Chemistry SAC

Portland Community College

Program/Discipline Review
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1. The Discipline

A. Introduction and Goals

“Chemistry is central to the intellectual and technological advances in many areas of science. The traditional boundaries among chemistry subdisciplines 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”.

This excerpt taken from the 2009 ACS (American Chemical Society) “Guidelines for Chemistry in Two-Year College Programs” exemplifies the goals of the Portland Community College Chemistry SAC. Chemistry is a central discipline for biology, physics, engineering, allied health, medicine, pharmacy and liberal arts. As such, the Chemistry SAC offers courses for chemistry students who will transfer to four-year institutions, who will complete requirements for career and/or technical training, or who are looking for personal enrichment. Although the fundamental concepts taught in the chemistry courses have not changed since the last program review in 2004, the direct applications for these concepts have changed to encompass green chemistry, nanotechnology, alternative energy, and several other very important advances in our society. In addition, the chemistry faculty is continually working to apply innovative teaching methodologies in the lectures and labs based on current pedagogical research.

B. The Discipline Within PCC

The Chemistry program at PCC plays an important role in fulfilling PCC’s mission, values, and goals.

PCC Mission

Portland Community College provides access to an affordable, quality education in an atmosphere that encourages the full realization of each individual’s potential. The college offers opportunities for academic, professional, and personal growth to students of all ages, races, cultures, economic levels, and previous educational experiences.

The Chemistry SAC continues to implement their mission statement to complement the college’s mission statement. The Chemistry SAC’s mission statement, learning outcomes and the manner in which we deliver instruction were developed to support the College Mission to provide a

1 ACS Guidelines for Chemistry in Two-Year College Programs, American Chemical Society, Spring 2009, p. 1
2 Chemistry SAC Mission Statement: To help students develop inquisitive minds and confidence by encouraging them to exercise critical thinking skills, use effective communication, apply science to real life situations, and utilize scientific literature and other media to become informed and take action in their community.
“quality education in an atmosphere that encourages the full realization of each individual’s potential.”

In support of PCC’s mission statement, six specific goals are listed and outlined below to show how the chemistry program supports each goal.

Goal 1 – Access: We will improve access to quality lifelong learning opportunities through the effective use of technology, affordable classes and the strategic location of facilities.

All courses taught district-wide at PCC are listed in Table 1 in Appendix 1. The highlighted courses are new distance learning (DL) courses that were developed and offered since our last program review in 2004. The addition of these DL courses allows students to access many of our classes from remote locations. Our district-wide chemistry program offers students access to a large variety of chemistry courses (see Table 1 in Appendix 1), including the most basic courses that teach the fundamental skills necessary to understand chemistry (i.e. CH100) to advanced courses (i.e. CH241-3) that provide students access to fulfill pre-requisites for graduate-level and professional programs. Consequently, our program provides access for students without any prior knowledge of chemistry, for students fulfilling requirements for health professional programs, for students completing careers in the sciences or engineering, and for students requiring just a few classes to enter professional programs, such as naturopathic medicine, pharmacy, chiropractic schools, and physician's assistant programs.

Goal 2 – Student Success: We will promote success for all students through outstanding teaching in lecture and laboratory settings, student development programs, and support services in all that we do.

Success for all students is promoted by the instructional expertise of faculty and support staff. The chemistry faculty incorporates a wide variety of instructional methodologies and pedagogies in order to reach the greatest breadth of learning styles. These include, but are not limited to lecture, hands-on laboratory instruction, inquiry-based student centered learning, demonstrations, field trips, computer molecular modeling, service learning, tutoring, and access to instrumentation relevant to their careers, both at PCC and at partnering institutions.

All campuses participate in student development programs. We have partnered with the University of Oregon to participate in the Undergraduate Catalytic Outreach and Research Experience (UCORE) program, a National Science Foundation (NSF)-funded grant to promote undergraduate research experience for community college students in the physical sciences. We also encourage student participation in Oregon NASA Space Grant Consortium and Research Experiences for Undergraduates at Portland State University and similar programs both regionally and nationally.
The chemistry SAC has been actively engaged with many support services at PCC. The SAC provided advising guidelines for all courses to the academic counseling center on each campus. The SAC also works with the Office of Students with Disabilities (OSD) to provide accommodations for students with disabilities to succeed in challenging situations such as the laboratory. Both full-time and part-time faculty work with the student learning centers across the district to provide tutoring and to improve student access to faculty and access to textbooks, molecular modeling kits, and additional resources. For example, the Sylvania campus has a separate physical science tutoring/computer/study lab maintained by the department and staffed by faculty and trained student tutors. Since the last program review, computer access has become widely available across the district, providing access to various on-line study aids while on campus.

**Goal 3 – Diversity:**  *We will enrich the educational experience by committing to the development of diversity in our student body, faculty and staff.*

The SAC recognizes that there is work to be done to achieve this goal. However, an awareness of diversity issues is the first step toward this goal, followed by faculty participation in various activities that strive to provide a continued awareness of the issues. Some examples include:

- The chemistry faculty complete cultural awareness training as part of our incoming job training at the new faculty institute.
- Many faculty members participate in the cultural activities at the various campuses, including presentations offered by the Teaching Learning Center (TLC).
- Ken Friedrich is currently the science liaison to the Native American Youth Association charter school.
- Our variation in teaching methods (such as small groups) helps provide access and exposure of all students to students with different ideas, opinions, and backgrounds.
- Faculty encourage students to apply for scholarships and to participate in research opportunities, which include programs that specifically seek minority or underrepresented applicants.

**Goal 4 – Continuous Improvement:**  *We will ensure the relevance and quality of all programs and services through planning, assessment and appropriate distribution of resources.*

Our faculty members are deeply committed to improving the quality of our lecture and lab courses we offer. Our full-time faculty stay current in their specialties and new teaching methodologies by reading literature and attending local, regional, and national conferences and workshops. Such conferences and workshops provide inspiration, training, exposure to new
ideas, and also the ability to establish and maintain networks with faculty throughout the country and world. These contacts allow our faculty to maintain courses and content in line with national standards in chemical education. We also train and mentor part-time faculty to prepare them for the same excellence that we expect in the classroom. An integral component of our part-time hiring process is searching for candidates with teaching experience and who possess an openness to utilize new techniques in the classroom to enhance student learning. With the growing number of part-time faculty, this is an increasing responsibility for the full-time faculty. We encourage all faculty to take advantage of professional development opportunities, including writing IIP grants to update and implement innovative curriculum in the lecture and/or lab. See Table 2 in Appendix 1 for a summary of IIP Grants awarded since 2004, see Table 3 for a complete list of faculty accomplishments, conferences and professional organizations attended by current chemistry faculty.

A current trend at PCC is the development of online programs. In order to keep our courses relevant with other technology programs that have gone online, we developed several distance learning courses in chemistry. For example, the development of the General, Organic, and Biochemistry (GOB) sequence as a totally online option, supports the Medical Technology online program, so that students can complete the courses required for this program from the rural areas of the state of Oregon.

Additionally, a partnership was recently established between the chemistry and engineering faculty to develop a course that meets the needs of the engineering technology program. This course was offered in the Winter and Spring 2010 terms and the effectiveness of this course is currently being evaluated by the chemistry and engineering faculty. The SAC is also aware of the changing population of students enrolled in the traditional CH104 series. Therefore, much discussion has occurred within the SAC for the need to evaluate and identify the needs of the students enrolled in this series.

For the past continuous ten years, two different chemists from PCC have been the editor of the Chemistry Outlook, a publication of the consortium on chemistry in two-year colleges, an activity of the Division of Chemical Education of the American Chemical Society. Moreover, one of the Western Regional Advisory Board members is from PCC. In addition, PCC hosted the western regional Two-Year College Chemistry Consortium (2YC3) Conference on September 10-11, 2010, in which the Program Chair from Sylvania, the Local Chair from Cascade, and the Exhibitors Chair from Rock Creek attended. A different faculty member is a co-coordinator for the Process Oriented Guided Inquiry Learning (POGIL) POGIL Northwest Regional Network, which is a branch of the national POGIL network. Overall, the chemistry faculty are actively engaged in many national organizations to continually improve methodologies and pedagogies utilized in the courses taught at PCC.
Goal 5 – Cultivating Partnerships: We will effectively respond to the educational needs of our students and communities through strategic alliances with business, government agencies and educational institutions.

We have established two critical partnerships that have increased student access to lab equipment and research opportunities. First, all three campuses have partnered with the University of Oregon to provide summer research opportunities and outreach experiences to encourage students to seek a career in the physical sciences through "Undergraduate Catalytic Outreach and Research Experiences (UCORE)." Second, the Sylvania campus has partnered with George Fox University to provide hands-on student access to Nuclear Magnetic Resonance Spectroscopy equipment for the PCC students enrolled in organic chemistry on the Sylvania campus. Although the chemistry faculty do not have a large number of partnerships, we are interested in establishing more.

Goal 6 – Community: We will facilitate growth and development of our district communities by accepting a leadership role and serving as a key educational resource to the community.

Since our last program review, Stacey Fiddler organized the Regional Science Fair associated with the Intel International Science Expo at the Sylvania campus from 2007-2009. This was key to establishing an invaluable resource to the Portland-area community.

PCC Chemistry serves as a key educational resource to the Portland community. The students depend on our affordable high quality classes. We prepare students for many professional programs that require just one, two, or even more chemistry courses. We prepare students to succeed in chemistry by providing preparatory courses and many transfer courses. Our community relies heavily on PCC to prepare students for the college/university level courses. What would Portland look like without a PCC Chemistry program? We truly are an integral resource for our community. We continue to open new sections of chemistry, hire more part-time faculty, and acquire new equipment to facilitate the growth and development of our district. We are seeking to offer a new non-science majors chemistry course that focuses on sustainability and a separate nanotechnology course that will teach students basic high tech terminology and hands-on experimentation with concepts utilized by the many nanotechnology companies in the Portland-metro area.
2. Curriculum

A. National and Professional Guidelines

The American Chemical Society (ACS) is the preeminent professional organization that supports scientific inquiry, education, and applications in the field of chemistry. The ACS Guidelines for Two-Year College Programs (Spring 2009) serve as an internationally accepted standard for curriculum evaluation. This document can be found at [http://portal.acs.org/portal/PublicWebSite/education/policies/twoyearcollege/WPCP_012239](http://portal.acs.org/portal/PublicWebSite/education/policies/twoyearcollege/WPCP_012239).

Curriculum guidelines can be found in sections 5, 6, and 7 of that document and include standards for pedagogy, course offerings, student research, and development of student skills.

A review of those guidelines indicates that the chemistry program at PCC meets the majority of current national standards for chemistry programs. However, there are some minor deficiencies that will be addressed below. In general, courses are offered that are equivalent to those at two and four year colleges and universities around the country, as determined through comparison with the ACS guidelines. What follows is a discussion of specific national standards for curriculum as developed by the American Chemical Society.

**Pedagogy.** Full time and part time instructors at PCC offer pedagogy informed by research on student learning. Examples include Process Oriented Guided Inquiry Learning (POGIL) which incorporates constructivism and collaborative learning, technology-aided instruction, service learning, inquiry-based labs, and for some classes, the incorporation of the Science Writing Heuristic (SWH) ([http://avogadro.chem.iastate.edu/SWH/homepage.htm](http://avogadro.chem.iastate.edu/SWH/homepage.htm)).

Included in our courses are laboratory components that are based on many appropriate pedagogies that reflect the experimental nature of this science. Inquiry based labs and the SWH are two examples that model the lab experiences in such a way as to reflect the nature of the science itself and the nature of professionals using the discipline. There are other examples, such as the application of green chemistry principles ([http://portal.acs.org/](http://portal.acs.org/)) follow the ACS Green Chemistry Institute link) in organic chemistry and some general chemistry labs, the introduction of nanotechnology as an emerging science, the production and analysis of biodiesel, to name a few. These experiences connect the vital role of chemistry in our modern society to the personal lives of individual students.

The ideal is to have lecture and laboratory tied together to provide a uniform experience where one experience reinforces the other, and in doing so provides practice in the development of critical thinking skills, content knowledge, and exposure to cutting edge ideas and equipment and facilities. As should be obvious, maintaining a high standard for such an endeavor requires...
significant support in both time and money, as chemistry is a rapidly changing and highly relevant field to our general society. Many full time (and some part time) faculty are provided the opportunity to maintain their knowledge of best practices in chemistry and modern theories of learning and cognition. Unfortunately, monies provided to divisions and departments for travel, registration for conferences, and membership in professional organizations is extremely limited. In the current biennium, at least one campus has no travel money available to faculty. In addition, while such opportunities as Instructional Improvement Grants are available for changing curriculum, the challenge and depth of revising a course such as chemistry that involves lecture and laboratory experiences exceeds the compensation in time and money available for such a venture.

**Prerequisites.** The chemistry SAC maintains a rigorous set of prerequisites for each course to help ensure student success and retention, as well as to maintain the transferability and accreditation of our courses and program. However, the current ACS standards state that “An effective assessment of each student’s preparation and readiness for a course can be achieved by testing, transcript evaluation and/or counseling.” The chemistry program at PCC currently does not have an effective assessment means by which instructors and students can assess student readiness for a particular course, outside of transcript and prerequisite evaluation possibilities. To that end the chemistry SAC has experimented on some campuses with a version of an “entrance exam” which was correlated to student course outcome. Initial results are spotty and inconclusive because there was no standardized method of administering the test across the district. Further research into this is necessary.

One major prerequisite deficiency seen across the district is readiness by many foreign students in English language comprehension and communication skills. Students with limited verbal (and written) understanding of English often are found in our introductory courses, even though they pass all English competency exams for admission to PCC. These students have severe difficulty in understanding verbal commands, and many have never had exposure to a laboratory classroom, in spite of the fact that in their country they have had high school chemistry. Such students pose a hazard to themselves and to their classmates and instructors. When using potentially hazardous equipment and chemicals, students must clearly understand the procedures and hazards associated with them. Unfortunately, there are few procedures available to evaluate these competencies of such students within the realm of the duties and professional skills of most faculty. In addition, it is difficult and time consuming to document such deficiencies in order to remove students from these classes and place them in remedial English speaking programs. The faculty do note that there are classes and groups available on campus for students to practice their skills. Unfortunately, being removed from a class when they are not competent in the language can set students back anywhere from 1 term to 1 year of their international studies, at a severe cost to the student.
Course Offerings. PCC offers a full complement of courses serving students in an allied health program, engineering program, microelectronics program, veterinary technician program, a pre-professional program, environmental studies program, biotechnology program or transfer into a four year institution as a science or non-science major. We offer these courses consistently throughout the year and with whole sequences in consecutive terms, including trailer courses and summer courses. Department chairs at each campus consult in order to offer at least one section of each course as often as possible in the district. PCC offers courses that meet the transferability requirements for the Oregon University System* (See Appendix 2) and meet the following requirements established by the ACS.

* Note: Oregon Health Sciences University does not currently transfer the CH241 Organic Chemistry series from PCC.

1. Specific courses currently offered at PCC fall under the following categories listed in the ACS Guidelines. Each course meets the course guidelines outlined by the ACS and transfers to four year colleges.
   - **Preparatory Chemistry Courses: CH 100**
   - **Specialty Chemistry Courses: CH 102- Organic Chemistry Principles for the dental hygiene program and CH 211-Introduction to Biochemistry for naturopathic and other health science majors.**
   - **Chemistry for Allied Health and Health Sciences: CH 104, 105, 106**
   - **General Chemistry: CH 221, 222, 223**
   - **Organic Chemistry: CH 241, 242, 243**

2. PCC offers student research opportunities through externally funded programs.
   - The Undergraduate Catalytic Outreach and Research Experience (UCORE) is an NSF funded project that brings PCC and other Oregon community college students completing their first year of college to the University of Oregon for a 10-week summer research program in Chemistry, Physics or Geology. Students return to their home campus for their second year of college where they conduct outreach projects to help other students succeed in the Physical Sciences.
   - PCC is an active member of the Oregon NASA Space Grant Consortium which offers a variety of competitive internships in fields related to space science. Many instructors also inform their students of undergraduate research opportunities as they become aware of them.
   - The SAC is working towards implementing the Honors Chemistry 221, 222, and 223 courses for the 2011-2012 academic year. Initial discussions on course components included ideas for original student research. Faculty have already begun making connections to four-year colleges and universities, potentially setting the stage for student
research collaborations. For example, PCC is part of a National Science Foundation funded grant through George Fox University to share the use of its modern nuclear magnetic resonance facility with our students through both on-campus and remote access utilizing instrument control via the internet. Other possibilities are currently under investigation by faculty including similar remote access to equipment involved in nanotechnology research. Other instructors are discussing partnerships with local colleges and universities for students to be involved in research projects with faculty there.

**Laboratory Experience.** All the chemistry courses at PCC involve a laboratory experience in which students “directly manipulate chemicals, study their properties and reactions,” and most courses “use laboratory equipment and modern laboratory instruments,” as quoted in the ACS Guidelines. Faculty continually assess and update laboratory goals and assignments to meet the needs of the students (see Table 2 Appendix 1 for a list of IIP Grants for improving labs). However, we do note one deficiency. As stated in the ACS Guidelines (p. 9) “Students pursuing chemistry careers should have access to instrumentation such as FTIR, FT-NMR, and mass spectrometers, if not at the institution, at other locations.” No campus at PCC currently has a mass spectrometer (in fact, Cascade is so limited in equipment it cannot offer Organic Chemistry courses). We currently do not have remote access to mass spectrometers as such has recently become available with the FT-NMR at George Fox University. It is in the best interest of our students to have access to such equipment, in the same way that a performance stage might be necessary to theater students or modern automobile testing and repair equipment are available to automotive technology students.

**Transferrable skills.** In addition to chemistry content, transferrable skills that students will use throughout their careers are an important part of any chemistry course. Instructors employ a variety of strategies for incorporating skill development activities into their courses, along with varying methods for evaluating these skills (see Pedagogy section on page 6 for examples).

- **Problem Solving:** Students in all chemistry classes are encouraged to employ chemical principles to analyze the problem and to evaluate if the relationship they derived is appropriate for the problem at hand.
- **Lab Safety and Chemical Hygiene:** Safe lab practices as well as handling and disposal of standard lab chemicals are stressed throughout the laboratory curriculum.
- **Teamwork:** Many instructors employ collaborative work during lecture sections or require a group project to produce a lab report, term paper, poster, power point presentation or web page. Students typically work in teams of two or three to collect data during lab; in several lab courses students are asked to share data with the entire class in order to identify trends.
• **Communication:** Students in chemistry classes are expected to communicate effectively both verbally and through concise scientific writing. Ample opportunity is given for students to demonstrate effective written communication through lab reports, group reporting, term papers, and exam essay questions. Oral communication is practiced in class and lab through peer discussions, oral group reporting, and more formal oral presentations.

• **Chemical Literature Skills:** Many instructors assign projects and assignments for which examination or analysis of peer reviewed journals is required.

### B. Changes to Course Content and Outcomes

In the spring and fall 2010 terms all the course outcomes were revised to meet the new State guidelines. Although these changes have not been approved by the Curriculum Committee, they were submitted on October 19, 2010 and are scheduled for approval at the December 1st Curriculum Committee Meeting. See Appendix 3 for the submitted paperwork for each chemistry course. Prior to these changes, and over the past several years, we have implemented a number of curricular changes that reflect changes in public attitudes that address environmental concerns and technological advances in our field.

**Green Chemistry:** Our organic chemistry labs have implemented and continue to develop laboratory exercises that use safer/milder chemicals, generate less waste and require fewer resources, resulting in increased cost efficiency for PCC. We have worked in conjunction with Oregon State University which has led to the development and implementation of green chemistry labs in Organic Chemistry. In fact, some of our part-time faculty have attended Green Chemistry Workshops and one of these part-timers received an IIP Grant to Green some of the Organic Chemistry Experiments (see Appendix 1 Table 2). Across the district, faculty continue to look for new areas to implement more environmentally sound practices in the laboratories.

**Alternative Energy:** At Sylvania, students in Chem 222 produce small scale amounts of biodiesel from waste fryer oil from the PCC cafeteria. After the production of the biodiesel, students compare their biodiesel with petro diesel and raw cooking oil in terms of energy density and other properties associated with the appropriateness of each as a fuel source. Students are taken on a “field-trip” to the Engineering Technology department to observe and discuss their small-scale (~50 gal) biodiesel reactor.

In addition some Chem 222 labs at Sylvania incorporate the production of ethanol via fermentation/distillation in the same lab experience and include ethanol as an alternative fuel in their analysis along with biodiesel, petro diesel and alternative fuels.
Modern Materials: At Sylvania, students in the general chemistry courses discuss and conduct laboratories regarding such modern materials as semiconductor chemistry and recently, nanotechnology. Some instructors have introduced some new labs involving nanotechnology and there are plans to do more.

Technological changes: Our gains since the last program review include access to NMR and expanded use of data acquisition hardware in the labs, which have improved student access to state-of-the-art technology to develop a deeper understanding of the chemical principles related to this instrumentation.

Specifically, our organic chemistry has recently begun to incorporate nuclear magnetic resonance (NMR) spectroscopy in our lab exercises. The lack of these experiences has always been a point of contention for Oregon 4-year colleges for students to receive upper division transfer credit for the equivalent class at the 4-year school. We’ve improved NMR access by the following methods:

1. Some organic chemistry classes have taken field trips to Portland State University to use their NMR facilities.
2. Some instructors have entered into a partnership with George Fox University as part of a National Science Foundation (NSF) grant. Students can now prepare samples at our PCC labs, have them sent to George Fox, and students can remotely via the internet control the NMR from our PCC labs.

The use of data acquisition hardware and software has been expanded to be a part of most lab courses across the district. Students in science and engineering fields require competence in data acquisition and analysis. For example, the publication “American Chemical Society (ACS) Guidelines for Chemistry in Two-Year College Programs”\(^3\) states that

- standard items, such as automated data-collection devices with associated probes, bench top centrifuges, melting point apparatus, microscale or full-scale organic kits, gas chromatographs, and UV-Visible spectrophotometers, are highly recommended for programs serving students pursuing careers in science or health.
- students pursuing chemistry careers should have access to instrumentation such as FTIR, FT-NMR and mass spectrometers, if not at the institution, at other locations.

Table 4 in Appendix 1 provides a summarized list of the equipment obtained since the last review by campus. A further discussion about lab equipment is found in Section 5 on p. 43.

\(^3\) ACS Guidelines for Chemistry in Two-Year College Programs, American Chemical Society, Washington DC, 2009.
Other Curriculum Changes: In some courses, instructors have modified their teaching methodology to include varying degrees of inquiry based learning. Some courses focus on the development of process-oriented skills such as working with other people, group leadership and management, the ability to complete a project with group members assigned different roles and tasks, shared responsibility for completion of an outcome, to name a few.

In addition, some courses have implemented a shift in pedagogy in their lab sections to include similar process-oriented skills and, importantly, the inclusion of aspects of the “Science Writing Heuristic”\(^4\). In these labs students focus on the process of the scientific method wherein they design their own, or portions of their own experiments, divide work amongst the class, carry out individual experiments, share data with the class, and then are responsible for generating claims and evidence based on their actual data. This is a shift from traditional “cookbook” type labs that require little original thought and even fewer critical thinking skills.

C. Assessment of course outcomes\(^5\)

i. Are assessments that address the course outcomes described in the CCOGs?

Our current assessments include examinations, quizzes, homework assignments, laboratory write-ups, poster presentations, research papers, small group problem solving, oral presentations or maintenance of a personal lab notebook. The degree to which these assessments address the course outcomes is variable and for the most part left to the discretion of the instructor. There are 2 differences:

National standardized exams created by the American Chemical Society (ACS), the largest professional organization in the world. The ACS has an exams institute that constantly develops and revises these national exams. At PCC we have used these exams as a summative evaluation at the end of our general chemistry sequence (CH 223) and organic chemistry sequence (CH 243).

Most importantly, the CCOGs as currently listed do not contain well-defined outcomes. The outcomes contain vague and somewhat intangible statements such as “increased curiosity”, “appreciation”, “develop an awareness” among others. Such outcomes are notoriously difficult to quantify and measure by means of practical assessments.

\(^4\) [http://avogadro.chem.iastate.edu/SWH/](http://avogadro.chem.iastate.edu/SWH/); Tom Greenbowe and Kathy Burke, Iowa State University, Ames, IA, 50011

\(^5\) This assessment of the course outcomes was completed in the 2009-2010 academic year. Consequently refer to the current outcomes and not the newly revised and submitted course outcomes.
Some instructors, however, have more well-defined outcomes for their courses (e.g. http://spot.pcc.edu/~tjenkins or our distance learning courses) that address specific content that is more easily assessed. Across the district course content is consistent as listed in the addendums to the CCOG’s. Specific course outcomes as required by Distance Learning (DL) for the recently developed DL courses have been created and are included in the syllabi for all distance learning courses.

ii. Describe evidence that students are meeting course outcomes.

At the moment, the most tangible evidence of students meeting outcomes would consist of the ACS standardized exams given to our general chemistry and organic chemistry students (See Appendix 4). The ACS exams represent one benchmark by which we might compare specific content outcomes nationally.

Other evidence exists somewhat sparingly. For example, one full time instructor has compiled a collection of emails from former students after they have transferred to 4-year institutions, primarily Portland State University. Students comment on the skill sets they have acquired at PCC, which in addition to content, include abilities to form effective study groups, how to ask critical thinking questions in their classes, how to work through problems when they encounter them, including how to ask for help and to whom they should ask, as well as various other “intangible” outcomes as are suggested by the instructor’s syllabus and the SAC CCOGs.

It has been suggested that different methods should be set up to measure both types of outcomes. For example, our ACS exams could be anonymously compiled. We could do longitudinal and attitudinal studies of volunteer students after they leave PCC.

One last piece of evidence that students are meeting outcomes is provided by course evaluations. Most faculty require regular course evaluations at the end of the course, and some faculty require occasional or even weekly feedback assignments from their students. For example, several instructors utilize an assignment called the “Weekender” which is a short writing assignment given each week to students. (See Appendix 5) It consists of two parts – a Process Skills section and a Metacognition section. In the process skills sections students are asked various questions about the functioning of their group and how improvements can be made to the ways in which students work, motivate themselves and work together to learn. The metacognitive piece asks students to consider what they know and what they do not know. They are asked to extract what in their mind are the most important themes of the course each week, and to reflect on what it is they must study further. The Weekender is a small instrument but has been determined to be extremely powerful for both students and the instructor. It is a required communication portal between
students and instructor, and has on more than one occasion caused changes in the design of the course.

Another excellent instrument that is used that is excellent for course evaluations is the Student Assessment of Learning Gains (SALG)\(^6\), which is an online course evaluation and feedback tool in which students are asked to assess the relevance and appropriateness, as well as the effectiveness, of various course components in regards to how they feel these components affect their learning and their perception of their learning. This type of feedback is very rich and contains both tabulated information (from Lickert scale questions, True-False, multiple choice) as well as compiled essays, all anonymous. This evaluation tool has the benefit over more traditional course evaluation tools in that it asks about the effectiveness of course components related to student learning and as such can provide direct feedback applicable to improvement of course design.

An important point, however, is that there is a lack of hard data that can be used to answer the question of whether or not faculty are meeting the outcomes set by the SAC. In part this is due to lack of quantifiable outcomes. Without good data it is difficult to assess the quality and success of innovative practices and experimentation, and in general, student learning outcomes. The only way to assess many of the outcomes is to follow student success or failure beyond PCC. This is not an option that is available to the SAC at this time.

The SAC has not compiled data on preparedness, advancement through programs and subsequent performance at four-year institutions. It has been suggested that the SAC work with Institutional Research to obtain information or develop studies and surveys to obtain such information during and after a student’s tenure at PCC.

The SAC also has limited hard data on whether we are meeting the needs of students in all areas. The faculty should implement a variety of assessment techniques and tools, providing necessary data for making informed decisions at the classroom, course and program levels.\(^7\) To that end, our institution must ensure that the infrastructural support is consistent with these goals and objectives. The development of student learning outcomes, assessment tools and follow-up studies, as well and support for innovative course revision as a result of such measures, must be strongly supported by the college and should include money or release time for training, implementation and reflection.

\(^{6}\) http://www.salgsite.org/

\(^{7}\) ACS Guidelines for Chemistry in Two-Year College Programs, Spring 2009, p. 19
iii. Identify/give examples of assessment-driven changes made towards improving attainment of course-level outcomes.

In order to answer this, we refer the reader to the previous section in which such assessment tools as “The Weekender” and “SALG” have been used extensively in the development of course design. One very relevant example of the implementation of these tools has been how they have shaped the structure of general chemistry courses at Sylvania which are taught using guided inquiry. There are a number of permutations of how a course can be taught with this method, and over at least the past 6-9 years, these student evaluations have resulted in changes in how different aspects of the course are presented, while at the same time maintaining and improving the robustness of the content learning aspect and improving critical thinking and other skills.

D. Assessment of Core Outcomes

The Mapping Matrix was updated by the chemistry faculty at the Fall 2010 In-Service Day. The changes included deleting a course that is no longer taught at PCC (CH 95), adding CH101, and updating the Mapping Level Indicators to better reflect the core outcomes addressed in each chemistry course across the district. The numerical values in the table correlate to the Mapping Level Indicators located below Table 5 on the next page and the COX, where X equals 1 through 6, corresponds to the specific College Core Outcome as defined below Table 5 on the next page.

A description of how the chemistry courses address the PCC Core outcomes, the strategies used to meet these outcomes, and specific examples that students are meeting these outcomes are outlined in Table 6 on pages 17 through 20.
### Table 5 Chemistry Mapping Matrix

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>CO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 100</td>
<td>Fundamentals for Chemistry</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 101</td>
<td>Inorganic Chemistry Principles</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 102</td>
<td>Organic Chemistry Principles</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 104</td>
<td>General Chemistry</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 105</td>
<td>General Chemistry</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 106</td>
<td>General Chemistry</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 110</td>
<td>ChemExcel</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>CH 211</td>
<td>Introduction to Biochemistry</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 221</td>
<td>General Chemistry</td>
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<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 222</td>
<td>General Chemistry</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 223</td>
<td>General Chemistry</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 241</td>
<td>Organic Chemistry</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 242</td>
<td>Organic Chemistry</td>
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<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CH 243</td>
<td>Organic Chemistry</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

**CORE OUTCOMES MAPPING**

**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.

**SAC CH: Chemistry**

**Core Outcomes:**

1. Communication.
2. Community and Environmental Responsibility.
5. Professional Competence.
<table>
<thead>
<tr>
<th>College Core Outcomes</th>
<th>How Courses Address Outcomes</th>
<th>Examples of Strategies Used</th>
<th>Evidence that Students Meet Outcome</th>
</tr>
</thead>
</table>
| Communication         | • In-class discussions<br>• Collaborative work in lecture and lab activities<br>• Student centered active learning<br>• Frequent writing assignments in lecture<br>• Oral presentations in lecture and labs<br>• Individual written lab reports<br>• Group written lab reports | • Instructors evaluate student communication skills in group settings through observations during the activities<br>• Students turn in individual weekly self-evaluations of group work through the use of “Weekender” assignments<br>• Students complete report sheets at the end of each lecture to assess group performance<br>• Students graded on ability to write conclusions effectively in laboratory reports<br>• Instructors evaluate oral presentations in class<br>• Students are required to present oral and written material after in-class group discussions<br>• Students turn in a “Team Contribution” form to evaluate the effectiveness of teamwork<br>• Students must explain concepts with written questions on exams using grammatically correct sentences<br>• Students present completed individual or group research posters at the end of the term. These posters include oral communication with peers, evaluators selected from outside the class, and the course instructor. | • Statistics from graded lab reports. (See Appendix 6)<br>• Rubric from Posters (See Appendix 7)<br>• All PCC campuses have poster presentations in a variety of courses throughout the academic year<br>• See Appendix 4 and Section 3.C. ii. for a Weekender assignment example<br>• See Appendix 8 for an example of a student reflection assignment<br>• See Appendix 9 for an example of a Daily Report Sheet

NOTE: The SAC will collect and compile more statistical data for evidence that students are meeting this outcome in 2010-2011.
## Table 6 (cont.) College Core Outcomes

<table>
<thead>
<tr>
<th>College Core Outcomes</th>
<th>How Courses Address Outcomes</th>
<th>Examples of Strategies Used</th>
<th>Evidence that Students Meet Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community and Environmental Responsibility</td>
<td>• Implement Experiments that Synthesize and Analyze Biodiesel</td>
<td>• Explain how traditional chemistry concepts relate to environmental issues</td>
<td>• At Sylvania in the Fall 2009 term 90% of the students who took CH 100 and CH 104 from Ted Picciotto and submitted a paper on sustainability received a passing grade</td>
</tr>
<tr>
<td></td>
<td>• Utilize Green Experiments in Organic Chemistry</td>
<td>• Develop labs that emphasize minimizing waste and proper disposal of chemicals</td>
<td>• Cascade Campus CH 104 Lab students evaluate “The Story of Stuff” video. They do a report and incorporate an activity into their lives. See Appendix 10.</td>
</tr>
<tr>
<td></td>
<td>• Assign term papers and projects that relate sustainability to chemistry concepts</td>
<td>• Organic chemistry students record identity and amounts of waste generated prior to and during each experiment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Awareness of chemical Waste Disposal</td>
<td>• Students complete independent research projects related to sustainability (both literature and experimental) in organic chemistry and some sections of CH100 and CH104 and other courses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Small Scale Chemistry at Cascade Campus (Waste Reduction Labs)</td>
<td>• Service-learning projects that require students to participate in sustainability issues at home and/or in habitat restoration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Participation in national Focus the Nation project in the Winter 2008 term</td>
<td></td>
</tr>
<tr>
<td>Cultural Awareness</td>
<td>• Historical discussions of the development of chemistry in other parts of the world</td>
<td>• Introduce how chemistry has evolved and developed with international cooperation, especially atomic theory</td>
<td>• The SAC recognizes that we currently do not have an assessment of this outcome. However, we recognize that this will be completed during the 3-year Assessment Cycle.</td>
</tr>
<tr>
<td></td>
<td>• Group work enhances cultural awareness among peers in the classroom</td>
<td>• Diverse working groups in the lectures allow students to learn about new cultures</td>
<td></td>
</tr>
</tbody>
</table>

18
<table>
<thead>
<tr>
<th>College Core Outcomes</th>
<th>How Courses Address Outcomes</th>
<th>Examples of Strategies Used</th>
<th>Evidence that Students Meet Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Thinking and Problem Solving</td>
<td>• Leading questions in lectures and labs&lt;br&gt;• Concept tests utilized in lecture&lt;br&gt;• Experiments designed to follow scientific method&lt;br&gt;• Analytical reading and writing&lt;br&gt;• Homework&lt;br&gt;• Quiz and exam problems that require application of concepts</td>
<td>• Use leading questions to enhance classroom discussions&lt;br&gt;• Electronic clickers are utilized to encourage students to answer critical thinking concept tests during lectures (See Appendix 12 for further details)&lt;br&gt;• Cascade incorporates “Thinker Buddy” icon on PowerPoint® lecture slides indicating to students that it’s time for discussion and problem solving in class.&lt;br&gt;• Some instructors utilize Process Oriented Guided Inquiry Learning (POGIL) in lectures (Students are given a model and answer a series of critical thinking questions about the model to guide them to an understanding of important concepts).&lt;br&gt;• Sylvania utilizes guided inquiry labs in the 221 series and the 241 series that require students to hypothesize relationships between measured values, collect experimental data, share data with classmates, and analyze the experimental results.&lt;br&gt;• Several experiments require students to explain the lab results through applying them to real-world situations using Summary Writing Assignments&lt;br&gt;• Grading of group work (See appendix 4A and 4B for examples of forms utilized to help grade group work.)&lt;br&gt;• Independent research projects in CH 243&lt;br&gt;• ACS Exam for Chemistry 223 and 243&lt;br&gt;• Frequent written and on-line homework assignments that require students to solve problems outside of lecture</td>
<td>• Students pass concept tests with 90% or higher after discussing concept tests with groups.&lt;br&gt;• See Appendix 12 for Clicker Data&lt;br&gt;• See Appendix 13 for Thinker Buddy Data&lt;br&gt;• See Appendix 4 for ACS Exam Data&lt;br&gt;• See Appendix 14 for Homework Grades versus Exam Grades for Critical Problem Solving&lt;br&gt;• See Appendix 15 for example Summary Writing Assignments utilized in the General Chemistry Labs.&lt;br&gt;• See Appendices 4, 8 and 9 for examples of forms utilized to help grade group work.&lt;br&gt;• Students choose, design, and complete new experiments in the last term of organic chemistry. For example, a pair of students in the S2008 term successfully investigated and identified methods to change a traditional experiment to extract caffeine from tea to a more environmentally friendly green procedure.</td>
</tr>
</tbody>
</table>

NOTE: See Appendix 16 for a complete assessment and comments for the Critical Thinking Assessment Completed in the Spring 2010 term.
<table>
<thead>
<tr>
<th>College Outcomes</th>
<th>Core Address Outcomes</th>
<th>Examples of Strategies Used</th>
<th>Evidence that Students Meet Outcome</th>
</tr>
</thead>
</table>
| **Professional Competence** | • Team building and group work  
• Evaluation of student work in the lecture and the lab  
• Students learn chemistry terminology and concepts as described in CCOG’s  
• UCORE with the University of Oregon  
• REU with Portland State University | • See Communication and Critical Thinking Sections above for group work strategies  
• Students must meet deadlines for assignments.  
• Instructors note when students consistently arrive late to class  
• Recorded student attendance  
• Utilize quiz and exams to measure student’s chemistry knowledge.  
• UCORE and REU are undergraduate research opportunities offered to our students to introduce and prepare them for graduate work. | • Partner Development with George Fox University encourages professional growth.  
• UCORE Presentations.  

**NOTE:** The SAC recommends administration help to obtain follow-up data for statistical evidence of student success or failure after completing our chemistry courses.  

• For example, when students complete the Medical Laboratory Technology (MLT) Program are the students successful in their employment? Requires follow-up surveys of jobs and course success rates.  
• Undergraduate completion rates?  

| **Self-Reflection** | • Post-exam reflections  
• Self-reflection forms  
• One component of several lab reports across the district includes a self-reflection statement. | • Students are given opportunities to reflect on individual exam performance by identifying study methods that worked or need to be improved for subsequent exams.  
• Self assessment of POGIL based inquiries (see Appendices 5 and 9)  
• SALG (Student Assessment of their Learning Gains) post-course evaluations and student reflections (See Appendix 16 and Section 3.C.ii.) | • PCC Chemistry students successfully fill out Reflection Statements in class and or lab.  
• SALG reports are required in higher level courses at Sylvania and are completed by more than 90% of the students who finish the course. |
Improving Attainment of Core Outcomes: It is clear from Table 6 on pages 17-20 that many faculty utilize a variety of creative assignments and strategies to meet the College Core Outcomes. However, the evidence that the students are actually meeting all these outcomes is currently lacking. The chemistry SAC has not directly addressed how to improve the attainment of core outcomes until the Spring 2010 term, when we completed the Critical Thinking Assessment as required by all departments throughout the district for the 2009-2010 academic year. This exercise helped us to realize that we need to improve our assessment of each core outcome, and specifically, we need to develop a plan to apply the same assessments across the district, rather than campus-by-campus or instructor-by-instructor. The chemistry faculty recognizes that PCC’s Learning Assessment Council provides the structure for the SACs to demonstrate student achievement of PCC’s Core Outcomes through their College Core Outcome Review (CCOR), and the chemistry SAC will continue to attend workshops and presentations to help us improve our future assessments of these outcomes.

Strengths of our Critical Thinking and Problem Solving assessment: We included both direct and indirect evidence for achievement of outcomes, and our specific assessment tools were helpful in demonstrating student learning and informing future teaching.

Areas for improvement: Instead of presenting a series of assessment tools from individual instructors in various classes, the SAC will develop and use a single tool administered early and late in the term in courses of all levels. We will also use a standardized rubric or a single team of assessors to provide consistency in assessment. Results from a broad assessment should provide insight into student progress through a course and across our program.

We will continue to assess how our students meet PCC’s Core Outcomes in accordance with the CCOR schedule.

We are currently in discussion about how to improve the attainment of these outcomes across the district through the 3-year assessment cycle. Stacey Fiddler and Kenneth Friedrich have attended the “Assessment Colloquium and Workshop” this fall to help our SAC improve these assessments in the near future.
E. Distance Learning

Since our last program review 7 of the 12 chemistry courses taught at PCC are now offered in a distance modality (see Table 1 in Appendix 1). These courses have been developed in response to meeting student needs and requests from technical programs at the college. The CH 100 and CH 104-106 courses are offered as fully online courses with an at-home laboratory component. The CH 221-223 courses are offered as hybrid courses, where the lecture component is fully online and the lab experiments are completed on campus. The three campuses do not individually offer all 7 courses. Cascade offers online sections of CH 100 and CH 104-106. Sylvania offers online sections of CH 100 and CH 104. Rock Creek offers hybrid sections of CH 221-223. See Table 7 in Appendix 1 for a summary of the development timeline for these courses.

Course Development

CH 100 Lecture: developed by Carol Handy (FT faculty)
CH 100 Lab: developed by Carol Handy (FT faculty)
CH 104 Lecture: developed by Kathy Carrigan and Carol Handy (FT faculty) during a joint sabbatical
CH 104 Lab: developed by Kathy Carrigan and Carol Handy (FT faculty) during a joint sabbatical
CH 105 Lecture: developed by Kathy Carrigan (FT faculty) and Jim Hart (PT faculty)
CH 105 Lab: developed by Kathy Carrigan (FT faculty) and Jim Hart (PT faculty)
CH 106 Lecture: developed by Kathy Carrigan and Kenneth Friedrich (FT faculty)
CH 106 Lab: developed by Kathy Carrigan and Kenneth Friedrich (FT faculty)
CH 221 Lecture: developed by Miriam Kloster (PT faculty)
CH 222 Lecture: developed by Miriam Kloster (PT faculty)
CH 223 Lecture: developed by Miriam Kloster (PT faculty)

A number of positive revelations have arisen from the process of teaching and developing online courses.

1. Faculty members who have taught or developed distance learning courses have found this to enhance their on-campus teaching skills. Maintaining the quality of instruction online provides an additional opportunity for self-reflection and evaluation of why we teach the way we do.

2. Distance learning provides flexibility in faculty and student schedules which improves access to all students. In fact we have students as far away as a soldier in Iraq and another student in
Australia. Distance learning requires little to no use of on-campus resources including labs, chemicals and equipment, student parking, and other facilities while increasing FTE.

Despite the growth and popularity of the online courses a number of difficulties and concerns have arisen.

1. Currently only 2 full-time instructors are teaching online. This leaves our dedicated part-time faculty to cover a bulk of the online courses. The SAC believes that full-time faculty participation in the courses is necessary. FT participation would include teaching, evaluating, and reorganizing the lecture and laboratory materials as needed. Other full-time faculty members have expressed interest in teaching online. However, they have not taught online due to lack of management support and flexibility for faculty, including issues surrounding workload and off-campus vs. on-campus hours.

2. As management begins to provide support and flexibility to our faculty concerning online instruction, we foresee offering more sections of the seven online courses, potentially at each campus. Therefore, we anticipate needing to hire a large number of part-time faculty whether they are teaching online or filling the gap from full-time instructors moving to DL. Campus department chairs will be responsible for hiring, scheduling, managing, and assessing these part-time faculty. The addition of these part-time faculty will also significantly impact the amount of training the current full-time faculty members must provide. Also, both part-time and full-time faculty must be trained for two consecutive terms in online instruction before they can begin to teach an online course. This puts a two-term gap between hiring new faculty and having them in the classroom. This poses a big challenge to the implementation of new online courses. In addition the loss of trained part-timers to full-time opportunities away from PCC has lead to some stressful situations since it is not easy to replace them due to the time delay. The growth of on-campus and distance learning courses intensifies the workload and stress level of current faculty who are committed to maintaining high quality instruction.

3. A major challenge for online chemistry or science courses is the inclusion of a lab component.
   - There are liability issues to be considered when offering an unsupervised at-home chemistry lab.
   - Nationally, there are a wide variety of opinions regarding the equivalency of the online vs. on campus labs. Teaching online chemistry labs is breaking new ground, both in technology and experience.
• An important factor that is challenging and absolutely necessary is the assessment of a laboratory component. Since the lab experience contains many concepts and skills such as manipulation of glassware, lab equipment techniques, safety and chemical hygiene, the evaluation of the efficacy of such a lab component requires additional time and funding.
• Development of a lab experience is different and distinct from the development of a lecture course, whether that lab experience is on campus or at home. Developing one numbered lab science course (e.g. CH 106) is equivalent to developing two full courses – the lecture component and the lab component.

F. Educational Initiatives

While the fundamental concepts at the core of any chemistry curriculum remain fairly constant, topics peripheral to the core curriculum such as global warming, nanotechnology, and solar power are updated regularly. These topics are often explored through the faculty participation in conferences, workshops and independent research.

While course content and CCOGs have not significantly changed since the last program review, the methodologies for instructional delivery have indeed been affected by current educational initiatives.

Service learning was a strong influence at the Rock Creek campus. Both CH 100 and CH 104 were being taught as service learning courses. Recently the full-time instructor most active in the initiative departed PCC. Currently, no chemistry classes are being taught with a service learning component due to the limited resources available to implement the necessary changes.

Inquiry-Based Learning has a strong influence on the chemistry curriculum. District-wide, most of the full-time and many part-time faculty members have attended training in and have implemented such methodologies as Process Oriented Guided Inquiry Learning (POGIL-http://www.pogil.org) and/or the Science Writing Heuristic (SWH-http://avogadro.chem.iastate.edu/SWH/homepage.htm) in the lecture and/or lab. Some specific implementation examples are listed below.

• The organic chemistry series taught at Sylvania changed the curriculum from a traditional lecture (F2006-S2008) to a predominantly inquiry-based lecture format. Students purchase a guided-inquiry workbook utilized in almost every lecture throughout the year.
• The general chemistry labs at Sylvania have continued to evolve and are now almost exclusively inquiry based labs, informed in a great deal by the SWH and POGIL pedagogies.
• A few of the labs at the Cascade and Rock Creek campuses are also inquiry based.
• All of the 221 series and most of the 104 series lecture sections at Sylvania are based on some version of the POGIL model. As well, other student-centered interactive techniques are also employed on a daily basis, including but not limited to “Concept Test” multiple choice questions, commonly called “clicker” questions, both in individual and group format, and short daily or weekly writing assignments (minute papers, “muddiest points,” etc.).

3. Students and the Community

A. Student Demographics

While students taking chemistry courses are broadly representative of PCC as a whole there are some differences (See Appendix 17). According to the 2008-09 data students taking chemistry are less likely to be African American (4.2% vs. 5.9%) or Hispanic (5.0% vs 8.2%), but more likely to be Asian/Pacific Islander (15.3% vs. 11.1%) or White Non-Hispanic (74.2% vs. 73.3%) when compared to the Lower Division Transfer Students. Although the chemistry courses are more populated by females (53.6%) than males (46.4%), there are fewer women compared to the distribution of the lower division transfer students (53.5% vs 56.5%). In addition, the chemistry program enrolls fewer students in the 14-20 and 41+ year old ranges (19.2% vs. 25.3% and 6.6% vs. 11.3%, respectively). This preference for the 21-40 year old age distribution can be attributed to the fact that many students require pre-requisite chemistry courses for advanced programs and degrees. Two areas that are significantly different when comparing the PCC Chemistry student to the Lower Division Transfer Students include the number of full-time students (72.1% vs 46.0%) and degree-seeking students (89.4% vs. 83.1%). The large number of degree-seeking full-time students indicates that the chemistry SAC should continue to prepare students for transfer to 4-year institutions and professional programs. Therefore, the chemistry faculty have not made any significant changes to instructional methods in the lectures and labs based on the information provided about demographics.

B. Community-inspired Changes

In general, we have not used any particular feedback to incorporate district-wide changes in curriculum or instruction. We are discussing the future of our allied health chemistry series due to the change in nursing student prerequisites, but have not made any decisions as we do not have enough data on this topic.
C. Enrollment patterns and projected demands

Enrollment data for this section taken from the Institutional Effectiveness website and data provided by staff from Institutional Effectiveness.

Below, Table 8 compiles enrollment data (Student FTE) for school years 2004-2005 through 2008-2009 as obtained from Institutional Research. This data is inclusive of all campuses district-wide. The bottom row of the table lists the entire chemistry SFTE across the district each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>04-05</th>
<th>05-06</th>
<th>06-07</th>
<th>07-08</th>
<th>08-09</th>
<th>09-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 100</td>
<td>65.39</td>
<td>66.42</td>
<td>84.1</td>
<td>95.35</td>
<td>103.86</td>
<td>140.80</td>
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<tr>
<td>CH 102</td>
<td>7.25</td>
<td>7.55</td>
<td>7.25</td>
<td>6.95</td>
<td>13.57</td>
<td>30.80</td>
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<tr>
<td>CH 211</td>
<td>1.04</td>
<td>1.74</td>
<td>1.04</td>
<td>1.79</td>
<td>1.04</td>
<td>2.00</td>
</tr>
<tr>
<td>CH 221</td>
<td>81.37</td>
<td>85.34</td>
<td>91.24</td>
<td>97.52</td>
<td>115.48</td>
<td>132.80</td>
</tr>
<tr>
<td>CH 222</td>
<td>52.7</td>
<td>57.78</td>
<td>62.48</td>
<td>67.79</td>
<td>72.34</td>
<td>92.10</td>
</tr>
<tr>
<td>CH 223</td>
<td>39.69</td>
<td>35.33</td>
<td>34.55</td>
<td>41.61</td>
<td>47.74</td>
<td>55.20</td>
</tr>
<tr>
<td>CH 241</td>
<td>15.29</td>
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<td>14.18</td>
<td>17.36</td>
<td>17.99</td>
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</tr>
<tr>
<td>CH 242</td>
<td>9.97</td>
<td>9.06</td>
<td>9.82</td>
<td>10.72</td>
<td>10.72</td>
<td>14.30</td>
</tr>
<tr>
<td>CH 243</td>
<td>7.3</td>
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<td>6.38</td>
<td>9.09</td>
<td>9.00</td>
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<tr>
<td>All CH courses</td>
<td>280</td>
<td>280.8</td>
<td>309.88</td>
<td>345.47</td>
<td>391.83</td>
<td>497.10</td>
</tr>
</tbody>
</table>

The series of graphs below illustrate the above trends broken down into appropriate course sequences. Note that CH 100, CH 102, CH 211 are individual courses and are not part of a sequence. They are plotted on the same graph for convenience only.
Overall enrollment has shown some minor variance initially since the last program review, but there has been significant growth in recent years. Overall, the SFTE has increased district-wide 77.5%. It could be hypothesized that enrollment trends inversely correlate to economic trends. It seems reasonable to consider that when the local economy is in decline, enrollment in our courses increases as individuals return for retraining or other reasons. The last large boom in enrollment came after the economic downturn following 9/11. The latest enrollment surge since 2007 also mirrors an economic downturn. However, the faculty also suspect that increases in building and classroom space on some campuses, and the offering of online, or distance learning (DL) courses for some of the series may also have contributed to the growth at some campuses.

Enrollments in specific course sequences tell interesting stories. The CH 104, 105, 106 series has shown an overall steady decline until recently, which is theoretically connected
to fact that 2-year nursing programs at PCC and elsewhere have eliminated chemistry as a prerequisite or co-requisite for their programs. Nursing was the major student group these courses served. Note the CH 104 course, which serves students in fields other than nursing, including Engineering Technology at Sylvania, mirrors the overall enrollment trends of the district. However, in spite of the nursing degree requirement change, CH 104 has rebounded to now have a 6.7% increase since 2004, especially significant when compared to the most serious drop of 32% in 2007. CH 105 and 106, which more traditionally serve nursing students, also appear to be rebounding. Our experience and data suggest that part of this recent growth may be attributed to the development of completely online (DL) course offerings of CH 104 initially, and in subsequent terms, CH 105 and 106. We note the most recent growth of this course series after the introduction of the DL version.

- The CH 100 course has shown significant growth of approximately 115% over the past 6 years. The reason for this particular growth at the moment is unclear, but faculty suspect it may in part be a result of the option of the offering of this course in a completely online (DL) manner, similar to the situation with CH 104. In addition, faculty have re-emphasized the necessity of CH 100 as a suggested prerequisite for students with no prior chemistry background entering the CH 221 series.

- The CH 102 course has become more popular in recent years primarily due, we suspect, to the fact that the dental hygiene program moved this course from a co-requisite within their program to a prerequisite for entering the program. Enrollment has grown 325% over the last few years, and continues to grow.

- Enrollment in the CH 221, 222, 223 majors sequence General Chemistry, shows a net increase in SFTE since the last program review, the increase occurring steadily since 2004. CH 221 shows an approximate 63% growth in SFTE since 2004.

- Enrollment in CH 241, 242, 243, Organic Chemistry, shows some growth since 2004, the most significant for CH 241, at approximately 31%.

- Other notable observations:
  - There is a strong request from current students at Cascade Campus to offer the Organic Chemistry Series.
  - The distance learning courses are fully enrolled and the demand is increasing.
One conclusion that can be drawn from this data is that overall, the enrollment of students in our chemistry courses continues to grow significantly. Our overall growth initially appears flat in relation to the trends in enrollment overall for the department across the years, and in relation to the hypothetical economic trend correlation. However, when the fact that our previously “bread and butter” sequence, CH 104, 105, 106 had shown significant decline due to forces beyond the control of the program (the nursing prerequisite being dropped as mentioned above) is correlated with the overall enrollment trends of the program and individual classes, and the implementation of some DL courses, we see that our program continues to grow significantly. The graph below shows the net SFTE of the program without the inclusion of the CH 104, 105, 106 courses.

These data show clearly that there is an overall 77.5% increase in student FTE since our last program review in 2004, the CH 104 sequence courses not included. However, this is NOT to say that the CH 104 sequence is unimportant. In fact, it is still a major contributor to our overall SFTE. What this data is saying is that even with the significant drop in that sequence’s enrollment, due to it no longer being a prerequisite course for a major degree program in Oregon, the enrollment of the Chemistry program has shown steady and significant increase over the past 6 years.

How is this growth distributed across the district? The graph on the left below shows unduplicated headcount since 2005-2006 school year. The graph on the right shows a similar count, that being of the SFTE across campuses over the years.
These graphs show similar information. Looking more closely at the SFTE data, the following percentage growth rates are shown in Table 9 below. We note the percentage increase in SFTE for the 2009-2010 year compared to a) 2005-2006, the oldest data available at the time of the review, and b) the lowest SFTE for each campus since that oldest data. For Sylvania, the lowest SFTE was the 2007-2008 year, and for Cascade and Rock Creek, it was the 2006-2007 year.

<table>
<thead>
<tr>
<th>Campus</th>
<th>05-06 to 09-10</th>
<th>06-07 to 09-10</th>
<th>07-08 to 09-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sylvania</td>
<td>6.1</td>
<td>26.5</td>
<td></td>
</tr>
<tr>
<td>Cascade</td>
<td>81.9</td>
<td>100.1</td>
<td></td>
</tr>
<tr>
<td>Rock Creek</td>
<td>52.0</td>
<td>61.5</td>
<td></td>
</tr>
</tbody>
</table>

It is clear that Cascade and Rock Creek have shown highly significant growth. Indeed, even Sylvania shows significant rebounded growth since 2006-2007. To what can these differences in growth rates be attributed? While it is difficult to surmise the reasons for this at this time, at least some hypotheses come to mind. First, new classroom facilities at Cascade have enabled the greater offering of course sections. The same can be said in part of Rock Creek. The offering of DL courses has also enabled some of this growth. However, growth at Sylvania has remained much smaller in comparison to the other campuses directly due to lack of classroom and lab space, as well as lack of trained lab technician help to facilitate the additional growth. Chemistry class sizes at Sylvania and Cascade are already at capacity and are generally larger than those at other campuses. Faculty generally teach more students per lecture section at Cascade and Sylvania than at other campuses. While all lab classes across the district are capped at around 24, the lab room capacity at Sylvania is at its maximum. No further growth could possibly occur at Sylvania unless increased and/or upgraded lab and classroom space are provided, as well as increased support staff. As expected, the same can be said to a similar degree across the district.

Of course, with significant growth in SFTE, the college is obligated to match that with growth in the number of full time faculty to fully support this growth. So far, the increase in full time faculty to match the growth in SFTE has not been equal. The program requires more full time faculty at Rock Creek and Cascade, in conjunction with equitable class sizes across the district, to fully realize the potential of the program and the students it serves.

How does the enrollment in Chemistry compare to the other programs at PCC? A snapshot of data comes from the Fall 2009 district-wide SFTE data. Of the 124 subject codes listed, chemistry ranks 13th in SFTE in this college, with the SFTE for that term of 215.84. The graph
below shows the SFTE for all the subject codes for Fall 2009, with Chemistry indicated. Chemistry contributes more SFTE to the college than does 111 of the 124 subject codes for which records were kept that year.

![SFTE for All District-Wide Subject Codes Fall 2009](image)

It is apparent that the Chemistry program is a major contributor (in the top 10% of all subject FTE) to the PCC community. As a science subject area, teaching all these courses requires the extra dedication of new course development to meet the needs of changing programs, society and scientific discovery, lab instruction and state and district guidelines that demand complex critical thinking, data analysis, scientific reasoning, mathematical problem solving, inquiry and discovery, and writing skills, among others, to be a major part of our curriculum, in addition to complex subject matter. It should be obvious that coupled with the significant growth in the subject area, the significant contribution in SFTE to the college begs that the Chemistry program be afforded a significant degree of support from the administration in order to maintain the high standards of enrollment growth and district learning outcomes.

The Chemistry program is not a backwater of the college, but a shining crown jewel with innovative instructional practices, enthusiastic (if not overworked) faculty and above national average performance. One could ask: “How have our facilities grown across the district to meet this growth?” Cascade campus has received one dedicated lab room, but still inadequate building expansion. Recall Cascade does not even have the structural ability to offer Organic Chemistry. The Rock Creek campus has also seen some expansion in facilities. However, it is glaringly apparent that Sylvania is significantly deficient in building and support services to meet this growing need. Sylvania is the largest department in the district. The three chemistry labs at Sylvania have not had a significant remodel since the college was built in the late 1960s!! When these facilities were built nearly 50 years ago, the enrollment was nowhere near the current enrollment and the possibilities for modern teaching methodologies was limited, in part, by technology. The Sylvania labs are operating at or above capacity and are at the safety limits each
term. The Sylvania chemistry department has ONE lab technician that is shared among THREE programs (Geology/General Science, Physics and Chemistry). The Cascade chemistry department has ONE lab technician that is shared among TWO programs (Microbiology and Chemistry). Instructors in the late afternoon and evening must fend for themselves at Sylvania, because there is no support staff. Disability accommodations are makeshift at best in these labs. Should disabled students be relegated to inadequate and unequal opportunities in lab simply because the college has not invested in facilities and staff to meet these standards? It is difficult to include modern teaching methods because the lab arrangements and infrastructure are out of date. Does the college wish to continue to represent itself as a leader in educational innovation with such outdated facilities and limited staffing?

D. Strategies for Access and Diversity

To facilitate access to our programs, the chemistry SAC is offering more sections of various courses. The most significant addition since the last program review is the large number of distance learning courses (see Appendix 1 Tables 1 and 6). On campus we have added many additional day, evening, and weekend sections across the district for the courses with the greatest demand.

In addition to adding more sections of existing courses, instructors have added new methods to provide course materials to the students. Many lecture and lab materials are provided on-line or as course packets in the bookstore. The on-line materials are beneficial to students with easy computer access and the course packets allow students on financial aid to purchase required supplemental materials. All the chemistry instructors who teach distance-learning labs have partnered with At-Home Labs, Incorporated to mail lab materials to students’ homes to allow them access to experiments. Furthermore, instructors allow students to tape record lectures, which allows more flexibility for student schedules and more access for students with English as a second language.

To facilitate diversity the chemistry faculty have opened the lab facilities to students with disabilities, such as hearing impaired, mobility impaired, vertigo. This required the following changes to the actual laboratories:

- lowered lab benches and lab area (except at Sylvania, where makeshift tables without electrical access and plumbing are employed)
- interpreters present in the lab with goggles
- installed new mobile eye wash stations (unreachable by wheel-chair bound students in Sylvania labs)
- special ergonomic chairs provided for those with back problems.

We have not made any curriculum changes in response to changes in ethnic, age, gender diversity, though we do encourage all students in our classes. We continuously work with the
Office of Students with Disabilities to find new and creative methods to provide access to all students wishing to take chemistry courses at PCC.

4. Faculty

A. Composition

i. Rationale for the size, distribution and composition of the faculty in the subject area.

The American Chemical Society’s Guidelines for Chemistry in Two-Year College Programs\(^8\) recommends enough full time, permanent faculty to teach the full range of courses on a regular basis. Specifically, full time faculty should teach 75\% or more of the total chemistry credit hours offered. The tables and subsequent graphs below indicate the current FTE data for both students (SFTE) and faculty (IFTE). Tables 10 and 11 show the % instructional FTE provided by part time or full time faculty at each campus across the district.

<table>
<thead>
<tr>
<th>Table 10. % PT IFTE/Total IFTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus</td>
</tr>
<tr>
<td>Sylvania</td>
</tr>
<tr>
<td>Rock Creek</td>
</tr>
<tr>
<td>Cascade</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 11. % FT IFTE/Total IFTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus</td>
</tr>
<tr>
<td>Sylvania</td>
</tr>
<tr>
<td>Rock Creek</td>
</tr>
<tr>
<td>Cascade</td>
</tr>
</tbody>
</table>

Clearly, full time faculty are substantially below ACS guidelines for FT/PT faculty ratios in chemistry courses. What is more, when we compare these percentages to the college-wide data given in Table 12 on the next page, we see that Chemistry is, on average, well below the norm \textit{district wide for PCC!} This is especially evident at Cascade and Rock Creek.

\(^8\) ACS Guidelines for Chemistry in Two-Year College Programs, American Chemical Society, Spring 2009, p. 5
Table 12. % of Sections taught by FT faculty district-wide

<table>
<thead>
<tr>
<th>College Total (SY, CA, RC, ELC)</th>
<th>Fall 05</th>
<th>Fall 06</th>
<th>Fall 07</th>
<th>Fall 08</th>
<th>Fall 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sections</td>
<td>2,843</td>
<td>2,832</td>
<td>2,973</td>
<td>3,206</td>
<td>3,535</td>
</tr>
<tr>
<td>Sections taught by ft faculty</td>
<td>1,245</td>
<td>1,223</td>
<td>1,275</td>
<td>1,291</td>
<td>1,274</td>
</tr>
<tr>
<td>%Sections Taught by FT Faculty</td>
<td>43.8%</td>
<td>43.2%</td>
<td>42.9%</td>
<td>40.3%</td>
<td>36.0%</td>
</tr>
</tbody>
</table>

This data is presented below in graphical form. In addition, the PT/FT IFTE Ratio is presented for each campus. While all campuses exceed the college and national limits for PT vs. FT faculty ratios, this is painfully evident at the Cascade and Rock Creek campuses.
How can these trends be explained? One hypothesis is that increased growth in the number of sections offered at Cascade and Rock Creek without the corresponding growth in FT faculty has caused this ratio to deteriorate. In addition, it is surmised that the expanded offerings of DL courses from or through Cascade has also contributed to the excess of PT compared to FT faculty. Both FT faculty at Cascade teach some of their FTE load through DL, which increased the need to hire and mentor more PT faculty to teach on-campus to fill in for the courses they gave up to teach DL..

One conclusion is clear: The PT/FT faculty ratios at all campuses exceed the recommendations of the world’s largest professional society and leader in chemical education since the 1920s, the American Chemical Society, by a significant amount. In addition, the PT/FT faculty ratios at Cascade and Rock Creek far exceed even PCC’s own internal norm for this ratio by a significant amount. This is clearly an unacceptable situation that does not promote the college’s goals of access and quality education for all students. It is the conclusion of the Chemistry faculty that the rectification of this inappropriate balance is a top priority for the department and the college for whom this department contributes a significant FTE.

This improper imbalance in PT/FT faculty becomes even more glaringly apparent and disturbing when taking into account Distance Learning (DL) classes. DL classes are currently offered at all three campuses but only two full-time faculty members are trained to teach DL classes. Taken together, there is more than heavy reliance on our part-time faculty to teach classes and our program has a strong need for additional full-time faculty. Any FT faculty that become trained and teach the growing number of DL classes will need to be replaced on-campus by other FT faculty or the PT/FT ratio will continue to increase.

ii. Quantity and quality of the faculty needed to meet the needs of program/discipline

Once again, the data in Tables 10-12 illuminate the problem faced by the Chemistry program. Specifically, the problem is that we have had substantial growth in SFTE, but nowhere near the equivalent growth in FT faculty in order for the department to maintain the high quality standards the faculty and PCC have set for our educational outcomes. The department has been forced into an over-reliance on a part time instructor pool that gets increasingly more shallow as qualified individuals with graduate degrees in chemistry opt for, or are forced into for economic reasons, better paying jobs outside of the part time teaching realm. To add to the problem, the number of qualified individuals in the part time...
pool that have experience or training in education is already very low. As has been and will be discussed elsewhere in this document, the Chemistry faculty are truly innovative in their teaching methods and pedagogy. One does not “walk on” to the job of teaching here with only a research degree in Chemistry and find success. New part time faculty must be trained in a variety of methods above and beyond the baseline of qualifications required to teach a class. To maintain our innovative and high standards requires us to properly mentor and train new and established part time faculty. When the reliance on part time faculty becomes as great as it has in this department, then inordinate amounts of time are spent training faculty instead of training students. It has been suggested by some faculty department chairs that in this dept (as in the rest of PCC), sometimes we have to function predominantly as a teacher training institution as opposed to a student training institution. To make matters worse, few part time instructors are “lifers” anymore. That is, they leave after a few years of solid training by our FT faculty in chemical education to accept FT teaching positions elsewhere. The result for PCC is the diversion of faculty resources from teaching students to training a workforce that finds jobs elsewhere. This leaves a continual cycle of part time faculty training that lies with the full time faculty and diverts energy away from our primary goal, to educate our students and support the goals of the college.

This point is so important to the faculty that we would like to reiterate this idea. The state of Oregon, the college, and the chemistry program in agreement, desire very high standards for the outcomes of our students in all disciplines across the district. In Chemistry (and other sciences), we have an especially difficult task since we must not only instruct our students in chemical concepts (ask yourself, what is your gut feeling about chemistry…is it “too difficult”?), but also higher order thinking skills, laboratory skills, communication skills, process-oriented skills, mathematical skills, scientific reasoning skills, and many others that are not found in lecture-only courses or in non-science classes. In addition, we must maintain facilities and equipment (note that some of the campuses do not have adequately trained lab tech personnel who can maintain much of our expensive analytical equipment, or in the case of Sylvania, have actual training in chemistry) that require time and expertise outside of our assigned teaching load. (See Table 13 on the next page). We have to do it all! We suspect the reader agrees that this is a complex set of tasks that cannot be accomplished by hiring a “warm body off the street”. The faculty feels this increased reliance on undertrained temporary faculty degrades our position and detracts from allowing the department to fully realize its potential. The ACS Guidelines states the following: 9

“Qualified individuals outside the full-time, permanent faculty (i.e. contingent faculty, [often

9 ACS Guidelines for Chemistry in Two-Year College Programs, American Chemical Society, Spring 2009, p. 5
referred to as adjunct, part-time, or nonpermanent faculty]) should only be used to provide specific expertise and accommodate term-to-term fluctuations in enrollment. Excessive reliance on contingent faculty is strongly discouraged. When hired, such faculty should be fairly compensated, given equivalent facilities and professional development opportunities to those of full-time, permanent faculty, and integrated into the program’s activities.”

Table 13: Job Responsibilities for FT and PT Faculty

<table>
<thead>
<tr>
<th>Part Time Faculty Responsibility</th>
<th>Full Time Faculty Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare for and teach lecture using approved course outcome guides.</td>
<td>Prepare for and teach lecture using approved course outcome guides.</td>
</tr>
<tr>
<td>Prepare for and teach lab, including lab setup and cleanup.</td>
<td>Prepare for and teach lab, including lab setup and cleanup.</td>
</tr>
<tr>
<td>Evaluate student performance and assign grades.</td>
<td>Evaluate student performance and assign grades.</td>
</tr>
<tr>
<td>In lab, ensure that students properly follow all safety and chemical disposal guidelines.</td>
<td>In lab, ensure that students properly follow all safety and chemical disposal guidelines.</td>
</tr>
<tr>
<td>Be available for a reasonable amount of student contact outside class (may be in the form of office hours).</td>
<td>Hold 5 office hours per week.</td>
</tr>
<tr>
<td>Attend and participate in one two-hour college-wide, campus/center division, department, or program meeting per term.</td>
<td>Attend and participate in all relevant college-wide, campus/center division, department, or program meetings each term.</td>
</tr>
<tr>
<td>Provide advising and assistance to students.</td>
<td>Provide advising and assistance to students.</td>
</tr>
<tr>
<td>Serve as course lead for all sections of a particular course taught at the campus. Includes many of the items listed below.</td>
<td>Mentor and assess part time faculty. (See Table 15 on p. 40)</td>
</tr>
<tr>
<td>Run labs: determine the lab schedule for a particular course for the term, provide a lab prep sheet and coordinating with lab prep staff, check and troubleshoot equipment, ensure proper safety guidelines are in place and communicated to students and PT faculty, ensure that chemicals in the lab are disposed of properly in cooperation with technical staff.</td>
<td>Evaluate equipment and instrumentation needs.</td>
</tr>
<tr>
<td>Evaluate, lead discussions, make decisions, and place orders for course materials (e.g. textbooks, workbooks, clickers, lab notebooks, online homework systems, etc.)</td>
<td></td>
</tr>
</tbody>
</table>
Evaluate software and hardware needs for lecture podiums and lab computers; place requests and follow up on work done.

Update both lecture and lab curriculum to include latest pedagogy and best practices in chemical education.

Evaluate the need for, discuss, plan and develop new courses.

Perform SAC responsibilities such as Program Review, updating CCOGs, Core Outcome Assessments, addressing course concerns due to changing demographics or program requirements, reviewing and discussing viability of DL courses, etc.

Plan and provide input on proposed upcoming changes affecting the Chemistry SAC (e.g. building remodels, Newberg campus classes, Southeast campus classes, etc.)

Serve on campus or district committees (hiring, safety, SAC, etc.)

Contribute to initiatives that benefit students (e.g. UCORE, tutor center, collaborations with 4 year colleges, etc.)

### iii. Extent of faculty turnover and changes anticipated for the future

Since the last program review, the composition of the faculty has significantly changed as shown in Table 14 on the next page. However, each campus has one faculty member who has 10+ years of experience teaching in a full-time chemistry faculty position at PCC. Three retirements occurred and one instructor resigned (moved) on the Sylvania campus and sadly, one of our very dedicated faculty passed away in May 2009. Currently, five of the ten full-time faculty members that have been hired within the last 6 years were replacements for the previously mentioned positions above. Two new chemistry faculty positions were added, one at Cascade and one at Rock Creek. Due to the younger ages of our full-time faculty, retirements and other significant changes are not anticipated before the next program review.
Our part-time faculty turnover rates are extremely high. Having a high turnover rate creates a larger workload for full-time faculty constantly mentoring and assessing part-time faculty. Consequently, the continuity of our classes suffers, and the level of continued development and improvement is compromised.

### iv. Extent of the reliance upon adjunct faculty and how they compare with full-time faculty in terms of educational and experiential backgrounds

We strongly depend on our part-time instructors who are hard-working professionals and who dedicate a tremendous amount of time to the PCC Chemistry program. However, department chairs have found that there is a limited pool to draw upon for adjunct chemistry faculty. They often have difficulty filling the positions needed to offer all desired sections of each course. Those who are hired to teach part time certainly meet (and often exceed) minimum qualifications in terms of chemistry education and experience. However, the majority are not experienced teachers. While it is often not emphasized in higher education institutions, there are specific skills and methods involved in effective teaching (defined as teaching which effects true student learning). Fostering effective teaching in all faculty is a priority for the Chemistry SAC.

### Table 14 Completed Years as PCC FT Faculty

<table>
<thead>
<tr>
<th>Cascade</th>
<th>Sylvania</th>
<th>Rock Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010 FT</td>
<td>2009-2010 FT</td>
<td>2009-2010 FT</td>
</tr>
<tr>
<td>Faculty</td>
<td>Faculty</td>
<td>Faculty</td>
</tr>
<tr>
<td>Kathy Carrigan</td>
<td>12</td>
<td>Stacey Fiddler</td>
</tr>
<tr>
<td>Kenneth Friedrich</td>
<td>4</td>
<td>Patty Maazouz</td>
</tr>
<tr>
<td>Ted Picciotto</td>
<td>1</td>
<td>Harry Davis (temp 2010-11)</td>
</tr>
<tr>
<td>Jim Schneider</td>
<td>10</td>
<td>Rozalia Dodean (temp 2009-10)</td>
</tr>
<tr>
<td>Danijela Vukic</td>
<td>2</td>
<td>Karen Radakovitch</td>
</tr>
<tr>
<td>Additional FT</td>
<td>Carol Handy</td>
<td>Carmen Martinez</td>
</tr>
<tr>
<td>Faculty</td>
<td>Retired 2008</td>
<td>Deceased</td>
</tr>
<tr>
<td>Wayne Yanamura</td>
<td>Retired 2009</td>
<td></td>
</tr>
<tr>
<td>Jennifer Harris</td>
<td>Moved 2006</td>
<td></td>
</tr>
<tr>
<td>Jim Anderson</td>
<td>Retired 2004</td>
<td></td>
</tr>
</tbody>
</table>
and we are very supportive to our part-time instructors and make every possible effort to make their transition into the educational field easier. An enormous amount of time is spent advising and monitoring part-time faculty, especially in their first year or two of teaching (see Table 15 below). This mentorship is essential to assure quality and continuity to the students and to ensure that all faculty—full-time and part-time—meet the College Core Outcomes. Strict supervision is also necessary in any program with a lab component, where the safety of students is the primary consideration.

Table 15: Tasks Associated with Mentoring and Assessing PT Faculty

<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training in standard PCC and department procedures</td>
</tr>
<tr>
<td>Initial and continuing training on learning theory, educational pedagogy and teaching methodologies</td>
</tr>
<tr>
<td>Visiting the classroom and providing feedback on teaching technique</td>
</tr>
<tr>
<td>Hosting a classroom visit from the adjunct faculty and discussing what they observe</td>
</tr>
<tr>
<td>Providing written feedback for performance assessments</td>
</tr>
<tr>
<td>Providing classroom resources and materials (slides, activities, handouts, review sheets, lab handouts, etc.)</td>
</tr>
<tr>
<td>Training in lab teaching methods, which may differ significantly from lecture protocol</td>
</tr>
<tr>
<td>Training in the proper handling of chemicals and equipment, including hazards, safety precautions and disposal.</td>
</tr>
<tr>
<td>Training in setup and use of unique lab equipment and instrumentation.</td>
</tr>
<tr>
<td>Monitoring labs to ensure that all safety criteria are being met.</td>
</tr>
<tr>
<td>Regular communication regarding class progress, upcoming experiments, teaching challenges, needs, etc.</td>
</tr>
<tr>
<td>Additional Tasks for On-line Courses</td>
</tr>
<tr>
<td>Training in effective on-line communication programs, such as Elluminate®</td>
</tr>
<tr>
<td>Provide support and training through migrations from one on-line management system to another (i.e. WebCT to Blackboard and Blackboard to D2L)</td>
</tr>
<tr>
<td>Training part-time faculty in computer management and problem-solving issues related to on-line course materials (i.e. Mac to PC compatibilities, necessary software programs, D2L, etc.)</td>
</tr>
</tbody>
</table>

*NOTE:* Each of these tasks must be accomplished for EACH adjunct faculty member. Faculty schedules often preclude common meeting times, so the tasks on this list are often done separately for each adjunct at great time expense to the full time faculty members.

As the time spent mentoring adjunct faculty has increased markedly over the last few years, the time we have to engage in curriculum development, participate in professional development activities, and community service has decreased drastically. We find that the majority of our time on campus is spent training, advising, assessing, and doing administrative work rather than teaching or engaging in learning and applying new teaching...
methodologies. Even though we believe that we continue to provide quality education to our students despite the additional workload, we cannot help but wonder how much longer we can provide this high-level of quality before experiencing ‘death by exhaustion’.

We find it important to reiterate that chemistry is a lab science and that we do spend a tremendous amount of time assuring safety of all parties, students and staff alike. As safety and disposal regulations have tightened over the last years, so have expectations of lab procedures, lab management and waste disposal procedure in the lab setting. In addition to the mentoring in the classroom, full-time faculty in chemistry spend a significant amount of time assuring safety of students and their adjunct fellows in the laboratory setting.

It is also very important to note that part-time faculty are currently not paid for necessary training. PCC must make funds available for our adjunct faculty to get the training they need in educational lecture and lab methods if we hope to offer consistently effective classes as part of a strong chemistry program to our students.

v. How does faculty composition reflects the diversity and cultural competency goals of the institution?

Each campus has moderate diversity in its full-time faculty, but good diversity in the adjunct pool (See Table 16 in Appendix 1). The full time faculty pool is mostly composed of individuals of European descent, with one faculty member of South American descent. No Asian, Indian, or African individuals are currently part of the full-time staff. The majority of the full-time faculty are Caucasian women many who have children.

Our adjunct faculty come from a variety of cultural and educational backgrounds. There is great variety in terms of culture, gender, and race that adds to the richness of academic dialogue in our area.

Though we don’t have great diversity in terms of gender and race in our qualified full-time faculty the diversity is very pronounced in their contribution to teaching, community service, and research (see Table 3 Appendix 1). We believe that our teaching and service to our community will encourage student diversity in our programs through equal access to higher education. Through mentorship we will continue to eliminate barriers that may prevent participation of students of color and women.

B. Instructor Qualifications

Instructor qualifications were reviewed and updated after the last program review in October 2004. At that time the updates included edits of the list of “related fields.” Instructor
qualifications were reviewed again in the Fall 2009 In-Service Meeting and approved to be sufficient without making any changes.

http://www.pcc.edu/resources/academic/instructor-qualifications/ch.html

C. Professional Development Activities

The American Chemical Society guidelines for Chemistry in Two-Year Colleges recommends that the institution provide opportunities and funding for professional development through sabbaticals, participation in professional meetings, and other professional activities. Additionally, the institution should offer mechanisms by which faculty members are mentored.

Limited funding is sometimes available for full-time faculty, though availability is dependent on PCC budget issues in any particular year, the amount available varies from campus to campus, and even on a good year the amount available per full time instructor is insufficient to fund travel to a national conference. Currently, there is no money set aside in PCC’s budget specifically for the professional development for adjunct faculty. However, part-timers can apply for staff development grants to receive minimal funding of these activities. In spite of this, faculty keep in touch with current chemical practices in industry and research by procuring outside (or personal) funding to attend conferences and workshops. It is also common practice to read journals, engage in discussions with colleagues, and utilize the full potential of the internet.

Professional activities have strengthened the program in that faculty bring back experiences in new teaching methods, new developments in research, instructional and curriculum changes and updates (see Table 3 Appendix 1). As a result of attending workshops and conferences, our full-time faculty have succeeded in revising laboratory experiments for their general and organic chemistry curriculum to include components that encourage critical and scientific thinking. Further examples include different teaching methodologies that have lead to self-propelled, guided-inquiry, and research-orientated classroom activities as well as hands-on activities used in the laboratory setting. Our hope is to be able to continuously update and include new and learner-appropriate teaching and learning methodologies as they arise and not fall back to traditional methodologies that have proven to be less effective.

We find it important to reiterate once again that full-time faculty do not have the time to fully engage in and develop these new and exciting activities for students. While some changes have occurred in specific classroom by specific instructors, there has been little time
for sharing good ideas among the faculty, especially the large number of PT faculty who may only be here on evenings and weekends. We need more time and energy to explore and share good ideas.

5. Facilities and Support

A. Equipment

Due to the overwhelming number of students enrolling in chemistry classes, most of the classrooms and laboratory spaces are filled to full capacity. Overcrowded classes are unsafe, unmanageable, and reduce student interaction and ability to use instrumentation / equipment.

All students need to be exposed to and learn the use of instrumentation, tools and techniques at the current modern chemistry level. ACS Guidelines\(^{10}\) suggest that labs should be equipped with a suite of modern chemical instrumentation and specialized laboratory apparatuses appropriate for the courses offered. This would provide hands-on laboratory experience in synthesis, characterization, and analyses.

It is necessary to invest in such modern instrumentation, its maintenance, and provision of space required in the laboratory. We are currently deficient across the district in lab instrumentation, and lack the ability to offer students the opportunity to learn current modern lab techniques.

The chemistry lab at Cascade, which was completed at about the same time as the last program review, is fully equipped for students with disabilities. Rock Creek facilities are compliant as well. However, accessibility for students with disabilities is limited and often inadequate at Sylvania. For example, lab access for students with wheelchairs is limited to a low table with no plumbing, electrical outlet or any necessary facilities required in the chemistry lab. Access to these facilities is unobtainable because lab benches are too tall for wheelchair access.

\(^{10}\) ACS Guidelines for Chemistry in Two-Year College Programs, American Chemical Society, Washington DC, 2009.
B. Library and other Sources of Information

The students use the library mostly to access textbooks available on reserve and e-reserves. Some students also use the computers available in the library to complete assignments or access materials posted on their course web page.

Most CH 106, 223, and 243 chemistry students at the Rock Creek and Cascade campuses and CH 241, 242, 243 at Sylvania, present a research poster during their time at PCC as a part of their course work. At Rock Creek this occurs at the annual Chemistry Fair in the spring term and at Cascade this occurs during the last laboratory session of every quarter when CH106 is offered. Both are open to district attendance. In order to find topics about current issues, they need resources. Therefore, we need to have easy access to more scientific journals and publications, to assist the students in completion of research and presentation projects. It would also be useful to have training opportunities for all faculty to learn easy access to available online journals.

C. Support Services

Clerical support: As of now, clerical support for faculty is absent. We could use clerical support such as a teaching assistant for menial tasks.

Technical support: All campuses have some available technical support for maintenance of computers, equipment and the chemistry stock room. Rock Creek has a great team to assist instructors in the chemistry stock room. However, this is not consistent across the district. For example, at Sylvania we have only one lab technician to support 25 weekly lab sections in the Fall term for chemistry alone. The Sylvania lab technician also supports physics and geology. Importantly, Sylvania has no lab technician support after 3 pm each day, although our afternoon labs extend up to 5:20 pm and 3-4 evening labs per week are offered each term, as well as Saturday labs. The ACS Guidelines\(^\text{11}\) state:

3.4 Support Staff. A sustainable and robust program requires an adequate number of secretarial, administrative, and support personnel, along with technical staff to maintain instrumentation, support laboratory functions, and assure regulatory and safety compliance. The number of support staff members should be sufficient to allow faculty members to devote their time and effort to academic

\(^{11}\) Ibid., p. 7
responsibilities and scholarly activities. **One full-time laboratory technician for every four full-time or full-time equivalent chemistry faculty members is needed.** Part-time and student help are not adequate substitutes for full-time laboratory technicians. To foster the development of a safe environment and a safety conscious culture, all technical staff members, including part-time and student help, should receive regular training in chemical safety protocols, proper use of equipment, and waste management.

**Administrative support:** The administrators are often misused and doing tasks outside their job description. They are generally very supportive and helpful.

**Tutoring support:** Sylvania and Cascade campuses provide their chemistry students with science tutors for most chemistry levels. There is a lack of science tutoring center at Rock Creek, so students rely solely on help from their instructors. There are some resources to support tutor training, but to be viable and successful, resources must be made available for proper training of tutors, otherwise they are a waste of money. The availability of an online science tutoring was announced at the beginning of this fall, but there is no available feedback from students about its efficiency. At Cascade and Sylvania, the full time instructors and some part time instructors spend office hours in the tutor center increasing accessibility to otherwise shy students who might not use office hours.

**Computer services support:** With the increased use of technology in the classroom and laboratory, comes the increased requirement for technical support from the Instructional Technology department. This is a crucial support service for a department such as ours. At Sylvania, ONE single IT tech is assigned to the physical sciences department, among his other departmental assignments. This person is overworked, and as a result is unable to accommodate our emergencies and requests in a timely manner at all times. Sometimes an entire laboratory or lecture experience depends on the functioning of hardware and software which may crash and become unusable temporarily. As faculty are not able to change programming on instructional computers, this leaves faculty and students high and dry. The faculty strongly recommend that the number of IT support personnel be increased to facilitate the growth in enrollment and the use of technology in the classrooms.

**D. Student Services**

Advising has a great impact on student success. Chemistry students, majors and non-majors, are often given inconsistent advice and planning help. Advisors need to be well informed about
majors and requirements for registering to classes. In 2008 the SAC created an advising guide chart (See Appendix 18) to help advisors guide chemistry students.

The Office for Students with Disabilities makes it hard to set up testing for students who require a quiet environment to take a test. There is a lot of paperwork to be filled out, advanced notice is required, and the available testing times are very limited. Sometimes the student does not give the instructor advanced notice to require this accommodation, and there is no time to schedule a test weeks ahead of time. At the end, the instructor has to accommodate the student to the best of his/her ability and available time. It would be helpful to have more flexibility from the ODS to set up testing.

E. Scheduling Patterns

Large class sizes reduce faculty-student interaction in general, which ultimately reduces student success and retention. Class size has a definite impact on the ability to use group work in class. If classes are too large, the instructor has no opportunity to spend an adequate amount of time with each group. Also, it greatly affects the ability of the instructor to write exams, quizzes and homework that do not take an eternity to grade.

Currently, most campuses teach some courses as sections of 48 students, which creates difficulties for effective student-teacher interactions in circumstances other than direct lecture.

The SAC and department chairs have been creative and supportive in scheduling courses at times convenient to students, including evening, weekend and classes holding both a full week of lecture and lab on one day. However, this requires hiring a large number of part time faculty to cover the range of course offerings in order to meet student needs. The ACS Guidelines state that 75% of course offerings should be taught by full time faculty.12

It can be difficult to schedule lecture courses in rooms near our lab facilities that are held at convenient times. For example, with the shortage of classrooms, instructors are often required to teach lectures far from the chemistry department. These long distances make it difficult, if not impossible, to bring course and demonstration materials to these classes.

Offering distance learning classes has allowed students who require flexibility in scheduling, as well as students who are located at great distances from PCC campuses, to take chemistry courses. For example, we offer a chemistry course series to support the students enrolled in the

12 Ibid., p. 12.
online Medical Lab Tech Program so that students can complete this program from anywhere in Oregon.

6. Recommendations for Improvements

A. Program Strengths

Based on the previous section of the program review, it is evident that the faculty in the chemistry SAC are committed to excellence in teaching. In order to maintain this high level of student education the chemistry faculty have completed the following to continue strengthening our Program.

- Individual continual assessment of teaching methodologies to improve student learning (i.e. feedback from students in office hours, weekenders, course evaluation forms, improved powerpoints, etc.)
- Implementing innovative pedagogy (See Tables 2, 3, and 4 in Appendix 1) (i.e. POGIL, clickers, Thinker Buddies, Weekenders, etc.)
- Involvement in professional organization (See Table 3 in Appendix 1)
- Establishing partnerships with other institutions (George Fox, PSU, and U of O for UCORE) due to involvement in professional organizations and attending conferences and workshops.
- Working towards greening the labs at all levels (CH100 through CH243)
- Leading the Nation in distance learning development for both lecture and at-home labs.
- Encouraging and supporting students to participate in research programs (UCORE, REU at PSU, etc.)
- Advising students in future career paths in chemistry and related fields (Professional and academic advising)
- Staying abreast on and implementation of the most recent technological developments (Odyssey, Spartan, OWL, Mastering Chemistry, Course Management Systems, lab equipment, etc.)
• Support or provide chemistry tutoring for students (Physical Science Tutoring Center, Cascade’s Tutoring Center, etc.)

• Maintaining collegiality between faculty; we support each other across the district. For example, when Rock Creek was experiencing great distress in the 2008-2009 academic year, the Chemistry SAC sent a letter of support to the administration.

• Functioning well as team of chemistry SAC members to achieve district-wide goals (examples: one of the 46% of SAC’s who completed Critical Thinking and Problem Solving assessment in 2009-2010; revised CCOG’s for 13 courses between June and October 2010 to meet the General Education State Guidelines)

• Diversity of faculty in regards to areas of expertise and backgrounds, which also provides flexibility in the courses that instructors teach from term to term

• Scheduling a variety of courses at various times to provide access to many students

B. Program Improvements

The Chemistry Program at PCC could be improved with the following:

• Improved Assessments
  o Long-term tracking of students after they leave PCC
  o Teaching effectiveness of current instructional practices (College Core Outcomes)
  o Student goals beyond our courses to inform curricular decisions (ie. Who is the typically student in the 105-6 series and why are they there?)

• Faculty
  o Larger percent of classes taught by full-time instructors (ACS Guidelines recommend 75% and the Chemistry is well-below PCC Norm) (See the two graphs on page 34.)
  o Effectively train and mentor part-time faculty for program consistency
  o More consistency for the hiring process of PT faculty
  o Increase the part-time pool (with larger numbers of part-timers needing to be hired, we need a better pool of qualified applicants)
  o Increase communication and collaborations with Chemists in other 2-year and 4-year institutions, especially those schools in the Oregon University System
  o Increase communication between chemistry faculty across the district
• Improved access to research articles in chemistry and pedagogy. FT faculty need more time to review professional journals in addition to better access.
• Improve pedagogical methods to meet the needs of the new tech-savvy generation of students
• Increase accessibility to underrepresented ethnic groups (See Demographics Data in Appendix 17)

PCC and Community
• Lab updates
  ▪ Improve faculty accessibility to lab support, especially for night and weekend classes
  ▪ Improve facilities to coincide with new pedagogical approaches
  ▪ Improve facilities for disabled students
  ▪ New modern Chemistry laboratory and instructional equipment
  ▪ Improved maintenance of current equipment
• Increase community outreach programs (K-12 educational system, etc.)
• Increase business partnerships with chemistry-related companies to identify potential degrees and certificates or courses that would meet the needs of the business community.

C. Recommendations

1. Additional Faculty in order of Priority for those requiring funding
   a. Full-time faculty position at Cascade
   b. Full-time faculty position at Rock Creek (Make the current full-time temporary position a new full-time permanent position)

2. Additional Lab Support
   a. Sylvania needs a new dedicated full time physical lab support to work on evenings and weekends. This person should have experience in chemistry and have the ability to trouble-shoot broken lab equipment.
   b. Sylvania labs need to be remodeled for the 21st century including ADA compliant. We need confirmation that this will be completed with the current bond remodel project.
   c. Cascade needs one full-time chemistry lab support. Currently, they only get 0.5 of a 0.75 non-chemistry lab tech.
d. The Cascade program requires an additional lab room for any further growth to occur.

3. Time for Chemistry Faculty to convene across the district to share innovative pedagogical ideas for program development. Currently the SAC in-service days are jam-packed with Assessment, Program Review, CCOG’s and many additional tasks that leave no time for discussion and sharing of great ideas.

Therefore, we request additional scheduled meeting times for full-time faculty across the district

a. Currently the SAC is required to meet only two times per year. However, due to the increased SAC workload over the past two years, the SAC has “unofficially” added a half-day meeting in June during finals week and a 2-hour time slot during Fall in-service week.

i. The Chemistry SAC requests one full paid in-service day during in-service week to provide the opportunity to share new ideas learned at chemistry conferences, new pedagogy implemented in some courses in the district, new software available, new lab equipment and experiments, etc. The SAC cannot just add another day to complete additional administrative requirements without compensation.

ii. The SAC requests a third full-day in-service scheduled in the winter term to work on assessments, course development, CCOG’s, etc.

4. Additional resources (time, administrative support, etc.) to assess the program—long-term student tracking, teaching effectiveness/Core Outcomes, and student populations to inform curricular decisions.

a. The SAC requests an administrative support person for 20 hours per year to compile assessment data—introductory questionnaire forms, rubrics, student evaluation forms, format documents, such as the Program Review, etc.

b. We need help with effectively collecting and analyzing the 100 level chemistry courses to identify the needs of the students currently enrolled in these classes. How should we proceed? Can we link a questionnaire to the enrollment process in Banner? Can Institutional Research do this? We need a 0.25 release time for one full-time faculty member to effectively develop a system, and to collect and analyze this data.
c. We need help with how to effectively collect and analyze the effectiveness of our program for the students when they get “Out There” in their professional programs, transfer programs, etc. Is there a way for institutional research to track these students?

d. On a more local level, can PCC track a student from the CH100 class through CH243 and beyond, so we can answer such questions as do our CH100 students succeed in their subsequent courses; are students who complete CH106 as successful as students who complete the CH223 course as successful in the organic chemistry class (CH241)? Is there a system already available to track this data, or do we need to work with a specific department to develop this? If faculty need to implement this system, then we need release time or other compensation.

5. Improve training for part-time faculty.

   a. Add 5 hours per term for required PT training with pay. This includes safety, lecture and lab training.

   b. Add an additional 5 hours training per term for all PT faculty that are scheduled to teach a new course. This includes safety concerns for each experiment, addressing both lecture and lab concerns, etc.

       NOTE: The training of the part-time faculty will be completed by the chemistry FT faculty.

   c. The PT training will require an additional 5-hour FT faculty salary to pay the FT faculty who conducts training workshops.

6. Additional resources to design and implement innovative chemistry courses, including sustainability, nanotechnology, chemistry for non-majors, honor’s chemistry, etc.

   a. FT faculty require 0.50 release time for one term per lecture/lab course to design and implement each new course. NOTE: this release time requires the hiring of new PT faculty, so refer to the section that requests a better part-time pool (see Program Improvements section on p. 48).

   b. How can the chemistry SAC assess the potential demand for new courses, before spending the time required for development and implementation? Is
this available through institutional research or is there another department on campus able to collect and analyze this data?

c. Increase business partnerships within the Portland community to identify the potential for new degrees, certificates, and courses that meet the needs of the business community. This will require a 0.25 release time (1 year) for a FT faculty member to establish these partnerships.

7. Increased Dedicated Travel Funds in the amount of $1500 per faculty per year across the district for FT and PT faculty.
   a. Conferences for national professional organizations, such as the American Chemical Society, cost up to $1500 per person per conference due to the increased cost of travel.
   b. PT faculty require a travel budget to attend local, regional, and national meetings to improve innovative pedagogy in their classrooms.

8. Resources, including time and administrative support to write grants for new equipment. We have a deficiency in our instrumentation that is expected of all 2nd year chemistry courses, these include a gas chromatograph mass spectrometer. The lack of this instrumentation is a point of contention for 4-year transfer schools. This is a significant investment but should be considered no more of an investment than equipment used in technical degrees such as auto mechanics or engineering tech. These instruments reflect equipment used by actual chemists in modern, current laboratories, and in this PCC comes up short.

   a. Gas Chromatograph Mass Spectrometry for Sylvania and Rock Creek. ($70,000 – 80,000 from Perkin-Elmer)
   b. Roto-evaporators for Sylvania and Rock Creek Organic Chemistry Labs ($2500-$4500 each. Several would be needed for each campus to accommodate the larger lab sections.)
   c. Fully equip all the campuses with the latest Odyssey software for molecular modeling.
   d. Atomic Absorption Spectrometer ($20,000 from Perkin-Elmer)
   e. New lab equipment for the CH102 course, including a UV Transilluminator ($1500 each).