternate accessible equivalent assignment. The course shell was reviewed by disability services and approved as accessible.

The CH 104 DL course shell is now fully accessible. Chemistry SAC members worked closely with disability services to make this happen during the summer and Fall of 2014.

C. Has feedback from students, community groups, transfer institutions, business, industry or government been used to make curriculum or instructional changes? If so, please describe (if this has not been addressed elsewhere in this document).

There were no additional changes made based on student or community feedback that have not been addressed above.

5. Faculty: Reflect on the composition, qualifications and development of the faculty Provide information on:

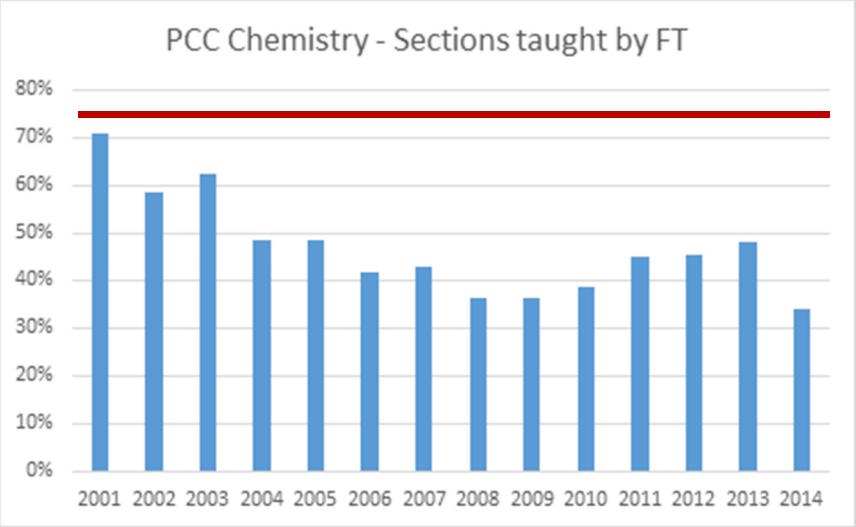
A. How the faculty composition reflects the diversity and cultural competency goals of the institution.

There are currently 11 FT faculty members at PCC. Since the last program review, the Chemistry SAC gained and lost one FT position at Rock Creek, and gained ½ position at SE (making one full position at SE) while losing ½ position at CA. We are striving toward reflecting the goals of the institution regarding diversity and cultural competency. Chemistry, as with all the sciences, has low numbers of minority individuals in the teaching ranks. The Chemistry SAC would like administrative help with ideas and strategies to increase the number of minority individuals who apply to our teaching pool.

The chemistry department at PCC relies heavily on the successful contribution of adjunct faculty members. Though we understand that we have hired qualified and competent adjunct faculty, faculty turnover in the adjunct pool is relatively high. We believe that with less than 50% of CRNs taught by full-time faculty over the last ten years, and considering the high turnover in the adjunct pool, a successfully functioning department cannot exist. The large turnover in our adjunct faculty requires full-time faculty to continuously orient new faculty, mentor our faculty, provide assistance with lab set-ups, help with student office hours, etc.
The goal for two-year College Programs set forth by the American Chemical Society is that "*..the number of credit hours taught by permanent faculty should exceed 75% of the total chemistry offerings."*

Our institution is currently staffed nearly 50% below the American Chemical Society's recommendation of 75% taught by full-time faculty. Figure 3 on the following page clearly shows that the Chemistry program at PCC has not met this goal in the last 15 years.

***Figure 3**. Chemistry courses taught by full time faculty. Data from IE. Data from Fall 2014 have been calculated without the temporary full-time position at Rock Creek to more accurately reflect the percent full-time faculty for the next academic year. Our 2014 percent falls below the College average of 37% of sections taught by FT faculty and well below the 75% recommended by the ACS.*



B. Changes the SAC has made to instructor qualifications since the last review and the reason for the changes.

Current Instructor Qualifications are listed in Appendix 1, and can be found at http://www.pcc.edu/resources/academic/instructor-qualifications/index.html

The chemistry SAC implemented a number of changes to our instructor qualifications. The majority of the changes were made November 2011. The instructor qualifications were expanded to include full-time and part-time chemistry instructors at PCC. In addition to Chemistry, Chemical Education and Biochemistry were added to the accepted main subject area degrees. The expansion of prominent subfields within the field of chemistry over the past 20 years influenced the SAC to make this change.

The list of related subject area degrees was expanded (see Table 2). The appearance of new degrees in related fields influenced the SAC to make this change.

***Table 2.** Chemistry-related Fields*

Related Fields before Nov 2011	Related Fields after Nov 2011
	Agricultural Chemistry
Biochemistry	(moved to main subject area)
Biophysics	Biophysics
	Chemical Biology
Chemical Education	(moved to main subject area)
	Chemical Engineering
Environmental Science	Environmental Science
	Materials Engineering
Material Science	Material Science
	Petroleum Engineering
Pharmacology	Pharmacology
Physical Sciences	Physical Sciences
Toxicology	Toxicology

Additionally a clear procedure for obtaining approval for a degree in the related field list was included. The SAC wanted a clear set of guidelines to maintain parity between the campuses. The new guidelines are as follows:

- These lists of subject and related areas may not be inclusive as there are other degree titles that may be appropriate. The Division Dean, in consultation with the Faculty Department Chair, will make a recommendation to the Dean of Instruction about the applicability of a particular degree that is outside the scope of this list.
- The SAC wanted to take advantage of the outstanding pool of local graduate students who were interested in teaching. This also helps expand the part-time faculty pool to meet the needs of the department. Provisional approval guidelines for hiring current Masters or Doctorate students nearing the end of their degrees were added. An instructor without a Master's or Doctorate degree may be approved if they have 30 quarter hours of graduate credit in the subject area and are actively pursuing the degree and are anticipated to be awarded the degree within six months of hire, as determined by the instructor's graduate advisor (a letter from the advisor will be required and kept on file.)

C. How have the professional development activities of the faculty contributed to the strength of the program/discipline? If such activities have resulted in instructional or curricular changes, please describe.

Both full-time and part-time Chemistry SAC members engage in professional development activities to stay current in their knowledge, improve their teaching, and provide access to STEM activities through community outreach. Below are several examples of professional development activities, curricular changes and outreach activities the Chemistry Faculty have engaged in since our last program. A full listing of each faculty member's professional development activities are given in Appendix 4A.

<u>Professional Associations, Conferences, and Workshops</u>

- Membership, leadership and editorial positions, and presentation for organizations such as the ACS (American Chemical Society), WCCTA (Washington College Chemistry Teachers Association), BCCE (Biennial Conference on Chemistry Education), 2YC3 (2-Year College Chemistry Consortium)
- Facilitation of NSF-supported workshops entitled *Distance Learning and Hybrid Teaching Mini-Workshop* at two annual meetings of CCWCS (Chemistry Collaborations, Workshops and Communities of Scholars)
- Participation in Seattle's Hub for Industry-Driven Nanotechnology Education (SHINE) Workshop
- Attendance of a national conference sponsored by The Council on Undergraduate Research (CUR) to help Community Colleges start research programs or encourage inquiry-based learning in their curriculum
- Completion of PCC-sponsored training programs including DL Instructor training, DL Accessibility training, PCC Non-discrimination training, and workshops such as Facilitation Skills for Leaders and Employee Engagement sponsored by the Professional Development Office

<u>Curricular Changes</u>

- Development of a new CH 100 course, Everyday Chemistry with Lab, in both on-campus and fully accessible DL format
- Development of an "ecologically friendly" solar cell creation lab using raspberry juice in the CH 223 course
- Development of a hydrogen-oxygen fuel cell lab in conjunction with the solar cell lab for CH 223
- Implementation of changes to teaching resources, lab safety regulations and information, instructional use of computer molecular modeling software based on the latest initiatives and national trends from the ACS Division of Chemical Education
- Development of field lab project giving students direct experience with the entire scientific inquiry process connected to their own community and environment.

Mentoring and Community Outreach

- Mentoring science students in Work-Study and volunteer positions. These student activities included development and testing of new labs and helping to facilitate Guided Inquiry small group activities in lecture and lab
- Mentoring students interested in careers in chemistry and chemical education through the UCORE program (Undergraduate Catalytic Outreach & Research Experience) in association with the University of Oregon
- Participating in the annual Hermanas (Sisters) conference sponsored by Intel to encourage high school Latinas in STEM careers
- Participating annually in STEAM and SMILE activities to promote STEM careers to middle school students
- Participating in a Chicas summer STEM camp
- Promoting Women in Science by participating in Girls Inc. and WRC Women's Care Retreat that expose high school girls to STEM careers with laboratory tours and experiments, panel discussions, "career" fashion shows
- Volunteering to consult with chemistry students at Jefferson High School on their science projects in collaboration with Portland Public Schools
- Participating in PCC Preview Days open house activities to introduce high school students to chemistry at the college
- Serving as the Faculty Mentor for student clubs such as the Cosmos Club, a universal science club
- Hosting a multi-discipline public forum on Hanford Waste Cleanup presented by a Washington Department of Ecology scientist, addressing regional issues surrounding the legacy of nuclear waste
- Mentoring students in a community outreach program funded by the American Chemical Society, "The Power of Partnerships: Educating Portland, Oregon in Climate Change."

The chemistry faculty are concerned about their ability to sustain this level of participation in professional development activities due to the lack of increased funding to attend conferences. Appendix 4B provides more details about the costs for chemistry professional development.

6. Facilities and Academic Support

A. Describe how classroom space, classroom technology, laboratory space, and equipment impact student success.

As a result of the investments from the past Bond measure in terms of the laboratory renovation and recent acquisition of new cutting edge instrumentation our students are able to conduct some experiments that are similar to the lab experience they would receive at a University. In a chemical industry survey performed by the Journal of Chemical Education, much of the newly-acquired equipment aligns with the professional skills desired by the industry[5]. A complete listing of instruments acquired since the last program review is given in Table 3 on the following page.

Each PCC campus has a variety of resources including learning spaces and equipment (Table 3). Both the Cascade and Southeast campus have limited lab spaces. As a result these campuses are unable to offer the Organic Chemistry course.

[5] http://pubs.acs.org/doi/ipdf/10.1021/ed400570f

Table 3: *New Equipment and Lab/Tutoring Space*

Campus	Equipment	Lab Spaces	Tutoring
Sylvania	GC/MS SEM Rotovaps Flame AA High Purity Water system FTIR	3	Shared room with engineering
Southeast	FTIR Vernier GC Vernier Equipment Laptops	0.8	Tutoring Center
Cascade	Vernier GC Vernier Equipment GC	1	Tutoring Center
Rock Creek	FTIR Rotovaps Vernier MiniGC Vernier UV/Vis Vernier Equipment HPLC	3	Tutoring Center

The Chemistry SAC is extremely proud of the investment the college has made in lab equipment and space over the last five years. Specific examples of integration of the equipment into teaching labs are detailed in Appendix 6.

The implementation and continued use of new equipment presents significant challenges:

- Maintenance costs (tech and software upgrades)
- Repairs
- Curator time (upkeep, training, etc.)
- Instructor training
- Consumables needed to run the instruments such as gases and solvents
- Development time for new experiments

The addition of this instrumentation has not been paired with an increase in dedicated departmental funding for consumables and maintenance, dedicated training funds for lab technicians and part-time faculty, and funding or release time for experiment development. This is crucial to ensure the long-term viability of our program and student success.

B. Describe how students are using the library or other outside-the-classroom information resources.

The library website has links to multiple useful reputable sources available to assist students. This list includes full text for over 890 peer reviewed health and life sciences journals, the CRC Handbook, an online version of McGraw-Hill Encyclopedia of Science & Technology, as well as other research databases for locating journal articles.

Students are required to obtain physical data to prepare for experiments, to write formal reports and to complete pre-lab assignments. Safety precautions are also part of the pre-lab assignments where students are required to look up chemical properties of the materials they are expected to use in each lab. Included on the library website are links to MSDS, NIST, EPA, PubChem and WebElements which are reliable and reputable sources for such material. However, it has become common for students to become complacent and use

Google search, Chemwiki, and YouTube for such information for the easy answer rather than using a more reliable source.

CH 102, CH 221 Honors, and all Organic Chemistry students are required to use external sources as part of their research project. This includes peer-reviewed journals and publications as well as multimedia sources and popular science publications.

Some instructors have required critical viewing and analysis of online video and audio presentations as part of their regular classroom assignments. An example is a BBC video that introduces quantum mechanics via its historical development. Students are asked to relate this new information to previous classroom information as a launching point for development of more complex ideas.

Most courses incorporate online learning and homework instruction (such as the commercial products *OWL* and *Mastering Chemistry*, among others) that includes a rich variety of outside information sources, including video problem solving presentations, video quizzes, online textbooks and other resources.

Some instructors have used or are considering the use of free or inexpensive online textbooks (many from open-source and Collective Commons sources) as alternatives to traditional text information sources. Such resources can be accessed using either computer or mobile devices. Preliminary investigation has determined that this is an extensive project for which release time or funding is needed.

C. Does the SAC have any insights on students' use of Advising, Counseling, Disability Services, Veterans Services, and other important supports for students? Please describe as appropriate.

Over the past several years, the chemistry SAC has worked closely with Disability Services. The Testing Centers' expanded hours coupled with the introduction of electronic Alternative Testing Contracts has vastly improved the ease of using the Testing Centers, which in turn supports our students. The Chemistry SAC appreciates the contributions of the Testing Center staff who went out of their way to solve particularly challenging scheduling problems.

The Chemistry SAC continues to work with Advising to ensure that students are receiving accurate information to place them in classes that match their skills and needs. Chemistry students, both majors and non-majors, are often given inconsistent advice and planning help. Advisors need to be well informed about majors and prerequisites. Better and more consistent communication between the Chemistry SAC and Advising needs to be developed. The SAC has previously created an advising guide flow chart to help advisors guide students; this chart needs to be updated (Appendix 8). Sending it to advising at regular intervals might remind them to use it and help inform new hires in their department. This is an area the SAC has identified as needing improvement. To this end the SAC will be contacting advisors annually to ensure Advising has accurate and timely information.

The Chemistry SAC is grateful for development of electronic Student of Concern Forms. Besides their ease of use, these forms insure that students in need of attention from Counseling receive it promptly. Faculty also refer students directly to Counseling Services. While many issues are referred to the counseling center and through the Student of Concern form, the resolution of issues are typically not shared with faculty. The Chemistry SAC recognizes the need for confidentiality but also recognizes the opportunity for improved communication.

8. Recommendations

A. What is the SAC planning to do to improve teaching and learning, student success, and degree or certificate completion?

1. Continue improvement of assessment for PCC core outcomes with guidance from the Learning Assessment Council, with a focus on creating improved assessment tools that include the ability to download individual data points and detailed comparison reports.
2. Create clear course-specific learning objectives for all courses to enable more consistent and meaningful assessment of outcomes.
3. Continue to track the effect the CH 151 pre-requisite on student success in CH 221.
4. Continue to work on Dual Credit offerings with local high schools.
5. Update Chemistry Advising Guide flow chart and work with Advising to establish effective communication regarding course pre-reqs, majors, and related fields of study.
6. Collect and analyze data on Chemistry Tutoring at all campuses in order to increase our commitment to student access, success and attendance.

B. What support do you need from the administration in order to carry out your planned improvements? For recommendations asking for financial resources, please present them in priority order. Understand that resources are limited and asking is not an assurance of immediate forthcoming support, but making the administration aware of your needs may help them look for outside resources or alternative strategies for support.

1. The Chemistry SAC is urgently requesting the addition of a permanent full-time evening technician at the Sylvania campus as a matter of safety.

A sustainable and well-functioning chemistry program relies not only on the chemistry faculty, but also on instructional support personnel (lab technicians). Lab techs are responsible for ordering chemicals, managing the waste stream, maintenance of sophisticated equipment, management of work-study students, and responding to emergencies in the teaching labs. These tasks are outside the job description of the chemistry faculty. The American Chemical Society recommends that Two-Year College Chemistry Programs have "One full-time laboratory technician for every four full-time or full-time equivalent chemistry faculty members." Furthermore, the ACS notes that "Part-time and student help are not adequate substitutes for full-time laboratory technicians."

Based on the ACS recommendation and the assumption that a full-time faculty teaches an average of 7 laboratory sections per year, each campus except Southeast falls short of acceptable staffing levels. Instructional support personnel are critical to providing a safe and well-functioning laboratory experience to our students. Currently, evening labs in particular are not being supported in some portions of the district and this lack of support raises safety concerns for students and staff. Ideally, there would be permanent evening coverage evening coverage at all campuses. Current staffing levels are shown in Table 4 on the following page.

The Southeast campus is teaching one or two evening chemistry labs per term; as this campus grows, additional evening tech support must keep pace with the addition of lab sections to the schedule.

The SAC has identified the Sylvania campus as needing a permanently funded full-time evening technician position. Staffing the evening lab technician position with casual personnel has met the immediate need of covering evening teaching labs; however, the casual positions are not meeting the needs of the Sylvania prep lab because of the additional responsibilities including:

- Handling chemical waste in the teaching labs which requires a knowledge and understanding of the DEQ regulations that govern identifying and handling of waste.
- Responding to chemical spills in a timely and appropriate manner.
- Managing over 750 chemicals currently stocked in the Sylvania prep lab.
- Maintaining and troubleshooting the wide variety of sophisticated instruments currently being used in the chemistry teaching labs and to support student research initiatives.

Table 4. *District-wide Laboratory Instructional Support*

Campus	Lab sections (FWS2014-15)	Shift	Job Classification	FTE	ACS Lab Techs
Southeast	23	Day	IST III	2.0	0.8
		Evening			
Cascade	48[6]	Day	IST III	Emergency coverage	1.4
		Evening	IST II	0.375 (0.75 shared with microbiology)	
Rock Creek	68	Day	IST III	1.0	2.4
		Evening	IST II	1.0	
Sylvania	68	Day	IST III	1.0 (Only 40% FTE is for chemistry as this is position is shared with physics and geosciences)	2.4
		Evening	Casual	<599 h	

Over the past year there have been four different casual employees in the evening casual position at Sylvania. A working knowledge of our chemical inventory and how it is managed is too vast to impart to short term staff. Laboratory technicians need to know which chemicals have limited uses. This past summer a chemical inventory of the Sylvania prep lab was completed. This inventory took 4 days to complete, and two additional Risk and Safety employees (one Casual employee worked for 4 days, and one Safety and Risk Services Specialist worked 1 day). The PCC Chemical Hygiene plan requires a complete chemical inventory to be conducted annually. This means every container must be physically inspected and the MSDS must be checked to ensure the information is current. This inventory was too large to be completed by a single employee.

An appropriate skill level of lab technicians is essential; they require extensive training to develop skills necessary to maintain and troubleshoot the wide variety of sophisticated instruments currently being used in the chemistry teaching labs and to support student research initiatives. All laboratory support technicians should have regular training and professional development opportunities to keep our teaching labs functioning in a safe manner. The commitment by the college to our laboratory technicians will ultimately allow the chemistry departments to attract and retain skilled lab techs. This is a direct benefit to the students because laboratory experiments cannot be completed without a properly functioning chemistry prep lab. In addition, the minimum qualifications for a lab tech in chemistry should be re-evaluated to better match the demands, technical challenges and equipment needs in chemistry.

[6] *Of the 48 sections taught at Cascade, 10 of those sections were at-home labs that required no tech support.*

2. **The Chemistry SAC is recommending the implementation of mandatory Campus-specific Safety and Laboratory Training.**
Knowledge of campus-specific chemistry laboratory safety features and advanced laboratory instrumentation is essential for chemistry laboratory instructors. Currently the only mandatory, paid training for chemistry faculty is a 4-hour annual OSHA training class taught by PCC Safety& Risk Services staff covering topics such as waste disposal, online materials safety databases, and emergency evacuation procedures. The SAC proposes to revise the training to include an in-lab practical component covering lab-specific safety features and procedures. PCC Safety& Risk Services has agreed to work with the PCC Chemistry faculty to revise and improve the mandatory safety training to include this in-lab campus-specific component. This mandatory training is currently paid for new hires.

The use of advanced instrumentation in PCC Chemistry labs is a great benefit to PCC students who gain experience with state-of-the-art laboratory tools and techniques, such as spectrometers, gas chromatographs and scanning electron microscopes. In order to teach students how to use these instruments properly and without damage to the equipment, instructors must be thoroughly trained in their use and maintenance. There is currently no mandatory training for chemistry faculty in lab instrumentation. FT faculty provide training for PT faculty in an ad-hoc manner. PT faculty are not compensated for their training time. This training should be mandatory for teaching in the chemistry laboratories, and PT faculty should be compensated for their training time. Ideally, training materials would be developed by FT faculty or experienced PT faculty.

The acquisition of modernized instrumentation in the chemistry labs throughout the district has raised the demands on our budgets. Additional dedicated funding for instrument maintenance and repairs is necessary to keep these instruments functioning. Lab technicians need time and training to keep our instruments properly functioning. When the instruments malfunction student learning stops as the experiments must be cancelled.

Table 5: *Training needed for Laboraotry safety and instrumentation*

Training Item	Current	Proposed	Needed
Safety	4-hour OSHA training by PCC Risk & Safety staff (paid)	4-hr updated safety training to include in-lab campus-specific component (paid)	Work with PCC Risk & Safety to revise training
Lab Instrumentation	Ad-hoc (unpaid)	Up to 3 hr training/term on campus-specific lab instruments for PT faculty new to teaching a lab course.(paid)	Development of Campus-Specific Training materials. Funding for PT faculty training time

3. **To support student retention and success in the CH 221-3 series the Chemistry SAC is requesting:**
   A. **Support to institutionalize the CH 151 competency exam by providing the proctored exam at the testing centers.**
   B. **Support in the form of release time or monetary support to develop a computerized version of the exam with automatic Banner connections. This would allow for a "Hands-Free" process to streamline the process for PCC students and employments.**
   C. **A more visible and accessible exam registration and information website.**

The data in section 2 A ii clearly show that the CH 151 prerequisite is helping students to succeed in the CH 221-3 series. Additionally, the CH 151 competency exam is providing greater student access and

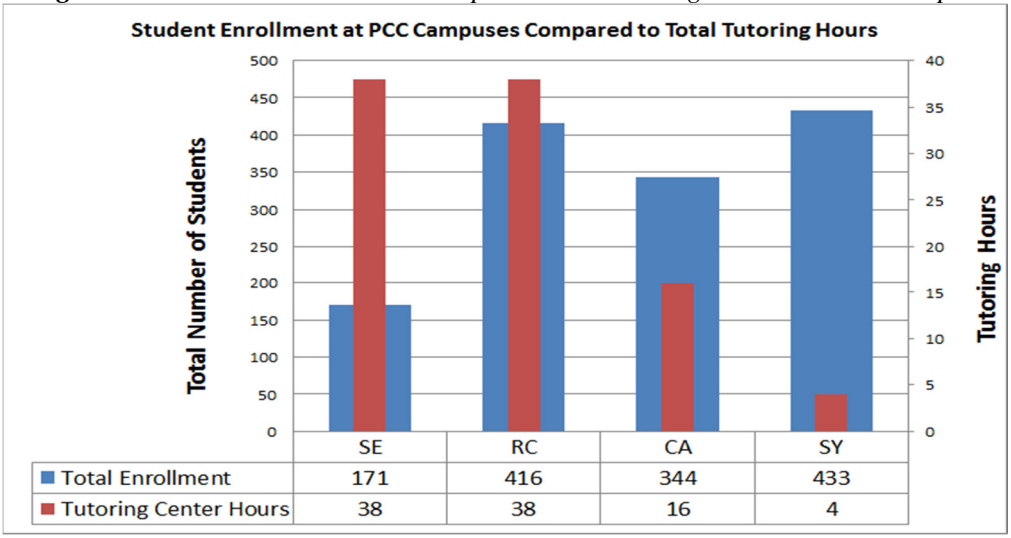
saving students time and money by helping to ensure they are in the correct chemistry class. Currently the administration of the exam rests with the district faculty and physical science admin Madhu Narayan at Sylvania. The 2-hour exam is being offered and proctored by FT chemistry instructors during our free time. We have put in 122 hours proctoring exams over the past 5 quarters including summer test dates. In addition, Madhu Narayan has spent over 100 hours creating and managing the information website about the exam for the entire district. This involves updating the website with times and dates of the exam, tracking the results of the exam, entering overrides into banner when students pass and checking on MTH pre-reqs before giving the override. The SAC is so very appreciative of Madhu's willingness to take on all of this extra work. This situation not only puts a strain on faculty and admin time, but is not the best use of our time.

To help alleviate this strain we have reached out to various departments at the college for assistance. Stacey Holland from Curriculum Enrollment Services has helped us create a field in banner to put in the test score to allow for an automatic override for students. This is now active as of Fall 2015. In addition, the SAC has met with various managers to seek having the exam proctored at the 4 testing centers around the district. Managers from both the instruction and student services sides of the college have been supportive of the idea as it encourages student success. We hope this can become a reality in the near future to support our students.

4. **To support student success in chemistry courses, the Chemistry SAC is requesting:**
   - **A. More availability of chemistry tutors and increased hours at the Sylvania campus.**
   - **B. Dedicated, trained and chemistry-vetted paid tutors (both students and PT faculty).**
   - **C. Increased resources (e.g. texts, model kits, computers with chemistry software).**
   - **D. A central location on campus where students can easily access the tutors.**

Decisions were made in the past to separate the PCC Physical Sciences from the central tutoring center for Math and English. Appendix 7 provides more detail regarding this past decision. The data which shows the dire need of tutors for PCC Sylvania chemistry students is shown below. The chart contrasts the tutoring hours and headcounts of chemistry students across PCC campuses. (Fall 2015 data, shown, is representative of other terms.) Clearly there are discrepancies between campuses. Additional data and survey results may be found in Appendix 7.

***Figure 4**: Student Enrollment in Comparison to Tutoring Hours at each Campus*



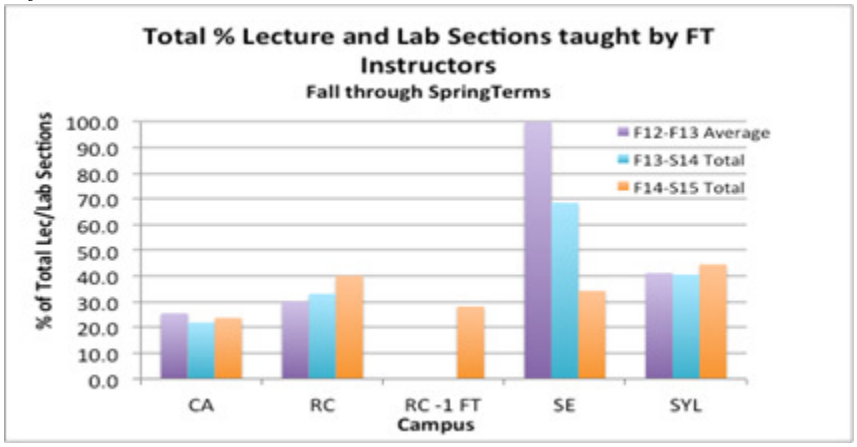
Resources are needed at the tutoring center, including PCs that have the chemistry programs utilized in the lab, modeling kits, and textbooks. The need for PCs is great as every campus utilizes online HW systems that students need access to and have many questions from.

Our students would benefit most from a centralized location for the tutoring center, near the building in which classes are being held. The current space which forces students out at various times during the day is located in the basement of the AM building far from the normal routes normally taken by students.

The onus of providing adequate tutoring for students should be the responsibility of student services. If student services is not immediately able to provide chemistry tutoring to students at Sylvania then the Chemistry SAC strongly supports a dedicated STEM center with adequate funding (see Appendix 7).

5. **The SAC recommends the creation of two full-time faculty positions: one at Rock Creek and one shared position between Cascade and Southeast.**
The American Chemical Society (ACS) recommends that full-time faculty teach 75% of the classes offered at a community college and that full-time faculty teach the full range of courses. Neither of these guidelines is met currently by PCC. Throughout the district, full-time faculty are substantially below ACS guidelines for FT/PT faculty ratio as shown in Figure 5.

Figure 5*: Percent of lecture and lab sections taught by full-time faculty at each campus during the last three school years. The data for Rock Creek during the 2014-15 school year includes an additional full-time temporary faculty member. Since this position was not renewed for the 2015-16 school year, the "RC-1 FT" data is calculated without including the full-time temporary position to better reflect current conditions.*



Rock Creek and Cascade have particularly low percentages of classes taught by full-time faculty; both campuses are currently below 30%. These campuses have lost full-time faculty members since the last program review, exacerbating the situation. The percentage of classes at Southeast taught by full-time faculty has also quickly fallen to levels below 40% despite the fact that the program is less than five years old.

In the past five years since our last program review the Chemistry SAC has made significant improvements in both lecture and laboratory courses. To ensure a meaningful lab experience, faculty write all the experiments for each course specific to the space, equipment and instrumentation available in each lab on each campus. The laboratory courses present a unique challenge in that faculty are tasked with effectively teaching the practice of chemistry in a ***safe*** and ***environmentally responsible*** manner. As new toxicology information on commonly-used chemicals becomes available, full-time faculty are ethically and professionally obligated to make changes in laboratory experiments. Unfortunately most changes are not plug and play, one chemical cannot often be effectively swapped for another. Instead entire laboratory

procedures must be developed to accomplish these changes and have the experiment work for students. This puts chemistry in the unique position of constant curriculum development. Additionally, there are not sufficient full-time faculty members to teach at least one section of every course offered at each campus offers during the academic year as shown in Table 6. So full-time faculty are not able to develop and update experiments in course they are not teaching. The SAC asserts that this situation is incompatible with offering high-quality instruction.

***Table 6**. Courses that were never taught by a full-time faculty member at a particular campus during the 2014-15 school year (considering lecture sections). *Courses taught at Rock Creek by a full-time temporary instructor.*

Cascade	CH 105, CH 222, CH 223, CH 100DL, CH 105DL
Rock Creek	CH 106, CH 211, *CH 104, *CH 105
Southeast	CH 151
Sylvania	CH 101

The SAC makes the following recommendations with respect to hiring new faculty:

- Replacement of the full-time faculty position at Rock Creek that was lost due to faculty resignation.
- Replacement of a 0.5 FT position at Cascade and creation of a new 0.5 FT position at SE.

Additional support NOT requiring financial resources

The SAC needs:

6. clearly defined best practices for assessment from the LAC.
7. college policy to establish and implement requirements for DL courses to address Integrity issues.
8. simple anonymous access to SAC-wide course evaluation data that includes the individual raw data points and comparison reports.
9. approval/support to use alternative course evaluation tools such as SALG.
10. increased dialogue with HR to develop effective strategies for recruiting a more diverse part-time and full-time teaching pool.

List of Appendices

Appendix 1: Instructor Qualifications

Chemistry Instructor
Master's degree (or higher) in the subject area OR a Master's degree (or higher) in a related area plus 30 quarter hours of graduate credit in the subject area.

Subject Area degrees includes but are not limited to:
- Chemistry
- Chemical Education
- Biochemistry

Related Area degrees include but are not limited to:
- Agricultural Chemistry
- Biophysics
- Chemical Biology
- Chemical Engineering
- Environmental Science
- Materials Engineering
- Material Science
- Petroleum Engineering
- Pharmacology
- Physical Sciences
- Toxicology

These lists of subject and related areas may not be inclusive as there are other degree titles that may be appropriate. The Division Dean, in consultation with the Faculty Department Chair, will make a recommendation to the Dean of Instruction about the applicability of a particular degree that is outside the scope of this list.

Provisional Approval
An instructor without a Masters or Doctorate may be approved if they have 30 quarter hours of graduate credit in the subject area and are actively pursuing the degree and are anticipated to be awarded the degree within six months of hire, as determined by the instructor's graduate advisor (a letter from the advisor will be required and kept on file.)

Revised: November 2011; Provisional Approval added December 2012

Appendix 2: Core Outcomes Mapping Matrix

CORE OUTCOMES MAPPING *SAC CH: Chemistry*

Course #	Course Name	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
CH 100	Fundamentals for Chemistry	1	1	1	0	1	0
CH 101	Inorganic Chemistry Principles	1	1	1	0	1	0
CH 102	Organic Chemistry Principles	1	1	1	0	1	0
CH 104	Allied Health Chemistry I	1	1	1	0	1	0
CH 105	Allied Health Chemistry II	1.5	1.5	1.5	0	1.5	0
CH 106	Allied Health Chemistry III	2	2	2	0	2	0
CH 151	Preparatory Chemistry	1	1	1	0	1	0
CH 211	Introduction to Biochemistry *	2	2	2	0	1	0
CH 221	General Chemistry I	2	1	2	0	1	0
CH 221H	General Chemistry I	2	1	2	0	1	0
CH 222	General Chemistry II	2	1	2	0	1	0
CH 222H	General Chemistry II	2	1	2	0	1	0
CH 223	General Chemistry III	3	2	3	0	2	0
CH 223H	General Chemistry III	3	2	3	0	2	0
CH 241	Organic Chemistry	3	2	3	0	2	0
CH 242	Organic Chemistry	3	2	3	0	2	0
CH 243	Organic Chemistry	3	2	3	0	2	0
CH 298A	Inorganic Chemistry Principles	0	0	0	0	0	0

Mapping Level Indicators:

1. Not Applicable.
2. Limited demonstration or application of knowledge and skills.
3. Basic demonstration and application of knowledge and skills.
4. Demonstrated comprehension and is able to apply essential knowledge and skills.
5. Demonstrates thorough, effective and/or sophisticated application of knowledge and skills.

* This class does not have a lab component

Core Outcomes:

1. Communication.
2. Community and Environmental Responsibility.
3. Critical Thinking and Problem Solving.
4. Cultural Awareness.
5. Professional Competence.
6. Self-Reflection.

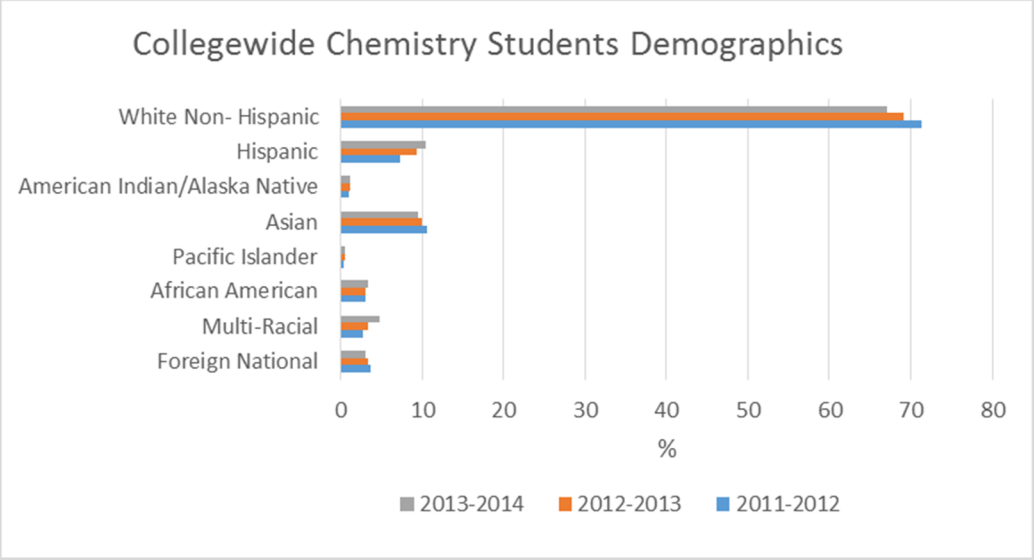
Appendix 3: Student Demographics Data

***Table 7**. PCC Chemistry student demographics data*

COLLEGEWIDE STUDENT DEMOGRAPHICS IN CHEMISTRY (%)[7]

	2011-2012	2012-2013	2013-2014	Portland metro region
Foreign National	3.6	3.3	3	-
Multi-Racial	2.8	3.4	4.7	3.2
African American	3.1	3.1	3.4	2.7
Pacific Islander	0.4	0.6	0.6	6.4
Asian American	10.6	9.9	9.5	
Indian/Alaska Native	1	1.1	1.2	0.7
Hispanic	7.3	9.3	10.5	11.2
White Non-Hispanic	71.3	69.2	67.1	75.7
Female	53.2	52.8	53.5	50.7
Male	46.5	47.2	46.5	49.3

Figure 6: Collegewide Student Demographics



[7] *Male and female data obtained from US census bureau accessed through (https://suburbanstats.org/population/oregon/how-many-people-live-in-portland), 6/12/2015*

Appendix 4A: Faculty Professional Development Activities

	What Professional Development or Activities led to change?					
Instructional or Curricular Changes or change to strengthen program	**Teaching**	**Research**	**Community**	**Professional Meetings**	**Professional Organization Memberships**	**Name**
Helped develop new CH 100 nonmjors course. At SY campus, developed field lab scientific inquiry project in CH 100.				POGIL NW Regional Meeting, Anderson Conference	ACS, POGIL Project (NW Regional Coordinator 2010-2011)	Stacey Fiddler
Helped re-design CH 151 Prep Chem course, develop required topics list, and contribute questions to CH 151 Competency Exam.						
Wrote CH 151 Competency Exam, wrote Math Mastery Exam	Experience in CH 221 series	Student Surveys, Math Mastery Exams		2-Year College Chemistry Consortium (2YC3) meetings	2YC3	Jim Schneider
Developed and taught CH 221 Honors Course Fall 13W	Experience in CH 221 series			2YC3 Meeting in New Orleans	2YC3	
Developed and taugh new CH 101 Course (and labs) for CMET students. Mentored instructors new to teaching this course.	Personal interest and meetings with CMET faculty			2YC3 Meetings - exposure to similar courses nationwide, discussions with course and text authors nationwide	2YC3	
General Instructional changes resulting from professional meetings and organizations, and teaching experiences with colleagues, including lab development and writing our lab manual, lecture workbook activities and compilation at publisher level.					2YC3	
Newsletter Editor (7.5 years) 2YC3 Chemistry Outlook				2YC3	2YC3	
Board member (7.5 years) American Chemical Society Committee on Chemistry in the Two Year Colleges					American Chemical Society, 2YC3	
Integration of nanotechnology to General Chemistry courses		Self-initiated /interest		2YC3	2YC3	
Mentored/Supervised Work-Study Postions: For future teachers and other interested students. Students help in nanotech lab development and testing, and assisted in implementation in the lab setting	self interest and training	previous materials science professional work		2YC3	2YC3	
Mentored/Supervised Volunteer Student Positions: Similar to Work-Study positions above	self interest and training	previous materials science professional work		2YC3	2YC3	
In Development: Integrating nanotechnology into the General Chemistry Curriculum, This is the subject of upcoming sabbatical 2015-16.	Previous success in developing nanotech labs for CH 221 Honors course	previous materials science professional work	Seattle's Hub for Industry-driven Nanotechnolgy Education (SHINE)	Micro-Nano Technical Conference, Seattle WA, June 24-26 2015. Giving workshop on nanotech labs		
Integration of nanotechnology labs into General Chemistry courses			Seattle's Hub for Industry-driven Nanotechnolgy Education (SHINE)		American Chemical Society, 2YC3	Patty Maazouz
Integration of new lab equipment (GC/MS) into the organic chemistry series lab curriculum. Students incorporated the GC/MS into capstone research projects.	Experience in CH241 series				American Chemical Society, 2YC3	
Developed and revised many Organic Chemistry Labs, including the adaptation of a 4-week experiment to synthesize an Aldol product while learning the fundamental experiment techniques in organic chemistry	Experience in CH241 series		Strengthening Sustainability Across the Disciplines and Across the Pacific Northwest Conference (WSU-Vancouver) and Discussions with Organic Chemistry Instructors at Clark College	2YC3	American Chemical Society, 2YC3	

	What Professional Development or Activities led to change?					
Instructional or Curricular Changes or change to strengthen program	**Teaching**	**Research**	**Community**	**Professional Meetings**	**Professional Organization Memberships**	**Name**
Currently working with the Civil and Mechanical Engineering Tech Program to create a recruitment and retention plan to help increase the enrollment and success of women and minorities. The skills learned in this class will hopefully strengthen the recruitment and retention of women in other science disciplines, including Physics.				NSF WomenTech Educations Online Training Fellowship by the Institute for Women in Trades, Technology & Science		
Improved the format and effectiveness of monthly full-time chemistry meetings at the Sylvania Campus.				PCC's Facilitation Skills for Leader Workshop (Professional Development Office)		
Collaborated with Charlie Washburn from the SYL Art Dept to create a 2-hr hands-on pottery workshop for students titled "Art of Chemistry; Chemistry of Art"				PCC's STEM Week Activities		
Helped contribute questions to CH 151 Competency Exam, prepared study guide, organized Competency Exam times, worked with Madhu Narayan to create registration and information website and to distribute flyers to advertise the exams each term, met with advisors numerous times to explain the pre-req and course changes during the CH100/CH151 transition; worked with Stacey Holland to get BANNER Code for Competency Exam; worked with Asst. Dean of Students to try to get exam proctored in Testing Centers (on-going).		SAC Discussions and Survey Data				
Integrated nanotechnology labs and material into the General Chemistry courses			Seattle's Hub for Industry-driven Nanotechnolgy Education (SHINE)	WCCTA	2YC3	Jon Riker
Converting all General Chemistry 222-223 labs from lab notebooks to worksheets, including rewriting of most labs	Success in CH221 course and cost savings for students				2YC3	
Integrated Scanning Electron Microscope (SEM) into General Chemistry courses, mostly lab environment	Experience in CH222 and relating chemistry to experiements. especially LED's	Previous work experience in industry using a SEM			2YC3	
Training of other instructors and students for using the SEM, including students from PSU	Utilizing use of the SEM including other campuses, disciplines, and schools	Previous work experience in industry using a SEM			2YC3	
Created a new CH100DL course including fully accessble content.			PCC training in on-line course development	WCCTA seminar on on-line teaching	ACS, 2YC3	Ted Picciotto
Instituted reflections and additional discussion board postings in all courses taught (102, 221-2-3, 241-2-3)	Based on experience in teaching DL coursework	Based on information gleaned from past SAC assessments on reflection	The move to go electronic with preivously paper versions of assignments was also motivated by PCC's 'Green' campaign.		ACS, 2YC3	
Requested the purchase of Rotary Evaporators for use in all organic chemistry based courses and rewrote labs for CH 102 and 241-2-3 to integrate their use into the curriculum once obtained.	Previous teaching experience at other college campuses which all used/had this equipment available.	Past research experience in industry in which this equipment was used. Additionally recent publications by the JCE have indicated experience with this equipment is one of the top priorities industry seeks for employment.			ACS, 2YC3	
Added 'alternate free resource' links to my DL course pages for on-campus courses such as ChemWiki for all 221-2-3 and 241-2-3 courses taught to help with those students who have difficulty with the costs of attending college				WCCTA seminar on open source content	ACS, 2YC3	

	What Professional Development or Activities led to change?					
Instructional or Curricular Changes or change to strengthen program	**Teaching**	**Research**	**Community**	**Professional Meetings**	**Professional Organization Memberships**	**Name**
As SAC co-chair initiated the development of CH 298A independent project research course				UCR Conference on Undergraduate Research at Community Colleges	ACS, 2YC3	
Switched to Sapling Learning on-line homework for CH 102			Discussions with Clark College instructors regarding the efficacy of using Sapling for drawing organic chemistry structures.	BCCE 2010 meeting	ACS, 2YC3	
Moving all course quizzes for CH 221-2-3 to on-line format and allowing multiple attempts	Positive feedback from students who like the idea of being given a 'second chance' to take a quiz	Reserach indicating additional self quizzing leads to better learning outcomes (Scientific American)	Discussions with Jim Schneider at PCC who has also moved to do quizzes on-line to save time during lecture.	WCCTA seminar on multiple quiz taking for competency	ACS, 2YC3	
Added 'Learning Objectives' and "preview/summary' to lecture slides for CH 102, CH 221-2-3	The emphasis on guiding students to learning outcomes during my DL course training and creation of an on-line course also helped guide my goal of clarity in my on-campus courses.			WCCTA/BCCE seminars on student learning	ACS, 2YC3	
Developed Rubrics for discussion posts in CH 100DL and for labs in CH 222 to help guide students to success in completion of their assignments				WCCTA/BCCE seminars on rubric writing	ACS, 2YC4	
Integrated the use of the GC/MS in a CH 241 disillation lab and CH 243 organometallic synthesis lab		The same JCE paper on Chemical Industry needs (2014, vol 41) ranked GC/MS the 5th mostly widely used equipment in the chemical industry			ACS, 2YC4	
Adapted a 'green' microwave experiment for CH 242 which uses column chromatography purification	Previously this technique was not in the organic chemistry curriculum.	The JCE paper on Chemical Industry needs (2014, vol 41) ranked column chromatography purification as the 5th in desired lab techniques			ACS, 2YC5	
Develop new CH 100 nonmajors course at CA campus.		SAC Discussions and Survey Data				Ken Friedrich
Helped re-design CH 151 Prep Chem course, develop required topics list, and contribute questions to CH 151 Competency Exam.		SAC Discussions and Survey Data				
General Instructional changes resulting from professional meetings and organizations, and teaching experiences with colleagues, including lab development and writing our lab manual, lecture workbook activities and compilation at publisher level.				WCCTA, BCCE		
Developed CH 100 and CH 151 lab Manuals	Implementation in the classroom has led to rewrites and improvements	SAC Discussions and Survey Data				
Collaborated on updating CH 221, 222 and 223 lab manuals.	Implementation in the classroom has led to rewrites and improvements					
Wrote CH221, CH222, CH223, and CH100 lab maunuals.					ACS	Mike Mackel
Developed CH100 nonmajors course.			Expanded Discussion of Sustainability in Chemistry Classes		ACS	
Developed and integrated new outreach activities for elementary school, middle school, high school kids, and underrepresented children in the K-12 age group.			SMILE, Hermanas, Centro Cultural		ACS	Gabriele Backes

	What Professional Development or Activities led to change?					
Instructional or Curricular Changes or change to strengthen program	**Teaching**	**Research**	**Community**	**Professional Meetings**	**Professional Organization Memberships**	**Name**
Enrolled and participated CEU-936E-0-45063 - Assessing Core Outcomes at PCC	Applied to Organic Chemistry sequence as assessment pilot program				ACS	
Integration of new lab equipment (GC, UV-Vis, Polarimeters) into the organic chemistry series lab curriculum.	CH 241 series and CH 106				ACS	
Promoting research in conjunction with the biology department in an effort to encourage teaching "across the disciplines". Designed a research project that aligns with the outcomes of both disciplines. Results will be presented at a Chemistry Conference sponsored by the chemistry department at Rock Creek.	CH 243 section of the OChem series	Intend to publish results in conjunction with biology faculty	An opportunity for all chemistry students to present their findings to the PCC community		ACS	
Developed CH 100 nonmajors course ar RC campus		SAC Discussions and Survey Data	Expanded Discussion of Sustainability in Chemistry Classes		2YC3	Danijela Vukic
Reidisgned CH 151 course at RC campus		SAC Discussions and Survey Data				
Developed and implemented new outreach activities for elementary school, middle school, high school kids, and underrepresented children in the K-12 age group.			SMILE, Hermanas, Centro Cultural			
Utilized the "Green Chemistry" labs at Cascade Campus to host lab sessions for Preview Day Students (each term) and with Jefferson High School Freshman.	Working with young High School Students certainly helps me to appreciate my college students!		Putting a good and fun face on PCC science courses encourages students into STEM fields			Kathy Carrigan
Helped re-design CH 151 Prep Chem course, develop required topics list.	It was apparent that our CH 221 students were consistently under prepared for success.	SAC Discussions and Survey Data		This was a common theme in the professional meetings I attend. The Washington State Colleges are now offering a Prep course for their General Cheminsrty courses.		
Collaborating and connecting with other two year college chemistry teachers keeps me up to date on a professional level				WCCTA, BCCE, 2YC3 Chair -Elect for 2017	WCCTA, BCCE, 2YC3 Chair -Elect for 2017	
Coordinating the work on updating the Chemistry 104 DL course shell that is available to be shared across the district. It is currently shared by SYL and CA. Technology for both the textbooks and the lab vendor is constantly changing and it is important to learn the new systems and disseminate this to PT Faculty. It is also enabling the ability to build and share a repository of teaching and learning resources that can be available faculty and students.	Consistently offering to "share" one shell and co-teach allows two sets of eys on one course. This enables us to see where inprovements are necessary	SAC Discussions		cCWCS Presented (with Ken Friedrich) a workshop for how to develop and best practices for teaching Chemistry online.		
Collaborated on updating CH 221, 222 and 223 lab manuals.	Implementation in the laboratory and comments from PT Faculty have led to improvements and the necessary rewrites.	We hope to have our students using desire to learn dropbox and eventually going paperless as in our online courses.				
As part of CH223, mentored students in independent research projects which formed the basis of demonstrations and activities to communicate climate change to the public.			Student-developed climate change activities presented at OMSI and Portland area elementary schools	Chaired symposium entitled "CitizenFirst: Communicating Climate Science to the Public" at the American Chemical Society National Meeting, Spring 2015, at which PCC students presented their work.		Tracey Scherban

Appendix 4B: Faculty Professional Development Funding

Professional Development

The full-time chemistry faculty currently spend much time training and mentoring part-time faculty every term for both lectures and labs. In the lab it is imperative for the full-time chemists to provide syllabus templates, lab schedules, weekly lab procedures especially with safety concerns, lab handouts with updated instructor notes, lab grading guidelines, etc. to ensure the consistency between all lab sections and for the safety of the instructor and students. In order to communicate effectively and efficiently with all the part-time instructors for a particular course, a lead instructor usually schedules weekly meetings to provide the necessary information for a successful experiment. This technical training is mandatory for all instructors to effectively teach students how to use the chemistry lab equipment.

In addition to these lab requirements, the part-time faculty also need to be mentored for any new lecture they are teaching and for any updates to the course materials. Since most part-time applicants have little to no teaching experience, especially with collaborative learning, the full-time faculty must train the part-time instructors. This includes providing a syllabus with the schedule and updated PCC policies, training for guided inquiry activities, online homework programs, clickers, Thinker Buddy, and other methodologies, as needed.

The Chemistry SAC will continue to provide the necessary training for part-time faculty. However, all this training is currently completed without pay for the part-time instructors and reduces the amount of time that full-time faculty could spend writing innovative labs, improving lecture materials, designing effective assessment instruments, etc.

In addition, the full-time and part-time faculty do not have sufficient access to financial resources to allow them to attend workshops, meetings, and conferences. Specifically, a full-time instructor may have up to $400 per year to attend a conference and the part-time instructors do not have any funding. As shown in Table 8 below, the cost of most chemistry conference registration fees and travel costs far exceed this amount. For example, the registration fee for the National American Chemical Society Meeting, the largest international meeting for chemistry, is $470 + a $158 membership fee NOT including travel costs, lodging, or meals. This meeting has numerous symposia and presentations on the latest technologies in chemistry and Chemical Education.

***Table 8**: Costs for Current Chemistry Conferences*

Conference	Membership Fee	Registration Fee	Travel
National American Chemical Society Meeting	$158	$390 early for ACS Member $685 for ACS Nonmember	$600 (to Boston for Fall 15 Meeting)
Regional American Chemical Society (NORM)	Same membership as above	$120 ACS Member $140 Nonmember	$700 (Pocatello, ID)
Two-Year College Chemistry Consortium 2YC3 Conference	$25	$40 Full-time Faculty $20 Part-time Faculty	$500 (St. Louis, MO)
Washington College Chemistry Teachers Association (WCCTA)		$433-662 (includes lodging)	$173 (300 miles)
POGIL NW Regional Workshop		$399	$0 (local)
Biennial Conference on Chemical Education		$300	$400

Appendix 5: Facilities and Academic Support

SYLVANIA

Lab Space:

In Summer 2012, as part of the bond remodel, Sylvania campus had 3 chemistry labs remodeled and upgraded. As part of this remodel, new fume hoods were installed, including additional fume hoods in two of the labs. The increased hood space allows for more modern experiments in organic chemistry (241-243) and other chemistry courses (221-223, 102, and 106), and increased safety as the result of the much-improved ventilation in all the labs. Also, a waste exhaust snorkel was installed in all three labs. The lab space at Sylvania was reduced in size from 24 students to 22 students per section, which has helped the learning environment, though even smaller sections would help even more.

With the additional labs, we now are offering a newly created CH 100 course for non-science majors titled Everyday Chemistry with Lab that utilizes an integrated lab/classroom space.

Also, with the newly remodeled labs, we had new deionized water (DI) filters and ultrapure water equipment installed for use in all 3 labs and for new development of nanotechnology labs in the 221-223 series.

Equipment:

Some of the new equipment that was purchased at Sylvania through grants were the Gas Chromatograph Mass Spectrometer (GC/MS), Scanning Electron Microscope (SEM), Atomic Absorption Spectrometer (AA), and rotary evaporators. These have allowed for more experimentation and new labs primarily in the organic chemistry (241-243) and general chemistry (221-223) courses, with further development ongoing. Also, numerous departments and disciplines across the district and even at PSU have been able to utilize of the SEM.

An important drawback of this new lab and water supply equipment is that during the bond remodel planning and the grant writing, we commented on the need for sustainable funding to include the regular equipment maintenance and replacement of consumables. While PCC strongly pushed for enhanced technology and experiences for students, the college has not increased the department's funding to deal with these new expanded costs. This has caused us to detract from our regular operating and equipment budget to funnel money into the maintenance.

SOUTHEAST

Lab Space:

Prior to the 2013-14 academic year, chemistry offerings at Southeast were severely limited due to lack of a lab with safety showers, natural gas lines, hoods, and chemical storage space. Only CH 100 was offered during the 2011-12 and 2012-13 academic years. With the opening of the Student Commons building at the beginning of Winter 2014, a fully equipped chemistry lab came online that allowed 200-level chemistry courses to be offered at Southeast for the first time. This directly benefited residents of East Portland neighborhoods who were previously required to travel long distances to take General Chemistry at other PCC campuses, Mt. Hood Community College, or PSU.

Equipment:

Much of the equipment purchases at Southeast have been focused on supporting a lab curriculum that stresses instrumentation and data analysis. Laptops and a full range of Vernier sensors were purchased for the program. Especially noteworthy among equipment purchases have been three mini-Gas Chromatographs and an Infrared Spectrometer for use in CH 221-222-223 General Chemistry course. Chromatography and spectrometry are central to chemistry practice (as well as being central to many other STEM disciplines) and introduction of these techniques to students early in their college careers provides an important foundation for future lab work.

CASCADE

Lab Space:

Currently Cascade Campus only has one lab room. This has limited the number and types of classes that Cascade can offer. Typically evening classes are highly enrolled at Cascade. This has led to 4-hour evening lectures (6:00-9:50pm) to accommodate having only one lab room available in the evenings. This is not the ideal way for students to learn chemistry. We regularly get students suggesting a change to which we have to respond "we only have one lab room."

Tutoring:

Chemistry tutoring is well supported at Cascade by the Teaching and Learning Center. The coordinator, Penny Thompson ,works regularly with the FT faculty to have a variety of student tutors. The FT faculty regularly hold 3-5 office hours at the tutor center. In addition many of the PT faculty spend at least 1 hour a week in the tutoring center. One PT faculty member holds a weekly online office hour in support of the DL classes at Cascade.

ROCK CREEK

Equipment:

Purchases of new equipment were limited to rotary evaporators for the organic chemistry labs and Vernier Spectro-Vis spectrophotometers for the general chemistry labs. These have allowed us to make important curricular changes in the older labs.

Appendix 6: Instrumentation

Table 9: *Integration of new instrumentation into the teaching labs.*

Instrument	Class Application
SEM *Scanning Electron Microscope*	● View micro/nano materials ● Verify student experimental outcomes by elemental composition analysis ● Shared with biology, engineering, and other disciplines across the district, as well as PSU
GC/MS *Gas Chromatograph/ Mass Spectrometer*	● Multiple experiments in organic chemistry I, II and III have been modified to use this instrument
AA *Atomic Absorption Spectrometer*	● In CH 106, students made dental composites and analyzed how much calcium was released from those composites into water. ● In ESR 172 students investigated the Ca released from various green vegetables. ● Also used for calcium analysis on dental research on samples provided by OHSU dental school

Appendix 7: Student Support and Tutoring Issues

Physical Sciences Tutoring Space: History

The split of the physical sciences at Sylvania campus from the centralized tutoring center was due to conflict resulting from an unwillingness to involve the PCC chemistry faculty in the vetting of chemistry tutors. Subsequent complaints by students regarding poor quality chemistry tutors predicated another solution. The resolution at the time involved a splitting of the physical sciences from Student Services-run tutoring and as a result Physical Sciences formed its own tutoring center.

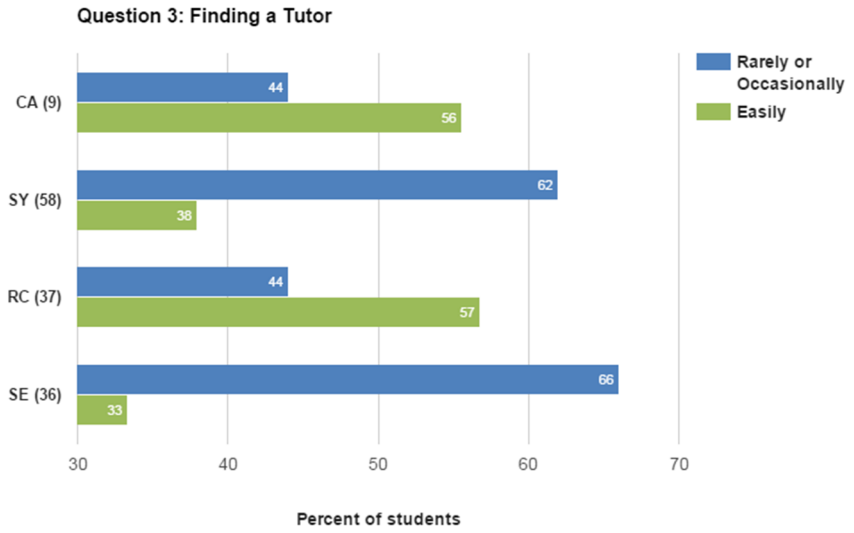
At the time of the formation of the Sylvania campus physical science tutoring center, a budget of $4000 per term and a separate room to house the physical science tutors was allocated. With the bond remodel at Sylvania we have lost the dedicated room. It is now shared with engineering and CMET, meaning the students have to leave the room when other classes and labs are scheduled. Additionally, since the budget was secured, it has not increased to keep pace with inflation (in terms of tutor salaries) or the increase in enrollment at the Sylvania campus.

Tutoring Needs at SY and SE

While there are no specific tutoring recommendations per student for two-year colleges, we collected data on our students' experience with chemistry tutors at different campuses and found significant differences in the students' experience at Sylvania compared to the other campuses.

One question asked was the ease with finding a chemistry tutor on each campus, as seen in Figure 7.

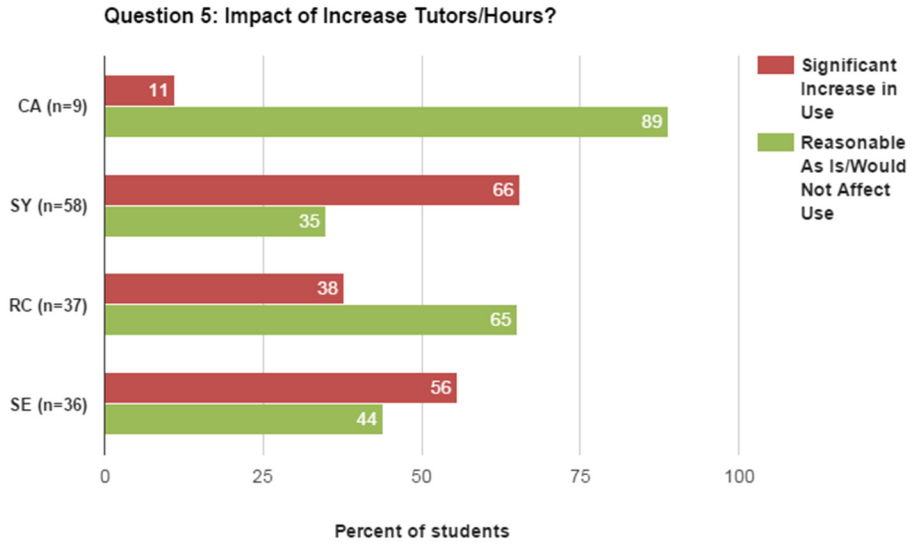
Figure 7: *Ease of Finding a Tutor by Campus*



Over 60% of students at the SE and SY campuses had a more difficult time locating a tutor for help. At Southeast, which has good coverage of chemistry tutoring, we believe outreach to students in our chemistry classes about where the center is located and how it works needs to be improved. The chair at the SE campus will be involved in creating more flyers to advertise the tutoring center and reaching out to part-time faculty to ensure that there is a link to the tutoring center hours through the various course websites.

Figure 8 show responses to another question that was asked in the research survey: "If there were increased number of tutors or increased hours, how would it impact the use of the tutoring center?" Sixty-six percent of Sylvania students polled indicated increased hours would significantly increase their use of the tutoring center and thereby improve student success.

Figure 8: *Potential Impact of Increased Tutor Hours*



Survey comments from students at Sylvania include:

> *"I really love chemistry tutors, but in SY campus, it is hard to find the chemistry tutors, so I have to go to a rock creek campus.*
>
> *"The tutoring center needs more times available. I have not been able to attend because of the lack of hours available. We need more tutors!"*
>
> *"There are very few hours available for tutoring and when in the tutoring center, you may not get even one question answered as the one tutor cannot accommodate everyone. Questions tend to take a lot of time, so the tutor isn't available for a long period, even if they are present and their hours are so short that there is hardly any opportunity to ask questions."*

Steps Sylvania Has Taken To Remedy the Issue

To deal with the paucity of tutoring, a number of Sylvania instructors have started to use their office hours as workshops to tutor small groups of their students in an available classroom or lab. While this has ameliorated the problem somewhat in the short term, not all instructors or classes are able to hold workshops, particularly part-time faculty. In addition, there is no dedicated space for these workshops to occur.

Dedicated Tutoring Space Needed at Sylvania

If student services is not immediately able to provide chemistry tutoring to students at Sylvania then the Chemistry SAC strongly supports a dedicated STEM center with adequate funding.

Funding. The tutoring budget for Sylvania for the physical sciences has been $4000/term for the past 10 years with no increase to account for increases in wages. If the tutoring center budget had kept pace with inflation and enrollment the budget should now be closer to $15,000 per term. We are requesting at a minimum a physical science tutoring center budget of $15,000 per term for the Sylvania campus to significantly improve student success (note: this budget is shared with physics and geology which are also impacted). This increase in funding

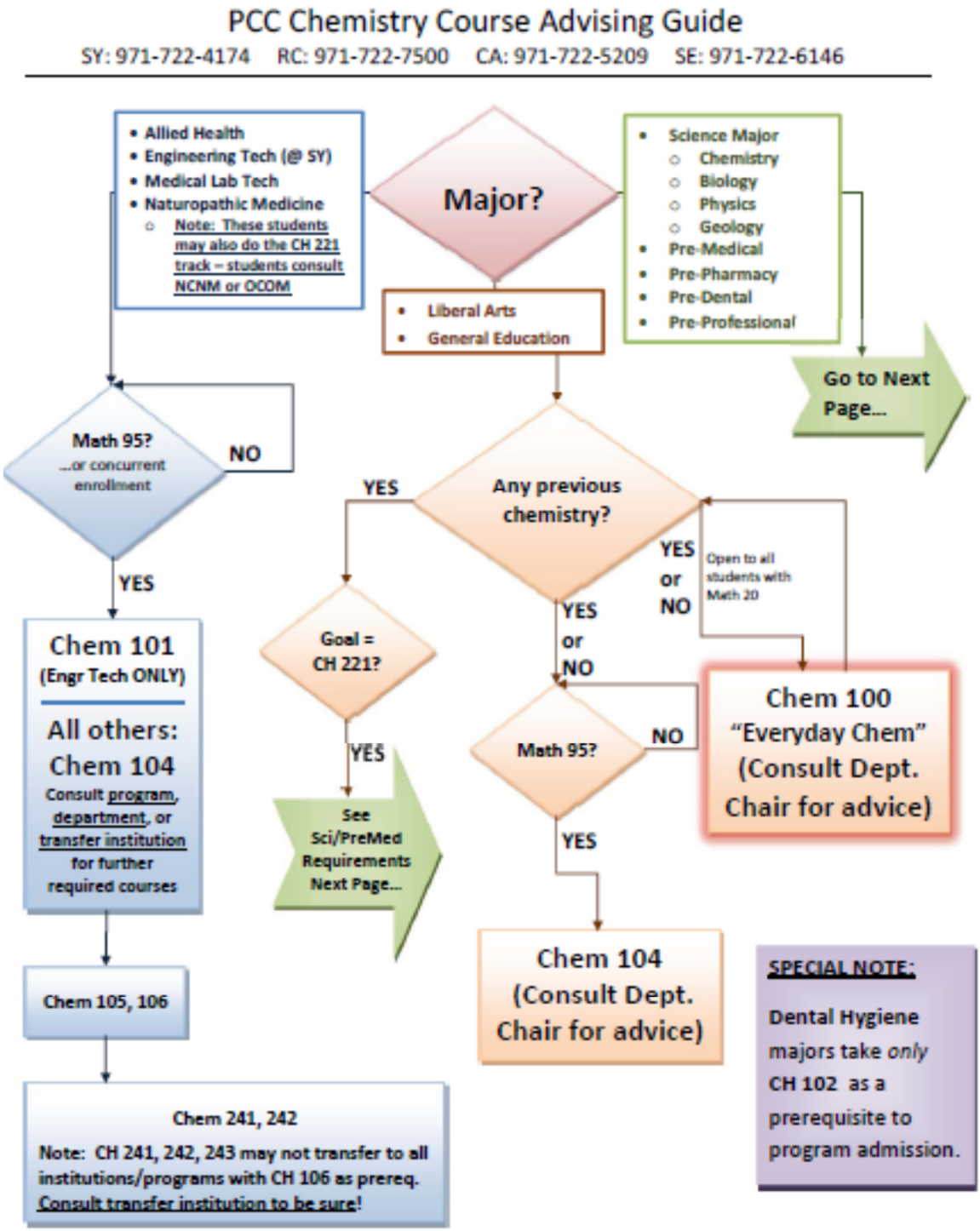
would subsequently increase the number of chemistry tutoring hours from 4 to 20 which would start to approach the current availability of tutors at the other campuses.

Dedicated STEM center. The current physical science tutoring center at Sylvania is in a separate building from where the classes are held and must share space with the engineering and CMET classes which limit days and times that the room is available to use for tutoring. We need to find a dedicated central space for tutoring STEM students closer to where the courses are being held to improve student access. A dedicated space could also allow for part-time faculty to hold office hours (with a white board and adequate space) and workshops with small groups of students. Currently, approximately 75 part-time physical and life science faculty at Sylvania share 9 work stations, allowing only minimal opportunities for part-time faculty who are eager to hold office hours and advising hours. If this were possible we would also be willing to try and set-up STEM advising hours to help students make choices within the STEM careers.

Materials and supplies needed. The current physical science tutoring center at Sylvania has access to 6 computers shared with engineering and also some textbooks that can be checked out for use on a limited basis. A dedicated STEM center with more supplies and space would contribute to student success greatly:

- A room large enough to have open study space with 10 tables and a reception desk for students to check and log in at.
- 12 computers that have the physical science image including licenses to programs like Odyssey, Spartan, LoggerPro and other key programs that students use in lab regularly.
- Copies of current textbooks and modeling kits that students may check out from the reception desk.

Appendix 8: Advising Charts



PCC Chemistry Course Advising Guide

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