

**Department of Chemistry
Program Review (2013-2014)**

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* The author of each section is given in parentheses. Each author is a member of the full-time chemistry faculty. Peter Doucette was responsible for the overall coordination of the program review and piecing together the document into a unified whole. The Dean of Natural Sciences, Jean Shankweiler, contributed significantly as a resource person and greatly helped with the proofreading. We thank the Program Review Committee members for their thoughtful and helpful suggestions during the revision of this document.

I. Overview

A. Program Description

The mission of the program in chemistry is to prepare students with the knowledge and skills to pursue further education and careers in the chemical, physical and health sciences, engage in chemical scientific inquiry and problem solving, work effectively in collaborative settings, and communicate scientific information clearly. Our department's vision is very much in line with the college's mission.

The Chemistry Department at El Camino College offers two "tracks" of courses. The first is a sequence that includes all of the traditional lower division chemistry classes while the second is a shorter tract that is designed to satisfy the chemistry requirement for allied health majors.

The first track is a sequence that is parallel to what is offered at most universities, beginning with a high-level preparatory course, Chemistry 4, continuing with General Chemistry, Chemistry 1A and 1B, and finishing with Organic Chemistry, Chemistry 7A and 7B. This sequence is very rigorous (especially when compared to other two-year colleges) and the department continually strives to keep it strong. The courses are transferable to University of California and California State University campuses and fulfill their comparable requirements. In an effort to maintain the rigor of this program, we require that students take Chemistry 4 at El Camino; that is, we do not accept an introductory course from another school as a prerequisite for Chemistry 1A. This ensures that students are given the best opportunity to succeed in the demanding chemistry classes that follow Chemistry 4.

The shorter of our two tracks is a choice between "Fundamentals of Chemistry," Chemistry 20, and "Inorganic, Organic and Biochemistry," Chemistry 21A and 21B. Chemistry 20 is for students who plan to obtain an associate's degree in nursing (ASN), or an allied health certificate from El Camino College, while Chemistry 21A and 21B are designed for those seeking to transfer to a bachelor's degree in nursing, or other health-oriented bachelor's degree programs.

All of the above courses fulfill general education requirements for physical science with laboratory, but Chemistry 20 is probably the broadest and most suitable for non-science majors.

We also offer "Introduction to Research," Chemistry 99, designed to enroll one or two students per semester to explore special problems of interest such as helping to design laboratory experiments for classes.

Much anecdotal evidence suggests that our students that transfer to universities (including top-tier UC schools such as UCLA and Berkeley) have been prepared at least as well as students who took their lower division chemistry courses at the transfer institution. For this reason our school is regarded as an especially strong chemistry school by institutions that accept our students as transfers. The strength and quality of educational services for our students is in line with the college's strategic initiatives A and B.

Students who complete the courses needed to transfer to a four year university as a chemistry major are eligible for a Chemistry A.S. Degree. Although not many A.S. degrees are granted by our department (because not many students transfer as chemistry majors), the number of A.S. degrees has increased recently, going from 4 in 2011-2012 to 13 in 2012-2013.

The Chemistry Department currently has eight (8) full-time permanent faculty positions and approximately fourteen (14) adjunct instructors. In the past two years we have hired two new full-time faculty to fill the positions left by two full-time faculty retirements. In recent history (approximately 15 years), we have been as low as seven (7) and as high as ten (10) full time faculty. The number of adjunct faculty has similarly ebbed and flowed. Our faculty members are generally quite active in campus-wide

and division organizations and activities, such as Academic Senate, Honors Transfer Program, Curriculum Committee. Our faculty have also been supportive of student groups such as ASO and clubs such as the Chemistry Club. The chemistry club at El Camino is an official chapter of the American Chemical Society, a distinction that is rare amongst community colleges. The development of an effective process of collaboration within the campus is in line with the college's strategic initiative C.

With the recent global movement towards environmentally sound practices and sustainability, the department of chemistry is in line with goal. We seek to continually reevaluate our curriculum to make sure that we are leaving behind as small of a footprint as possible. The push towards green chemistry is big and we hope to do our part by providing a comprehensive laboratory experience that focuses on low-waste, high efficiency chemical processes without the typical levels of exposure to toxic materials. This effort to move towards sustainable environmentally sensitive practices is in line with the college's strategic initiative G.

The number of course sections and thus the enrollment in chemistry has fluctuated over the last six years in large part due to uncertainty in state funding as a result of a global recession, but the demand for chemistry classes has remained high. When classes have been added due to this high demand, they consistently fill very rapidly.

Our current students are more computer and technology savvy than ever before. The chemistry department plans to take advantage of this by incorporating technology in the classroom and using it as a teaching tool. The chemistry department is in the process of incorporating SPARTAN and Odyssey computer simulation programs into our General Chemistry curriculum. These computer simulation programs allow students to study molecules and properties of molecules from a computer station. This avoids the process of having to perform time consuming experiments in the lab to acquire data. The use of technology by integrating of these instrument and computer programs is in line with the college's strategic initiative F.

Our department participates and will continue to participate in SLO's, program review and program planning. The department is in line with the college's strategic initiative E.

B. Status of Previous Recommendations

Five recommendations from our last program review have been completed or partially completed. Three of the more important recommendations and their current status are listed below:

- *Recommendation:* We need to have at least four more full-time "teaching" faculty just to get back to where we were a few years ago when we offered fewer sections than we do today.
Status: Partially Completed. We have hired four full-time faculty since the last program review, however, two of our longstanding full-time faculty members have retired leaving us two below what was called for in this recommendation.
- *Recommendation:* We need to offer more sections for most of our courses as we currently are not meeting student demand.
Status: Partially Completed. The global recession that occurred shortly after the last program review, caused a number of sections to be cut despite increasing demand. Economic recovery and voter approval for proposition 30 funding has enabled courses to be added back, however demand for classes remains high. Even with classes being added back, large numbers of students trying to add into already full classes are turned away each semester.

- *Recommendation:* Tutoring needs to be tied more closely to the department and to individual courses. All of the chemistry tutors on campus need the approval of and coordination with the chemistry department.
Status: Partially Completed. While there is dedicated chemistry tutoring available in the learning resource center on campus, there is little if any communication between the tutors and our department. Furthermore, the tutor on duty may not be qualified for a given class. In fact there are not any tutors qualified for the biochemistry that is covered in chemistry 21B.

All of the recommendations from our last program review and their current status are summarized in the table below.

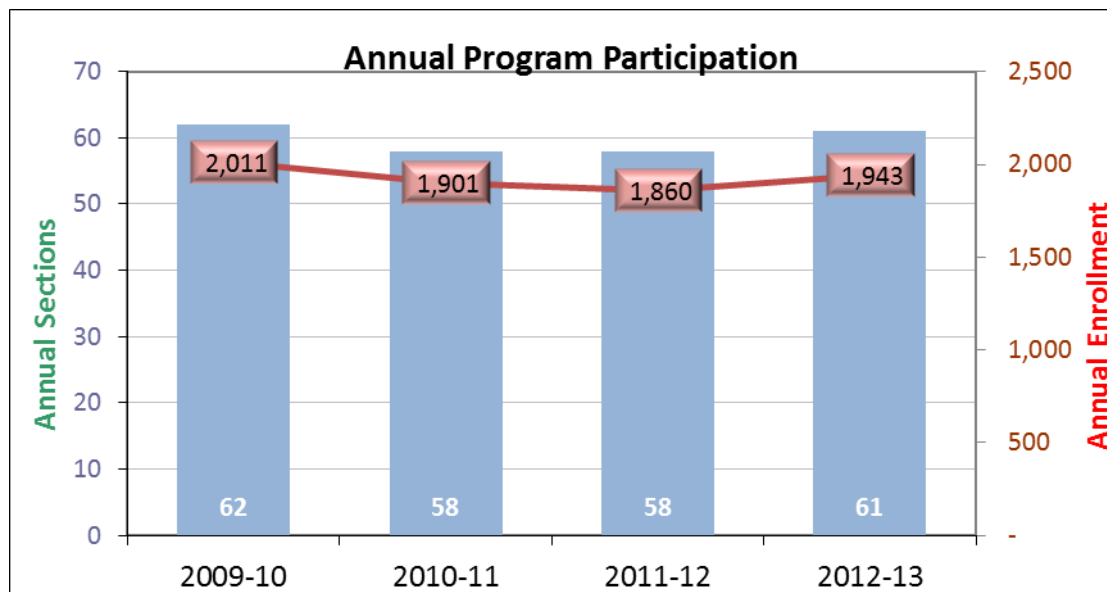
We need a department chair to coordinate all the activities of the department and to provide proactive leadership as the department plans for the future.	Incomplete
We need to have at least four more full-time “teaching” faculty just to get back to where we were a few years ago when we offered fewer sections than we do today.	Partially Completed*
We need our lab technician position which is assigned three quarters to chemistry to be changed to a full-time assignment in chemistry	Incomplete
We need to offer more sections for most of our courses as we currently are not meeting student demand.	Partially Completed*
The air conditioning noise has been a long term problem ever since the chemistry building was remodeled. It needs to be fixed.	Incomplete
Temperature control has been a long term problem ever since the chemistry building was remodeled. The temperature runs way too hot sometimes and way too cold at other times.	Incomplete
We need a more efficient system of projector replacement, maintenance and repair. Repairs often take too long.	Incomplete
The MESA workshops are important asset to the chemistry program and should be continued.	Completed
Tutoring needs to be tied more closely to the department and to individual courses. All of the chemistry tutors on campus need the approval of and coordination with the chemistry department.	Partially Completed*
Due to limited board space we recommend sliding white boards be installed in all lab and lecture rooms.	Incomplete
Given the proper resources, we will establish a formal mentoring program for all new full-time and adjunct faculty.	Incomplete
We need to review and update two of our course outlines: Chem 20 and Chem 99 are currently in review during spring 2009.	Completed

* Partially Completed: moderate to significant progress made.
 Incomplete: little to no progress made.

II. Analysis of Research Data

A. Offerings and Fill Rate

The graph below shows that the annual program participation has been stable for the last four years with a modest jump over the last year. The last annual participation count has increased by 4.5% from 1860 to 1943.



The graph above and the table below show that although the number of sections was reduced due to budget cuts, the demand for chemistry classes remained high. The high demand for chemistry classes is demonstrated by the over 100% fill rates of sections over the last five years (Figure below). In addition, the relatively level value of the “Enrollments/students” in the table below indicates that there is a constant steady supply of new students enrolling in chemistry classes.

Academic year	2009-10	2010-11	2011-12	2012-13	4 year average
Annual section count	62	58	58	61	60
Annual seat count	2,011	1,901	1,860	1,943	1,929
Headcount	1,609	1,539	1,520	1,543	1,553
Enrollments/Student	1.25	1.24	1.22	1.26	1.24

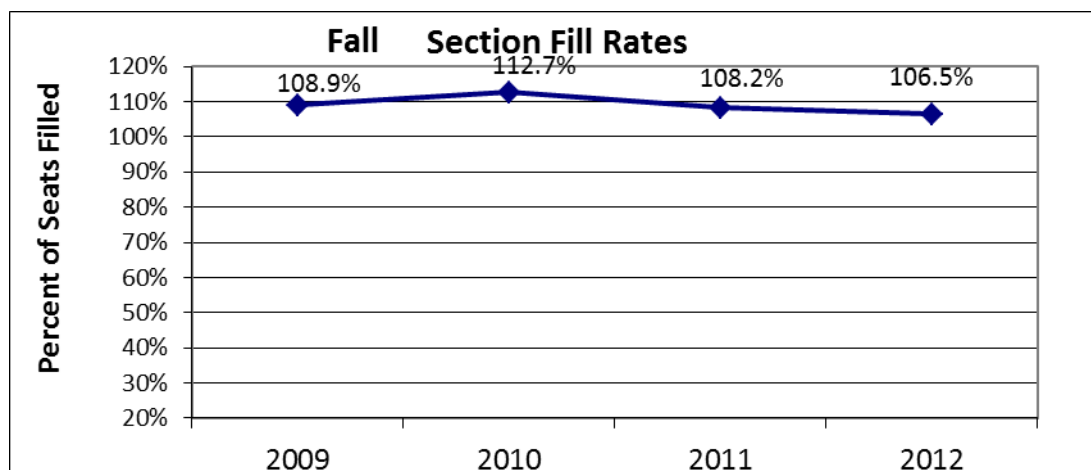
B. Demand: FTES by Course (using first census data)

Course	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012
Chem 20	31.52	35.02	32.03	32.28	32.28
Chem 21A	34.72	32.01	23.49	23.52	22.01
Chem 21B	6.43	7.46	7.12	6.7	6.91
Chem 4	81.51	84.54	76.77	77.42	83.62
Chem 1A	55.52	56.79	58.97	54.61	63.25
Chem 1B	19.25	22.5	23.43	18.12	19.68
Chem 7A	23.26	19.75	21.67	21.99	22.63
All Chem Courses	252.19	258.07	243.48	234.64	250.38

As the data in the above table show, the department had decreased the number of sections offerings for the fall of 2010 and 2011 in line with El Camino College's planned Full Time Equivalent Students (FTES) reduction. While cuts were made, demand for chemistry courses has steadily increased, causing existing sections to be overrun by an even higher number of students wanting to add those classes. Over the last five fall semesters, the overall demand has increased in each successive year without exception. To meet the increased demand the department has begun increasing sections again, starting in 2012. The reasons more sections were not offered sooner and additional sections are not currently offered was due to lack of administrative approval to offer more sections (due to uncertainties in state funding), lack of a sufficient number of qualified faculty, and lack of classroom space (at popular scheduling times) appropriate for teaching chemistry.

The graph and table below show that the fill rate for chemistry classes (day and night sections) is extremely high and holding steady over the four years indicated. The data indicate the high demand for chemistry classes, even when more sections are offered.

All the data in sections IIA and IIB of the program review are consistent with a high level of demand for chemistry classes as well as pent up demand for more. When new sections are offered they generally fill very rapidly indicating that there is more demand than we are currently able to meet.



Enrollment by Time of Day and Overall Fill Rate (seats taken at census vs class size)

Fall Term	2009	2010	2011	2012
Day	76.8%	74.9%	73.8%	72.3%
Night	23.2%	25.1%	26.2%	27.7%
Overall Fill Rate	109%	113%	109%	106%

C. Retention and Success Rate

Chemistry courses are generally known as demanding courses. Success in a course is dependent on several factors. Students must have adequate preparation from the math and/or chemistry prerequisite for the course. Students must have the discipline to study and learn between classes so that they come to class prepared, so they can use previously discussed material in the learning of new material. Study typically requires repetition of the material as well as a great deal of time.

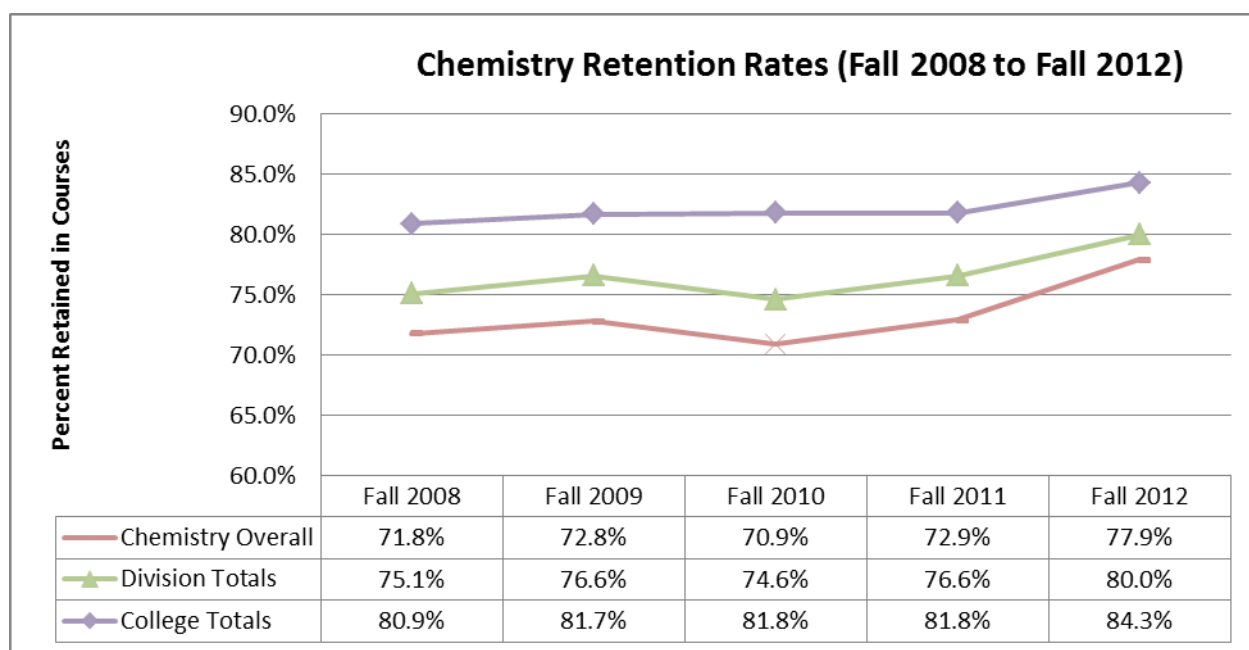
Based on a large amount of anecdotal evidence, the chemistry faculty find that the single greatest impediment to retention and success is lack of effective studying and preparation. Despite instructor suggestions and the resources available, many students don't take the time to figure out how to study chemistry effectively. Course material builds on itself, so any gaps in knowledge make later topics more difficult to learn. As a result, catching up is very difficult once a student falls behind.

The data in the tables and graphs below indicate that chemistry retention and success rate averages are lower than the Natural Sciences Division whose results are lower than those found campus wide. Faculty feel strongly that maintaining high standards to better prepare students for transfer to universities is paramount to maintaining our excellent reputation with the universities as well as later student success after transfer. Accordingly, slightly lower retention and success rates are expected in highly demanding courses such as chemistry.

Retention Rate (census vs end of course)

Course	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012
Chem 20	74.9%	66.1%	64.4%	73.8%	80.9%
Chem 21A	69.5%	82.4%	80.0%	64.9%	81.0%
Chem 21B	77.0%	70.0%	78.3%	77.5%	78.3%
Chem 4	67.7%	69.9%	79.5%	67.6%	67.0%
Chem 1A	62.1%	67.6%	76.5%	71.9%	87.9%
Chem 1B	69.0%	75.2%	63.5%	77.6%	79.3%
Chem 7A	79.5%	87.1%	75.0%	60.9%	71.8%
Chemistry Overall	71.8%	72.8%	70.9%	72.9%	77.9%
Division Overall	75.1%	76.6%	74.6%	76.6%	80.0%
ECC Overall	80.9%	81.7%	81.8%	81.8%	84.3%

Since most chemistry courses are part of a sequence, the more demanding courses tend to attract better prepared students. As a result (and as the table above and graph below show), entry and higher level chemistry courses tend to have similar retention rates on average. Most individual courses have a great deal of variation in retention rate. This variation is likely due to a large number of faculty (with different levels of teaching experience) teaching the same course.

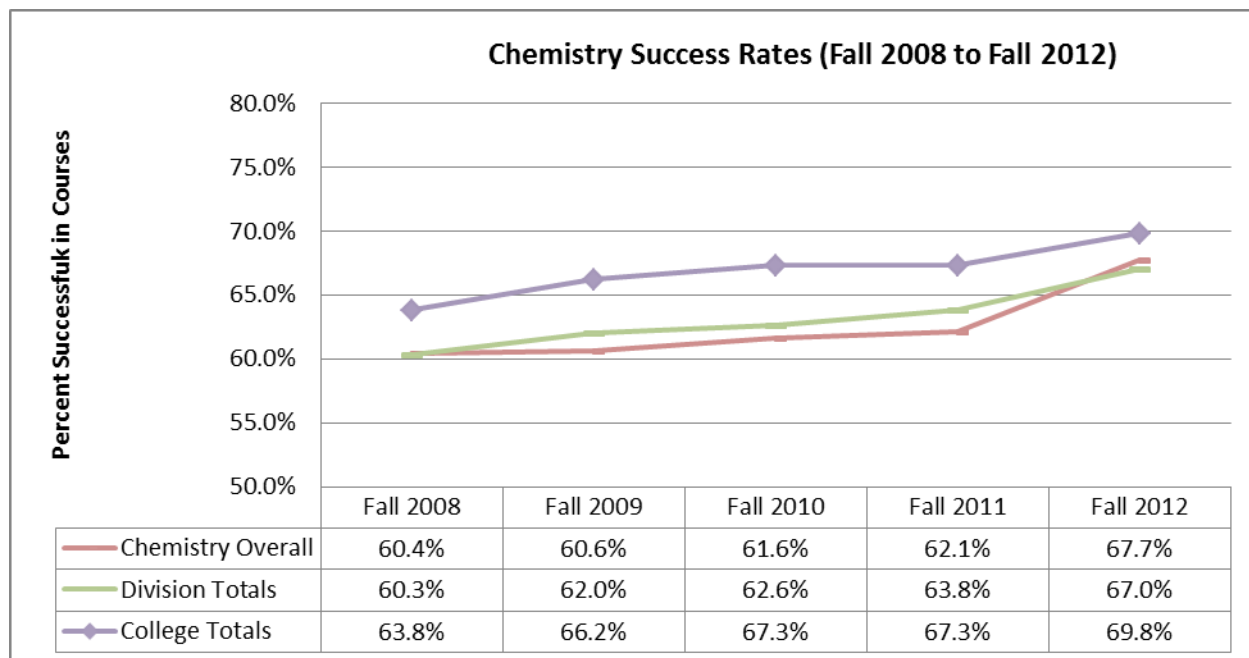


A trend in the data is an increase in retention rate after bottoming three years ago. From fall 2010 to fall 2012, the overall chemistry retention rate has increased by 10% from 70.9% to 77.9%. The same trend may be found for the Natural Sciences Division. Meanwhile, the campus wide average has been relatively stable.

The various above comments concerning retention rates also apply to the success rates as may be seen in the table and graph shown below. From fall 2008 to fall 2012, the overall chemistry success rate has increased by 12% from 60.4% to 67.7%, though most of this increase was observed only in the final semester, fall 2012.

Success Rate (census vs received C or better)

Course	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012
Chem 20	64.9%	56.5%	58.0%	65.1%	70.1%
Chem 21A	45.8%	69.1%	78.7%	54.4%	65.1%
Chem 21B	69.8%	57.9%	73.6%	70.5%	62.0%
Chem 4	58.2%	54.1%	65.2%	51.4%	55.3%
Chem 1A	62.1%	64.7%	70.6%	68.8%	84.4%
Chem 1B	53.3%	60.3%	49.6%	65.0%	72.2%
Chem 7A	74.0%	83.9%	63.2%	49.3%	66.2%
Chemistry Overall	60.4%	60.6%	61.6%	62.1%	67.7%
Division Overall	60.3%	62.0%	62.6%	63.8%	67.0%
ECC Overall	63.8%	66.2%	67.3%	67.3%	69.8%



To maintain and continue to improve retention and success, it is important that we continue to have MESA workshops facilitated by well-chosen individuals. Campus-provided tutors are also important. In beginning-level courses (particularly Chem 20, 21A and 4), we should be sure that students understand how to study and how to use their time efficiently. The thorough mentoring of new (full-time and adjunct) faculty is also important to retention and success. Mentoring is always a challenge since there is no one in charge of the mentoring process (such as a department chair). Adjunct faculty should be more available to students by being required to hold office hours and they should be compensated for this additional time required. It should be noted that a number of our part time faculty do hold unofficial office hours, but they are not compensated for this additional work.

D. Recommendations:

- We need to hire two more qualified full-time instructors to meet the high demand for our courses as well as maintain the high level of rigor we expect in our courses.
- To meet the demand of increased enrollment and additional sections, the amount of available laboratory technical staff (as well as laboratory and equipment budget) should be increased.
- To maintain and continue to improve retention and success, we need adequate student resources especially in the form of in-person and online tutoring.
- To maintain and continue to improve retention and success, it is important that we continue to have MESA workshops facilitated by well-chosen individuals.

III. Curriculum

A. Course Offerings

As the table below shows, all of our courses have been reviewed within the last six years. Chem 20, Chem 4, Chem 1A, Chem 1B, and Chem 99 have all been reviewed in the last four years. Chem 21A, Chem 21B, Chem 7A, Chem 7B, and Chem 50 will be reviewed in the next two years.

Course Number	Course Title	Course Review Date	Transferability
Chem 20	Fundamentals of Chemistry	2009-2010	Fully
Chem 21A	Survey of General and Organic Chemistry	2008-2009	Fully
Chem 21B	Survey of Organic and Biochemistry	2008-2009	Fully
Chem 4	Beginning Chemistry	2012-2013	Fully
Chem 1A	General Chemistry I	2011-2012	Fully
Chem 1B	General Chemistry II	2011-2012	Fully
Chem 7A	Organic Chemistry I	2008-2009	Fully
Chem 7B	Organic Chemistry II	2008-2009	Fully
Chem 50	Special Topics in Chemistry	2008-2009	Limited
Chem 99	Independent Study – Introduction to Research	2009-2010	Limited

We have not deleted or added any courses in the last four years. None of our courses are classified as distance education. We have designated two sections of Chem 1A as honors transfer program (HTP) sections in fall 2013. We plan to offer more HTP sections of Chem 1A as well as Chem 4 and Chem 1B based on student demand.

Each fully transferable course is offered every semester and there is high demand for all courses. Many students are regrettably not able to enroll in their required chemistry courses. Meeting student demand by offering more sections should allow the students to transfer more quickly to four-year institutions.

We are confident in the quality and articulation of our courses. The Chemistry Department does have concerns about the large numbers of part-time faculty we currently depend upon. Part-time instructors are not required to hold office hours, which is a disservice to our students. Furthermore, having a large number of part-timers also affects the continuity of the sequential courses in our program which may affect our courses negatively over time. Hiring more full-time faculty will bring further cohesiveness to the department.

There has been a small, but significant increase in the number of students earning a Chemistry A.S. degree in the past year as shown in the table below.

Year	2007-8	2008-9	2009-10	2010-11	2011-12
Chemistry A.S. Degrees Awarded	1	5	4	4	13

We hope the number of degrees awarded each year remains high - perhaps around 10 per year. Although the number of degrees awarded in any year is small, it should be noted that the majority of science majors, including geology, physics, biology and engineering, are required to take one or more chemistry courses. These students are therefore more likely to earn a degree in another field, or transfer without a degree, despite (in some cases) having taken enough chemistry courses to earn an A.S. degree in chemistry. Additionally, pre medical, dental, pharmacy, nursing and allied health students also require at least one of the chemistry courses offered by our department, but do not qualify for an A.S. degree in chemistry.

In order to continue to improve our curriculum and engage students, we also hope to pursue the following course additions:

- El Camino students who are not science majors may find a Consumer Chemistry course as an interesting way to fulfill their general education requirements. Consumer Chemistry would explore the chemistry of products and processes that students encounter every day. We might also consider offering an honors section of this course.
- Engineering students are generally required to take one semester of General Chemistry. They might find that a 1-semester General Chemistry course, tailored specifically to their needs, would be more appealing than taking the first semester of the current 2-semester offering.
- Forensic Chemistry has become popular in movies and on television. As forensics become more important in crime-solving, a Forensic Chemistry course could become quite popular among ECC students.
- One or more hybrid courses would offer students an alternative style for taking a course. Such a course would be taught online with the laboratory offered on campus.

B. Recommendations:

- We need to hire two more qualified full-time instructors to meet the high demand for our courses as well as maintain the high level of rigor we expect in our courses.
- We would like to add at least one additional chemistry class to improve curriculum and better engage our students.

IV. Assessment and Student Learning Outcomes (SLOs)

A. Course and Program Level SLOs

Chemistry has three SLOs which serve for both the program level and the course level.

- Given a word problem, students will be able to correctly write a chemical equation. The equation will contain correct formulas, states of matter (when required), and balancing.
- Students will be able to create (via molecular models or drawings) accurate representations of compounds. The representations will contain appropriate bonds, lone pairs, and geometry.
- Students will adhere to safety protocol in the laboratory regarding eye protection. Students will follow the proper procedure regarding wearing goggles in the laboratory, and keeping them on to protect their eyes.

B. SLO and PLO Alignment

The statements are the same for both course- and program level. We used the same statements in order to ensure that the goals of the Chemistry Department were reflected in the goals for each course. For each ILO, we considered the relationship of the ILO to the individual SLO/PLO statement.

I. Content Knowledge: Students possess and use the knowledge, skills and abilities specific to a chosen discipline, vocation or career. We gave the highest correlation for this ILO to all of our statements (4/4). For students to be successful in a Chemistry career, they must master equation writing, representing compounds, and following a lab safety protocol.

II. Critical, Creative and Analytical Thinking: Students solve problems, make judgments and reach decisions using critical, creative and analytical skills. We gave the highest correlation (4/4) to this ILO for equation writing and representing compounds. Students must be able to employ critical thinking to solve complicated chemistry problems.

III. Communication and Comprehension: Students effectively communicate in written, spoken or signed, and artistic forms to diverse audiences. Students comprehend and respectfully respond to the ideas of others. Writing equations and representing compounds is a means of communicating in the language of Chemistry. We assigned a fairly high correlation (3/4) between equation writing, representing compounds, and this ILO.

IV. Professional and Personal Growth: Students exhibit self-esteem, responsible behavior and personal integrity. Students are reflective and intellectually curious; they continue to improve themselves throughout life. We gave a fairly high correlation between this ILO and both equation writing and representing compounds (3/4). In order to master these skills, students must study with discipline and be intellectually curious.

V. Community and Collaboration: Students appreciate local and global diversity and are respectful and empathetic during personal interactions and competitions. Students effectively collaborate and resolve conflicts. They are responsible, engaged members of society, who are willing and able to assume leadership roles. We felt that the lab safety statement had a higher correlation (2/4) to this ILO than the other two SLO/PLO statements. The laboratory is a collaborative environment. In part, students stay safe because other students are looking out for them.

VI. Information and Technology Literacy: Students locate, critically evaluate, synthesize, and communicate information in various traditional and new media formats. Students understand the social,

legal, and ethical issues related to information and its use. We felt this ILO was most correlated (2/4) to our SLO/PLO that involves structural representations of compounds. Many of our students use advanced software such as ChemDraw and SPARTAN to model compounds.

C. SLO and PLO Timeline

Academic Year	Semester	Course-Level SLOs Assessed	Program-Level SLOs Assessed
Academic Year 1 of 4-Year SLO Cycle (3 years before Program Review)	Fall 2014	Lab Safety: all sections but Chem 7B	Lab Safety: all sections but Chem 7B
	Spring 2015	Lab Safety: Chem 7B	
Academic Year 2 of 4-Year SLO Cycle (2 years before Program Review)	Fall 2011	Structural Representations of Compounds: all sections but Chem 7B.*	Structural Representations of Compounds: all sections but Chem 7B.*
	Spring 2012	Structural Rep. of Compounds: Chem 7B	
Academic Year 3 of 4-Year SLO Cycle (1 year before Program Review)	Fall 2012	Equation Writing: all sections but Chem 7B	Equation Writing: all sections but Chem 7B
	Spring 2013	Equation Writing: Chem 7B	
Academic Year 4 of 4-Year SLO Cycle (Year of Program Review)	Fall 2013	See note above for Fall 2011	
	Spring 2014		

* Due to sabbatical of SLO Rep, this will be assessed in Fall 2013 (Year 4) just for this cycle.

D. SLO and PLO Assessment

We have not yet assessed 100% of course SLO statements, but we are on the verge of doing so. In spring 2009, the lab safety SLO was assessed for one section of Chemistry 4. In fall 2010, the structural representation SLO was assessed in 2 sections of Chemistry 20. In spring 2010, the lab safety SLO was assessed in 30 sections of chemistry, including Chemistry 4, Chemistry 1A, Chemistry 1B, Chemistry 7A, Chemistry 20, Chemistry 21A, and Chemistry 21B. Both full- and part-time faculty at ECC and Compton Center turned in data for assessment. In fall 2012, the equation writing SLO was assessed in 30 sections of chemistry, including Chemistry 4, Chemistry 1A, Chemistry 1B, Chemistry 7A, Chemistry 20, Chemistry 21A, and Chemistry 21B. Both full- and part-time faculty at ECC and Compton Center turned in data for assessment. In spring 2013, 1 section of Chemistry 7B was assessed (that course was not assessed in the fall semester because it was only offered in the spring). In fall 2013, the structural representation SLO will be assessed for all sections of Chemistry except Chemistry 7B. At that point, nearly 100% of course SLO statements will have been assessed for the Chemistry Department. Spring 2014 will bring the structural representation SLO for Chemistry 7B, bringing our assessment level to 100%.

E. Summary

Spring 2009 and fall 2010 were 'test semesters'. SLOs were only analyzed for one or two sections of one course. Information gathered during those assessments enabled us to then assess larger numbers of students. Information about how data were collected led to the development of a streamlined, online data collection system that was implemented in fall 2012. This has eased the collection of data so that we can accommodate 800 students at a time.

Perhaps the biggest changes we have made to the Chemistry Program have been to laboratory safety. In 2010, 30 sections of Chemistry were assessed for goggle compliance both early in the semester, and later in the semester. In March, instructors gave an average of 2.4 warnings of noncompliance/class period. When tested again in May, instructors gave an average of 0.7 warnings/class period. While the Chemistry Department was encouraged by these results, we thought our students could do even better. We felt that the laboratory safety program could use an overhaul. Since that assessment, the department has acquired a new custom-made safety video (obtained through a generous iGrant), and has also implemented a new safety-consciousness activity that is used at the beginning of the semester. We hope these changes will improve goggle compliance and overall lab safety in the future.

In the spring of 2012, 30 sections (787 students) were assessed in equation writing. Overall, more than half (55%) had no or one minor error and only 10% of students had major errors. As a result of these data, all instructors have been encouraged to emphasize the formulas of diatomic molecules (and formulas in general) during the equation writing part of the course. We hope this review of the material will improve students' ability to write equations flawlessly.

We believe the Chemistry Department is at the level of Sustainable Continuous Quality Improvement.

- Student learning outcomes and assessment are ongoing, systematic and used for continuous quality improvement. We are strictly adhering to our timeline, ensuring that all courses are assessed appropriately and regularly.
- Dialogue about student learning is ongoing, pervasive and robust. We meet weekly to discuss Chemistry Department issues. Most of our meetings involve discussion of SLOs.
- Evaluation of student learning outcomes processes. The SLOs are analyzed and evaluated appropriately. They evolve over time.
- Evaluation and fine-tuning of organizational structures to support student learning is ongoing. We have made departmental changes to our safety protocols, and we have flagged content areas that could use improvement.
- Student learning improvement is a visible priority in all practices and structures across the college. Student learning improvement is always a priority for the Chemistry Department. We work hard as a department to make changes to help students. Recent improvements to our laboratory safety program are evidence of our student-centered approach to teaching.
- Learning outcomes are specifically linked to program reviews. We take our SLO obligation seriously, and that is reflected in our program review document.

F. Recommendations

- In the future, we will have the opportunity to compare SLO and PLO results from previous years. It is our hope that this data will help us further refine our program and provide even more recommendations to faculty for improvement. And as our student body changes, we will change as well.

V: Facilities and Equipment

A. Department Needs and Rationale

Our department has a number of facilities and equipment needs that are listed below.

- 1) Many reactions that the students run in the laboratory require the use of hot plates. Without enough hotplates in the lab, some students will be negatively impacted as hotplates are on a first-come first-served basis. This impacts students at the end of the cue in that they may not have enough time to complete the lab before the period ends.
- 2) Spec 20 spectrophotometers are used extensively in general chemistry labs. Normally we like to pair students for the labs requiring this instrument. This is not possible due to the limited number of instruments that we currently have. These labs require us to have the students work in groups of three to four. Groups of three to four are much too large to give each student effective hands-on experience.
- 3) We would like to purchase three diode array spectrophotometers. These instruments are a much faster method of collecting absorption spectra due to its photo diode-array detection system. A spectrum obtained using our current spectrophotometers might take an hour or more to obtain, but a diode array spectrophotometer can take an entire spectrum in a few seconds.
- 4) We would like to incorporate the use of Gel Electrophoresis System in the chemistry laboratory courses which cover biochemistry topics. Gel electrophoresis is used for separation of macromolecules such as proteins and DNA.
- 5) One of the problems that we currently have in our facility is the cooling and heating of the building. The temperature control seems to be malfunctioning which causes the laboratory classrooms and some of the offices to be are either too cold or too hot. This is an issue for students, especially when they take exams during the lab period. In addition, the air conditioning can be quite loud; this can make it difficult for students to hear the lecture.
- 6) Lecture room Chem 133 has a support beam in the middle of the room which obstructs the view of at least 3 students and effectively lowers the student capacity of this room. This is an issue when students are taking notes or taking an exam.
- 7) Lecture room Chem 103 does not have sufficient board space. It would be better if we could install sliding boards instead. This would allow the instructors to easily use PowerPoint while presenting a substantial amount of material on the board.
- 8) Much of our laboratory equipment and glassware will need replacing in the near future as it breaks.
- 9) Maintaining and repairing existing laboratory equipment will insure that our department is running at an optimum level.

B. Recommendations

- | | |
|------------------------------|-----------------------|
| 1) Hot Plates | 10 x \$500 = \$5,000 |
| 2) Spec 20 Spectrometer | 7 x \$3000 = \$21,000 |
| 3) Diode Array Spectrometer. | 3 x \$6000 = \$18,000 |

4)	Gel Electrophoresis System + power supplies	\$5,000
5)	Repair HVAC system	\$50,000
6)	Re-engineer Chem 133	\$100,000+
7)	Install sliding boards in Chem 103	\$25,000
8)	Laboratory glassware and equipment	\$20,000
9)	Increase Repair and Maintenance Budget	\$7,000

VI: Technology and Software

A. Department Needs and Rationale

The technological needs of the department are listed below.

- 1) Our multimedia projectors, which are an almost essential part of our teaching in both lecture and lab classrooms, need to be repaired or replaced immediately when they break down. In the event this cannot be done in a timely manner, it is also necessary to have spare projectors on hand so that we can continue teaching. We have had many projectors break down recently and our spare projector had to be used to replace them. We are at a point now where if a projector breaks down, we do not have a backup.
- 2) The computers, media control centers and printers in all the classrooms and labs need to be continually replaced. Without functioning computers instructors are unable to use PowerPoint for lecture and computer visuals. The media control centers in our labs and classrooms are aging and some are completely broken and have to be bypassed by an IT technician. This makes it difficult to switch the projector input. As printers break they need to be replaced.
- 5) We need to renew our Odyssey Site License annually which we use in most of our chemistry courses.
- 6) We need to upgrade our Spartan Software as new editions are released. Spartan is currently used in several of our chemistry courses, as it helps the students master the concepts of molecular geometry and bond energies.
- 7) We need to purchase an additional Spartan site license for faculty computers.

B. Recommendations

1)	Purchase Epson Powerlite 822+ ceiling projectors	4 x \$2,000 =	\$8,000
2)	Replace computers, media control centers and printers		\$63,000
3)	Renew Odyssey site license		\$2,500
4)	Upgrade Spartan software		\$4,000
5)	Purchase additional Spartan license		\$18,000

VII. Staffing

A. Faculty

In the fall of 2013, the Chemistry Department added a tenure-track faculty member bringing the number of total full-time tenured or tenure-track faculty members to eight (8). Historically, the chemistry has had ten full-time faculty members. The department teaches eight different chemistry courses, usually offering multiple sections of each course; in spring 2013, 30 total sections were offered, 16 (53%) of which were taught by full-time faculty, while in fall 2013, 30 sections were offered, 18 (60%) of which were taught by full-time faculty.

All full-time faculty members are qualified by academic background and experience to carry out their program responsibilities in accord with the purposes of the program. Teaching effectiveness remains the principal criterion for the selection of the teaching faculty, including adjunct faculty; a teaching demonstration during the interviews plays a major role in the selection process. Chemistry faculty members are generally quite active in campus-wide organizations and activities, such as Academic Senate, Honors Transfer Program, Curriculum Committee, and other committees. Faculty specialization has, in almost all cases, met the needs for the course they teach.

The department relies heavily on part-time faculty. Some courses are taught predominantly, or solely, by adjunct faculty. Because each chemistry course includes a laboratory component, individual course loads are such that a part-time faculty member can teach only one class; thus there are roughly twice as many adjunct faculty members (12-14) as full-time faculty. There is a fair amount of turnover and reassignment of part-time faculty, which requires mentoring and evaluation of those new to the college or to a course. It is increasingly difficult to ensure the continued high standards of quality we expect of each of the courses in our program. This comes from experience in teaching and familiarity with course presentation. Over the last ten years the number of sections taught has increased by two full-time equivalent faculty positions, while the number of full-time teaching faculty has decreased by two

The demand for STEM course continues to increase. Each semester, including fall 2013, large numbers of students are turned away due to lack of space in the classes. Additional staffing will be required to meet increased demand. No current full-time faculty is intending retirement immediately.

The cost of each new full-time faculty we hire is estimated to be about \$100,000. This estimate includes fringe benefits and assumes hiring a Ph.D. at step 4 or 5. We don't view this as a new cost because we have lost two full timers from our baseline of ten. We need two more full-time faculty members to get back to ten and then we feel we need one additional hire to accommodate curriculum expansion and program growth.

Planning, budgeting, scheduling, and hiring responsibilities for the department fall primarily to the Dean of the Natural Sciences Division. While faculty usually voluntarily specialize in various aspects of departmental maintenance to aid the Dean, it would be very beneficial to have a department chair to coordinate such activities and have some responsibility for their completion.

B. Technical Staff

The Chemistry Department currently has 2 $\frac{3}{4}$ full-time technical staff (one is $\frac{1}{4}$ time assigned to the Biology department) who prepare materials for lab experiments and demonstrations and check out equipment to students for individual experiments. Each technician is assigned a course or set of courses for which they are responsible, although that person may not be the one on duty at the time of each lab period. There is need for a full-time technical staff member to take care of instruments and lab equipment – or at least to making the $\frac{3}{4}$ -assigned staff member fully assigned to the Chemistry

Department to better meet this need. The cost of backfilling the $\frac{1}{4}$ time loss of this technician from Biology would be approximately \$15,000.

There is no “lead” technician, and each technician reports directly to the dean. Faculty and technicians generally work together well, but there is no line of authority through faculty when there are conflicting assignments or responsibilities or specific questions about performance. The chemical technicians should be under direct supervision of someone with an expert level understanding of our day to day operations and a great deal of chemical knowledge to guide those who work with equipment and chemicals in a student laboratory setting. There is an increasing number of night lab sections, but only one technician on staff in the evenings. It is at times difficult for that one person to meet the needs of multiple lab sections, and this problem will grow along with the number of lab sections. A department chair would be a good bridge in authority between faculty, technical staff and the dean; part-time student help (to handle checking in and out of equipment) could be beneficial in covering multiple simultaneous lab sections, and in freeing technician time for other duties.

C. Department Chair

As mentioned above, the Chemistry Department needs a department chair to effectively manage the duties currently shared by the Dean of Natural Sciences and the full-time faculty. As it is we are all responsible for managing our department so no one person is actually responsible. Maintaining a high quality program and making changes, updates and improvements are not easy; they take a great deal of time, often quite a bit more time than professional responsibility requires. It is too easy for even the most professional of us to let problems ride until they become too severe to ignore. We get very busy during the semester and no one of us has the individual responsibility to deal with a given departmental problem.

The dean should provide leadership at the divisional level but at the department level a dean does not have the time to deal with all the issues. A dean may not be aware of all department level issues. A dean cannot be expected to have sufficient expertise in all the disciplines in his/her division to provide the leadership necessary.

To maintain as high a quality of education as possible, we want to have departments running as smoothly as possible and morale to be as high as possible. We want to improve the coordination between faculty and laboratory technicians. Department chairs would provide the missing leadership.

The Chemistry Department has a history where, generally, everyone pulls his/her weight. Nevertheless, we often very busy with day-to-day issues and problems may arise that the faculty have no quick fix for. We tend to have phases where we respond (or at least partially respond) to problems and other phases where problems are let go far too long. This occurs because no one is in charge except a dean who may not be aware of all the issues and is not in a good position to provide departmental leadership.

We have seen deans who try to help tend to departmental issues. We have also seen deans who pay little or no attention to department problems, at least beyond talking to faculty who come to them. They completely rely on faculty to deal with their own department even though no one within the department is actually responsible. This is a recipe for letting nagging issues fester and only dealing with the major thorns.

The work required to maintain a chemistry program is substantial. The Chemistry Department has special needs that are not being met sufficiently under the current organizational structure. The battle to keep (become) up to date in technology and facilities is never ending. The divisional dean's efforts are necessarily split among many related departments so the attention to each area is diluted. Chemistry

needs a great deal of attention from people who understand science and science laboratories. Additional leadership from department chairs is needed.

The department chair would be a leader, a champion, within the department. His/her duties and responsibilities could include:

- scheduling and chairing department meetings
- collecting and keeping department policies, records and wish lists
- coordinating department projects and intradepartmental communications
- seeing that department documents such as course outlines are updated when appropriate
- overseeing laboratory operations and equipment maintenance
- monitoring student learning outcomes (SLOs) development, assessment and recommendations
- serving as a resource person for adjunct faculty
- coordinating an effective mentoring program for all new full-time and adjunct faculty
- serving as a contact person for outside offices, committees, clubs, organizations, and suppliers
- being a liaison with the laboratory technical support staff
- responding to student needs and grievances
- with the division office, coordinating the development and use of the department budget
- with the division office, coordinating faculty evaluations
- with the division office, coordinating hiring of faculty and technicians
- with the division office, coordinating class scheduling and cancellation

D. Recommendations

- We need to hire two more qualified full-time instructors to meet the high demand for our courses as well as maintain the high level of rigor we expect in our courses.
- To meet the demand of increased enrollment and additional sections, the amount of available laboratory technical staff (as well as laboratory and equipment budget) should be increased.
- To run our department effectively and efficiently a department chair (or some form of one) is necessary.

VIII. Direction and Vision

The direction and vision of the department of chemistry is to provide students at El Camino College with the best education possible. Our future goals and plans are centered on this vision. To achieve this vision, our department will continue working towards improving previous methods and by developing new ways to better prepare students to possess the knowledge and skills to pursue further education and careers in physical, biological and health sciences; engage in scientific inquiry and problem solving; work effectively in collaborative settings and communicate scientific information clearly.

The demand for chemistry classes is currently high and will continue to grow as our world becomes more dependent on scientists for everything from sustainable energy to medicine to technology. The number of courses El Camino offers will have to continue to grow accordingly and while this trend is favorable, the lack of classroom space will hinder and eventually limit further growth in the future. As a department, we are exploring ways to cope with this problem. One possibility we are exploring is the development of some hybrid chemistry courses. The hybrid courses would be a combination of online

instruction with on campus lab activities. The labs could be scheduled on weekends to free up some classrooms for other classes. In addition, our department has considered increasing the curriculum by offering alternative courses. For example, our department has explored offering a "Chemistry for Engineers" course, which would serve as an alternative to the General Chemistry 1A. This class would cover similar topics as those covered in Chemistry 1A, but would be geared toward engineering majors. While we have faculty with the proper background and/or interests to take on these projects, a shortage of full-time faculty would cause the future of these projects to be open ended and unknown; we are unable to spare anyone from our regular curriculum. We are also in the process of converting some sections of lower level course (Chemistry 1A, 1B and 4) into honors courses.

With the recent global movement towards environmentally sound practices and sustainability, the department of chemistry is in line with goal. We seek to continually reevaluate our curriculum to make sure that we are leaving behind as small of a footprint as possible. The push towards green chemistry is big and we hope to do our part by providing a comprehensive laboratory experience that focuses on low-waste, high efficiency chemical processes without the typical levels of exposure to toxic materials.

We are continually searching for ways to improve our core curriculum. We are aware that technology is rapidly evolving and new instruments or new technology which can benefit our students should be purchased and incorporated into our classrooms. Our department recently purchased both a Nuclear Magnetic Resonance (NMR) instrument and a Gas Chromatography/Mass Spectrometer (GC/MS) instrument. These analytical instruments are common instruments in chemistry labs. To date we have successfully incorporated the NMR instrument into our organic chemistry curriculum (Chemistry 7A and 7B). In these courses the students operate the NMR instrument and use it to acquire NMR spectra for organic molecules, which they have synthesized in the lab. In Chemistry 1A, we are using the NMR instrument to study the chemical shifts of molecules as a function of pH. We are currently working on integrating the GC/MS into our curriculum as well.

Our current students are more computer and technology savvy than ever before. The chemistry department plans to take advantage of this by incorporating technology in the classroom and using it as a teaching tool. The chemistry department is in the process of incorporating SPARTAN and Odyssey computer simulation programs into our General Chemistry curriculum. These computer simulation programs allow students to study molecules and properties of molecules from a computer station. This avoids the process of having to perform time consuming experiments in the lab to acquire data.

There are many tasks that need to be accomplished within our department that are essential for the health of our department. For example, tasks such as organizing department meeting, hiring full-time and part-time instructors, delegating responsibilities, supporting adjunct faculty, and in general overseeing the functioning of the chemistry department. Currently, many people contribute many hours to the complete these tasks, which need to be done for the good of the department. A great deal of good will is exhibited by the faculty toward the maintenance and improvement of the program. To most efficiently plan out the future of our department and to ensure that a quality education is being provided our faculty need to know about future budgets, deadlines and philosophies of the administration so that we can plan for future equipment, courses, support staff and faculty accordingly. Effective planning and coordinating between the administration and our department is essential. One solution that has been a longstanding view of our department would be to have a dedicated faculty department chair.

The chemistry department, in general has a very good academic reputation. This reputation is something that we in the department take pride in and strive to maintain. Over the past several years our department has become reliant on part-time faculty to teach a large portion of our courses. This becomes an issue of concern within our department when part-time faculty are being asked to teach general chemistry (1A/B) and even organic chemistry (7A/B). In the past, part time instructors almost exclusively taught introductory level courses and only the best and most experienced part-time instructors were selected to

teach general chemistry classes (for any part-time instructor to teach organic chemistry was essentially unheard of). To teach these classes at the high level our department traditionally has requires a large amount of time and energy. Because most part-time instructors teach at two or three different schools, and in some cases are not experienced instructors, it is near impossible for them to devote enough time to our higher level courses. This has also increased the burden on our full-time faculty to mentor them. This requires a significant amount of time for our higher level classes, especially if the instructor is not very experienced. Additionally, the high turnover rate of part-timers and part-timers being reluctant to seek help sometimes makes mentoring seem overwhelming. While we strive to provide mentoring to our entire part-time faculty, there are simply not enough full-time faculty to accomplish this task. In some instances this has resulted in essential topics going uncovered or being covered inadequately, and students find that they are underprepared for the next chemistry class in the sequence. This inevitably weakens our department curriculum. Despite the heavy reliance on part-time faculty our department faculty and staff continue to work towards improving our program, processes and services for students.

IX. Prioritized Recommendations

Priority	Recommendation	Cost	Strategic Initiative
1	Add two full-time faculty	\$ 180,000.00	A
2	Modernize Instructional Tech Classrooms & Labs	\$ 150,000.00	A
3	Chem Technician 3/4 to full-time	\$ 15,000.00	B
4	4+ ceiling projectors	\$ 8000+	F
5	10 Hot plates	\$ 5,000.00	F
6	7 UV-Vis Spectrometers	\$ 21,000.00	F
7	Equipment Replacement/Repair	\$ 20,000.00	F
8	Replace all Computers & Printers	\$ 63,000.00	F
9	3 diode array spectrometers	\$ 18,000.00	F
10	Increase Maintenance Budget	\$ 7,000.00	F
11	Gel electrophoresis system	\$ 5,000.00	F
12	Hire tutors	\$ 14,400.00	B
13	Renew Odyssey License	\$ 2,500.00	F
14	Upgrade Spartan License	\$ 18,000.00	F
15	Repair HVAC system	\$ 50,000.00	F
16	Re-engineer Chem 133	\$ 100,000.00	F
17	50% Reassign time for a department chair	\$ 0	F