Instructional Programs
2014-2015 Self-Study

Three-Year Program Review
Chemistry
Natural Sciences Division

Statement of Collaboration
The program faculty listed below collaborated in an open and forthright dialogue to prepare this Self Study. Statements included herein accurately reflect the conclusions and opinions by consensus of the program faculty involved in the self-study.

Participants in the self-study
Mohd Ansari, Ph.D.
Annie Bianchino, Ph.D.
Janice Chadwick, Ph.D.
Theodore Chan
Guy Dadson
Samuel Foster, Ph.D.
Charlesworth Fraser
James Gregson
Bridget Salzameda, Ph.D.
Tilahun Yimenu, Ph.D.

Authorization
After the document is complete, it must be signed by the Principal Author, the Department Coordinator, and the Dean prior to submission to the Program Review Committee.

Guy Dadson		Instructor	
Printed name of Principal Author	Signature	Title	Date
Guy Dadson		Instructor	
Printed name of Department Coordinator	Signature	Title	Date
Mark Greenhalgh		Acting Dean	
Printed name of Dean	Signature	Title	Date

1.0 Mission and Goals

Mission

The Department of Chemistry in the Division of Natural Sciences is an integral part of Fullerton College and shares in the College's mission to prepare students to be successful learners and is dedicated towards promoting excellence in learning. The Chemistry Department embodies the universal aspect of the College's mission by offering courses needed to meet general education requirements and to transfer to a four-year institution or professional school as chemistry or science, technology, engineering and math (STEM) majors. The program excels in balancing academic tradition with innovation as described in the core values of the institution by using a variety of methodologies in the classroom and laboratory environment. The course retention and success are both impacted and improved by the use of class response systems ("clickers") and presentation tools (iPads and Doceri software) in the classroom, computer studios and Vernier probes and software within the laboratory environment, and online homework for out-of-class instruction and assessment.[1]

Vision

The academic mission of the Chemistry Department is characterized by the pursuit of academic rigor and integrity, excellence in instruction, intellectual accomplishment, and community service. The program is aligned with the vision statement of the College. The Department has created a community that promotes inquiry and intellectual curiosity, personal growth and a life-long appreciation for the power of learning.

Chemistry is an experiment-based discipline that promotes inquiry and intellectual curiosity. Students in the program regularly make discoveries within the laboratory environment that mirror the concepts and ideas being discussed in the classroom. The very nature of chemistry ensures that students will be given an opportunity to explore the material that is encountered in the classroom. The curiosity that leads to the discovery of new ideas in the classroom and laboratory environment carries over into the lives of students beyond the classroom. Many students in the program are involved in both weekend and summer research opportunities and also participate as volunteers in organized chemistry events. The experience and education provided to students by the Chemistry Department provides for both academic and personal growth of students in the program, and creates an appreciation for learning that undoubtedly continues through the lives of students in the program.

Core Values

The Chemistry Department is proud of its accomplishments and, like the institution, strives to improve the program to enhance excellence in student learning. The Department recognizes the importance of the College's core values in achieving its vision and, to this end, encourages the faculty and students to respect and values diversity, involve all in decision making processes, continue growing and learning, and value and promote the well being of the local and campus communities.

[1] As will be reported in Section 2, the success rates for the chemistry program are higher than three of the four peer institutions identified in this Program Review.

The Chemistry Department respects and values the diversity of the entire community. The program consists of an ethnically and academically diverse group of eight full-time faculty and fourteen part-time faculty members, teaching four courses for non-majors and five courses for majors. The broad background and engagement of the faculty within the Department ensures that all constituents (i.e. staff, faculty, administration) are included in discussions surrounding important decisions. Furthermore, the faculty of the Department supports the involvement of all in the decision-making process; whereas individual contribution is welcomed and supported, the strength of the Department is realized in collaborative efforts.

The Chemistry Department emphasizes student success and academic achievement within a supportive learning environment. The personnel within the Department are respectful of all persons participating in the program and efforts are made to provide an environment conducive to strong academic scholarship and success. Students are closely connected to faculty and take advantage of many educational opportunities, adding value to their course experience.

The Chemistry Department is actively involved in special programs which promote the well-being of the local and campus communities. These programs include weekend and summer research opportunities and bridge programs to California State University, Fullerton and University of California, Irvine. These opportunities provide students of varying backgrounds with different opportunities to succeed and excel in chemistry. The faculty of the Department are involved in Supplemental Instruction (SI) and the development of a Peer Undergraduate Mentoring Program (PUMP), aiding and encouraging students academically and providing an environment that promotes students to major in STEM fields.

College Goals

As a result of the program review process, the Chemistry Department has reflected on the goals and outcomes of the program and how they relate to course-level assessments, modifications in methodologies, and approaches to the curriculum and program. The program goals, objectives and strategies to achieve the objectives are all student-centered and driven by the desire to increase student success and reduce the achievement gap in the program.

Program Goals

The Chemistry Department will provide exceptional classroom and laboratory opportunities for students to achieve success in chemistry courses. Students will master content, develop critical thinking skills, communication skills and technology skills using ethical standards to prepare them for professional careers and to be scientifically literate citizens. While being sensitive to the needs of all students, the program will pay particular attention to diversity, the underrepresented and underprepared students.

Program Objectives

1. Students will demonstrate in-depth knowledge of the principles of chemistry to solve multi-faceted scientific problems using critical thinking and quantitative reasoning skills.

2. Students will apply the necessary laboratory skills to answer questions of chemical relevance that synthesize classroom learned principles of chemistry with the experiments they conduct in the laboratory.

3. Students will engage collaboratively and independently in classroom and laboratory settings with integrity and honesty.

Strategies to Achieve Objectives

The Chemistry Department will:

1. Provide textbooks and select classroom and laboratory methodologies along with other instructional resources that are supported by evidence to improve student critical thinking and quantitative reasoning skills based on proven pedagogies

2. Engage students with course material and technology relevant to their real-world experiences

3. Provide an environment where students develop skills using safe laboratory practices and academic honesty

4. Develop sustainable and green chemistry methods whenever possible

Alignment of Program to Fullerton College Goals

The Chemistry Department program goals, objectives, and strategies to achieve the objectives support the College Goals through the promotion of student success, efforts to reduce the achievement gap and the strengthening of its connections with the local community. The exceptional opportunities for students both in and out of the classroom and laboratory promote student retention and success; this is particularly important for the underrepresented and underprepared students. The Department is well-aligned with College Goal 1 as the faculty in the program continually identify opportunities to increase student success, retention and transfer through effective teaching strategies and adhering to best practices as identified by the American Chemical Society. The efforts of the chemistry program are further highlighted by the awarding of more degrees than were awarded by the chemistry programs of peer institutions. Respecting the diversity of students in our courses, the faculty strive to reduce the achievement gap in College Goal 2 by treating students fairly and paying attention to students at risk. In alignment with College Goal 3, the program reaches out to the community in a variety of ways. For example, Chemistry for Daily Life (CHEM 100) students visit a 5^{th} grade class and conduct experiments with the elementary school students and motivate them to consider science courses as they move on in their studies. Furthermore, the Chemistry Department is actively involved in community outreach with faculty providing hands-on activities for children at the Santa Ana Zoo during the American Chemistry Society's celebration of National Chemistry Week and Kindercaminata. Students within the program are encouraged to become actively involved in these community programs, and are also directed toward research programs at local four-year institutions, e.g. HHMI Summer Research Experience at California State University, Fullerton.

2.0 Program Data and Trends Analysis

2.1 Key Performance Indicators (KPI)

The Office of Institutional Research and Planning (OIRP) presented the Chemistry Department with five-year longitudinal data. This data, as seen in Appendix A, demonstrates the effects of mandated budget

cuts to the Chemistry Department. The reduction in the annual budgets, starting in 2008 and ending in 2012, led to reductions in both the number of section offerings and operating budget for the Chemical Stockroom, and also resulted in decreases to both the retention and success of students in the program. Additionally, the retirement of one full-time faculty member was not accompanied by a replacement hire. The commitment and determination of the faculty and staff lessened the impact of the economic hardships. The impact of the reductions with respect to a number of important program statistics is presented.

Enrollment

Student enrollment decreased by about 12% for the first few years in the period presented in the five-year longitudinal data. The decrease in enrollment resulted from mandated cuts to the program even as the demand for chemistry courses remained strong over the five-year period reported; fill rates ranged from 97% - 105%. Following low enrollment during the 2011 – 2012 academic year the student enrollment increased rapidly to levels seen before the budget cuts. This increase has continued, with predicted enrollment levels for the 2014 – 2015 academic year exceeding those seen before the cuts (2007 – 2008) by about 300 students.

Total FTES

The total full-time equivalent students (FTES) statistic is directly related to enrollment and therefore these values also decreased and subsequently increased during the five-year period presented in the longitudinal data. The average total FTES for the last five years is 392 FTES, ranging from 363 to 411 FTES. Though the five-year longitudinal data illustrates an increase in the total FTES by about 48 FTES (13%) from 2011 to 2014, the Chemistry Department predicts a growth in the total FTES of 60+ FTES (15%) for the 2014 – 2015 academic year when compared to the 2013 – 2014 academic year.

Sections

The five-year longitudinal data presents the same trend in the total section count as seen with both the enrollment and total FTES data. The total section count decreased over the first few years by about 7% due to budget cuts. Although the demand for preparatory chemistry, general chemistry, and the allied health science courses remained significant throughout the last five years, these courses and the general education courses all experienced cuts in the number section offerings.

Since the 2011 – 2012 academic year, the number of sections offered by the Chemistry Department has increased significantly. There has been a net increase of 14% in the total number of sections offered has been since the low point (2011 – 2012). The courses with the greatest increase in section offerings have been Elementary Chemistry (CHEM 107), General Chemistry I (CHEM 111A) and General Chemistry II (CHEM 111B) with increases of 19%, 17%, and 14%, respectively.

Fill Rate

The average fill rate for courses in the program has been incredibly strong over the last five years. The range in fill rates and average fill rate were 97% - 105% and 101%, respectively. The courses offered by the Chemistry Department are required courses for many different programs and therefore are always in high demand. The incredible demand for chemistry courses is reflected in the high fill rates that have been

observed over the last five years. These fill rates were given consideration when adding sections over the last few years and strongly suggest the need for continued growth.

WSCH/FTEF

The ratio of weekly student contact hours (WSCH) to full-time equivalent faculty (FTEF) experienced a low during the 2011 – 2012 academic year but ended the five-year period with a net increase of more than 14%. The annual WSCH/FTEF ratios averaged 468 for the last five years, ranging from 427 to 524. Though these ratios are lower than the standard target of 525, they are comparable to the College-wide ratio of about 483[2].

The standard target is based on a class size of 35 and the majority of chemistry courses have seat counts of 25 due to extensive individualized instruction and safety considerations. Scaled for the reduction in class size--25 is about 71% of 35--an expected WSCH/FTEF ratio for the chemistry courses may be around 375. When compared to this scaled value, the chemistry program has been operating incredibly efficiently. This of course, is not unexpected given the high fill rates that have been observed over the five-year period examined.

Finally, there is concern that the values reported by the OIRP may be in error. The summer WSCH more than doubled for the 2011 – 2012 and 2012 – 2013 academic years when compared to the 2010 – 2011 academic year, though the student enrollment decreased. Additionally, the WSCH reported for summer 2009 was 1,414 and for summer 2013, was 3,177. This increase of 225% was accompanied by a decrease in student enrollment by 33%. As the length of the summer terms were not changing, there remains some confusion as to how an increase in WSCH could be observed if the student enrollment decreased.

Retention

The retention of students within the program was relatively constant over the last five years, averaging 82.6% with a standard deviation of 1.7%.

Success

The success of the students within the program, like that for retention, was generally constant over the last five years, averaging 73.4% with a standard deviation of 1.3%.

2.2 Peer Institution Comparison

A group of comparable institutions was selected by the Integrated Postsecondary Data Systems for the 2013 Fullerton College Data Feedback Report. From this group of comparable institutions, four Hispanic-Serving Institutions (HSI) were selected for comparison with the Chemistry Department program: Los Angeles City College, Modesto Junior College, San Diego Mesa College and Santa Barbara City College. The retention and success rates from the fall terms (annual data for Fullerton College) for the last five years are presented in Tables 2.1 and 2.2, respectively. The retention and success data from the fall terms for Fullerton College appear in Appendix B. Additionally, graphs of the retention and success data were

[2] The College-wide ratio WSCH/FTES was reported by the OIRP for fall 2013.

produced and appear as Figures 2.1 and 2.2, respectively. The tables and figures appear on the following pages.

The average retention and success rates for the peer institutions selected are 82 ± 12% and 67 ± 16%,[3] respectively. The average retention and success rates for Fullerton College are 83 ± 4% and 73 ± 2%, respectively, and are within the ranges for the peer institutions selected. Though the average success rate for Fullerton College is higher than the average success rate for the peer institutions, the retention and success rates are within the 95% confidence interval. Considering the demographics and knowledge of the programs of the peer institutions, there is no significant difference between the retention and success rates for Fullerton College and the peer institutions selected in this program review. The retention and success rates for all of the HSI institutions identified as being peer institutions by the OIRP are 86 ±10% and 73 ± 14%, respectively. The retention and success rates for Fullerton College are very similar to that of these peer institutions, suggesting that the chemistry program is performing as well as other institutions throughout the state. The low success rates of Los Angeles City College and Modesto Junior College may be impacted by an achievement gap as both colleges had an average Hispanic population that exceeded 30% for the last five years.

Table 2.1: Retention Data – Fall Terms*

Institution / Academic Year	2009	2010	2011	2012	2013
Fullerton College	83%	82%	80%	84%	84%
Los Angeles City College	74%	74%	73%	86%	74%
Modesto Junior College	72%	80%	81%	80%	78%
San Diego Mesa College	85%	85%	85%	90%	88%
Santa Barbara City College	88%	83%	90%	87%	88%

*Annual data is presented for Fullerton College – See Appendix B for fall term data.

[3] All intervals referenced within this review represent two standard deviations, or a 95% confidence interval.

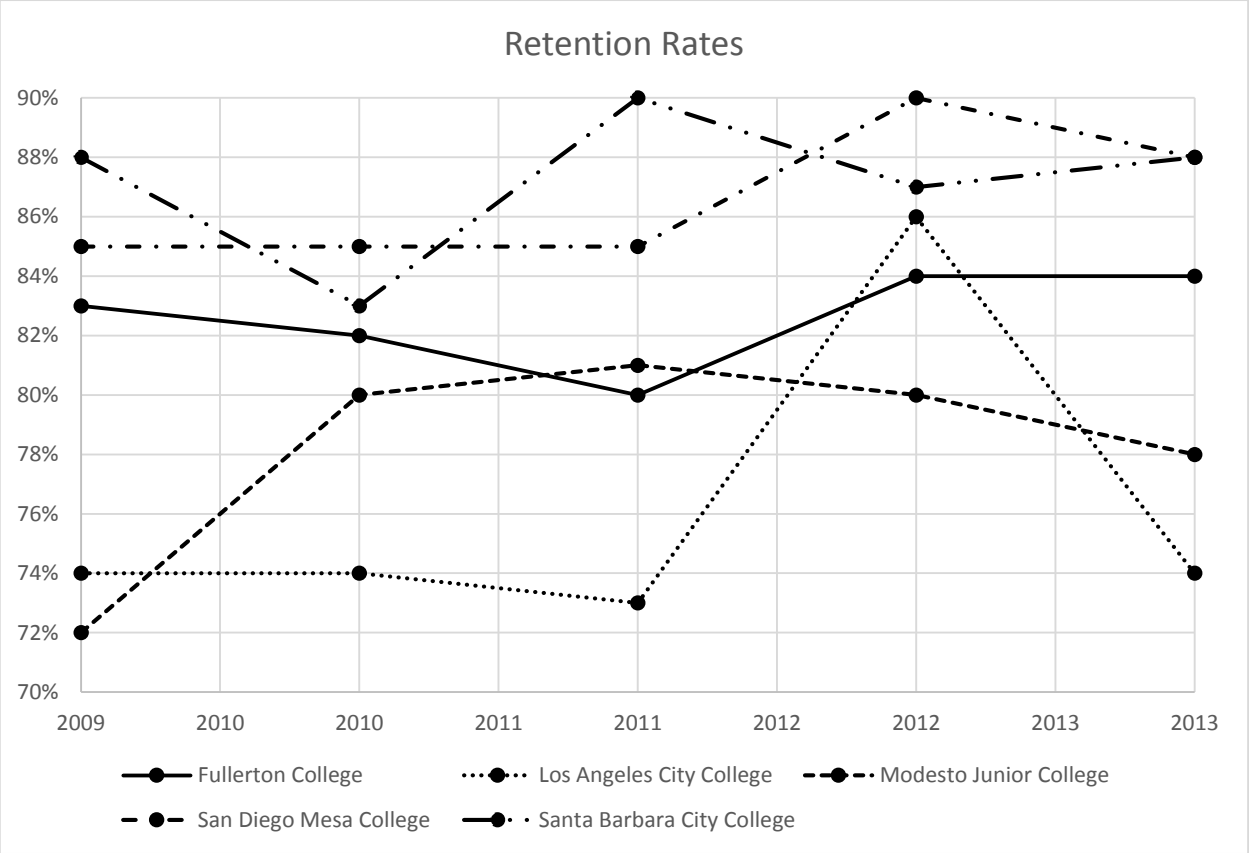

Figure 2.1: Retention rate data for Fullerton College (annual) and the selected peer institutions (fall terms). The retention rates for Fullerton College's chemistry program lay mid-range and tend to be more stable compared to the peer institutions.

Table 2.2: Success Data – Fall Terms*

Institution / Academic Year	2009	2010	2011	2012	2013
Fullerton College	74%	74%	71%	74%	74%
Los Angeles City College	65%	65%	63%	63%	77%
Modesto Junior College	57%	51%	55%	58%	60%
San Diego Mesa College	76%	73%	74%	75%	77%
Santa Barbara City College	75%	71%	66%	71%	71%

*Annual data is presented for Fullerton College – See Appendix B for fall term data.

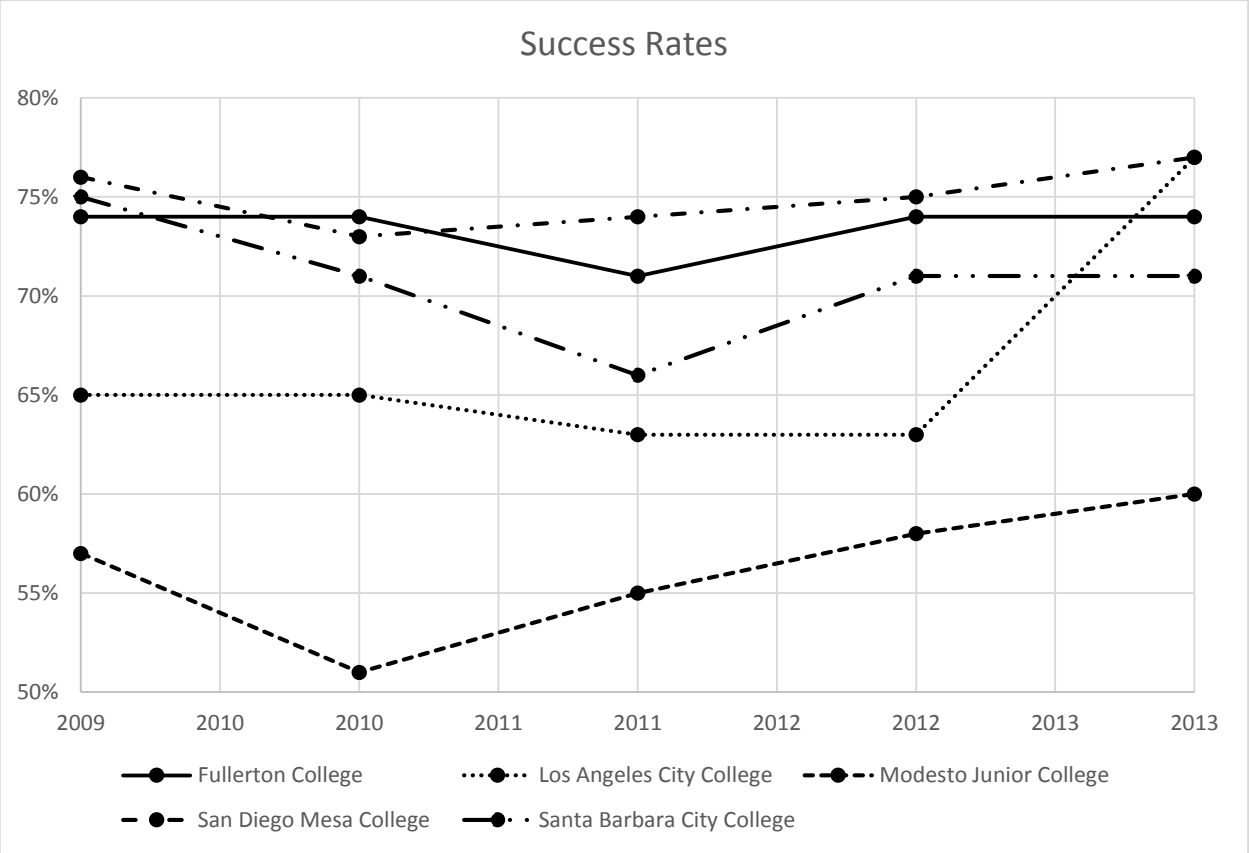

Figure 2.2: Success rate data for Fullerton College (annual) and the selected peer institutions (fall terms). The success rates for Fullerton College's chemistry program are generally above the success rates for peer institutions.

The retention and success of students at Fullerton College are well correlated with the retention and success of students at both San Diego Mesa College and Santa Barbara College. As the student populations are similar between Fullerton College and the four identified peer institutions, this similarity may be due to the general area in which the colleges are located. Whereas Fullerton College, San Diego Mesa College and Santa Barbara College are located in relatively suburban communities, Los Angeles City College and Modesto Junior College are located in relatively urban and (more) rural communities, respectively. The differences that exist between rural, suburban and urban communities may account for the differences in both retention and success.

The strength of the program when compared to the peer institutions is conveyed not only by Fullerton College's success rates, but also by the number of awarded degrees. As seen in Table 2.3, Fullerton College awarded a larger number of associate degrees in chemistry than the identified peer institutions. In three of the last five academic years, the number of associated degrees in chemistry awarded by Fullerton College exceeded the total number of degrees awarded by all four of the identified peer institutions. Additionally, there has been a clear increase in the number associate degrees in chemistry awarded by Fullerton College. From 2009 to 2014, the number of awarded associate degrees in chemistry increased by over 300%. Finally, as the number of majors within the program average about 190 each academic year, it is likely that many students are transferring prior to receiving a degree. However, the Key Performance Indicator (KPI) data presented by the OIRP (Appendix A) only shows 15 majors transferring in the last five years and therefore, it is not possible to comment further on the success of students within the program.

Table 2.3: Program Awards – Associates Degrees (Certificates) Awarded*

Institution / Academic Year	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Fullerton College	9	16	26	26	33
Los Angeles City College	6	1	2	4	1
Modesto Junior College	2	3	6	7	14
San Diego Mesa College	3 (2)	0 (0)‡	5 (2)	5 (3)	4 (4)
Santa Barbara City College	8	8	7	15	12

* Certificates are not offered by the Chemistry Program at Fullerton College.

‡ Absence of degrees and certificates may be due to a reporting error.

2.3 Achievement Gap

The KPI Report provided by the OIRP provides the relative retention and success for each of the different groups (gender and ethnicity) within the program. The values for retention and success by gender as presented within the KPI report appear below in Tables 2.4 and 2.5, respectively. With respect to gender, it is clear from the retention and success data that the male and female student populations are performing equally well.

Table 2.4: Retention Rates by Gender

Gender / Academic Year	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Males	82%	82%	79%	84%	84%
Females	84%	83%	81%	85%	84%

Table 2.5: Success Rates by Gender

Gender / Academic Year	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Males	74%	74%	71%	73%	73%
Females	75%	73%	71%	75%	74%

The values for retention and success by ethnicity, as presented within the KPI report, appear below in Tables 2.6 and 2.7, respectively. Generally, with exception to extreme fluctuations associated with ethnicities which have relatively small student populations[4], both the retention and success data is positive:

[4] Absolute and relative FTES by ethnicity appear in Appendices C and D, respectively.

Table 2.6: Retention Rates by Ethnicity

Ethnicity / Academic Year	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Overall	83%	82%	80%	84%	84%
Asian-American	87%	83%	85%	89%	90%
African-American	70%	56%	85%	71%	82%
Filipino	81%	89%	81%	91%	89%
Hispanic	78%	82%	73%	82%	82%
Native American	71%	86%	100%	100%	58%
Other Non-White	72%	74%	77%	50%	40%
Pacific Islander	100%	75%	80%	50%	100%
White	84%	84%	81%	83%	82%
Unknown	85%	79%	86%	83%	73%
Range (Max-Min)	100% - 70%	89% - 56%	100% - 73%	100% - 50%	100% - 40%

Table 2.7: Success Rates by Ethnicity

Ethnicity / Academic Year	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Overall	74%	74%	71%	74%	74%
Asian-American	78%	78%	78%	81%	82%
African-American	40%	50%	71%	48%	64%
Filipino	76%	81%	76%	82%	76%
Hispanic	68%	70%	62%	69%	70%
Native American	71%	79%	100%	60%	50%
Other Non-White	67%	74%	62%	50%	40%
Pacific Islander	100%	50%	60%	50%	100%
White	77%	74%	74%	74%	74%
Unknown	79%	69%	75%	77%	67%
Range (Max-Min)	100% - 40%	81% - 50%	100% - 60%	82% - 48%	100% - 40%

Over the five-year period presented in the KPI data, the retention rates for African-American and Hispanic students increased by 3% and 1%, respectively, for the 2013 – 2014 academic year compared to the 2009 – 2010 academic year. The calculated success rates for African-American and Hispanic students increased over the five-year period. There are however, two notable observations from the data. First, the success rates for the African-American students have significant variability. This variability is likely due to the incredibly small population of African-American students (five-year average FTES is 2% of the program FTES) and the inherent variability that arises from examining small data sets. A second observation noted within the KPI data is the definite gap in achievement between Hispanic students and the overall student population. The Hispanic achievement gap, averaging 5.6% (presented in both Figure 2.3 and Table 2.8), is less than the average achievement gap seen throughout the State ($7.0 \pm 1.4\%$).[5]

[5] The State-wide retention and success data by ethnicity appears in Appendix and, therefore, is smaller than that seen throughout the State (Appendix E). Relative to white students, the Hispanic achievement gap for the State is $11.3 \pm 1.7\%$.

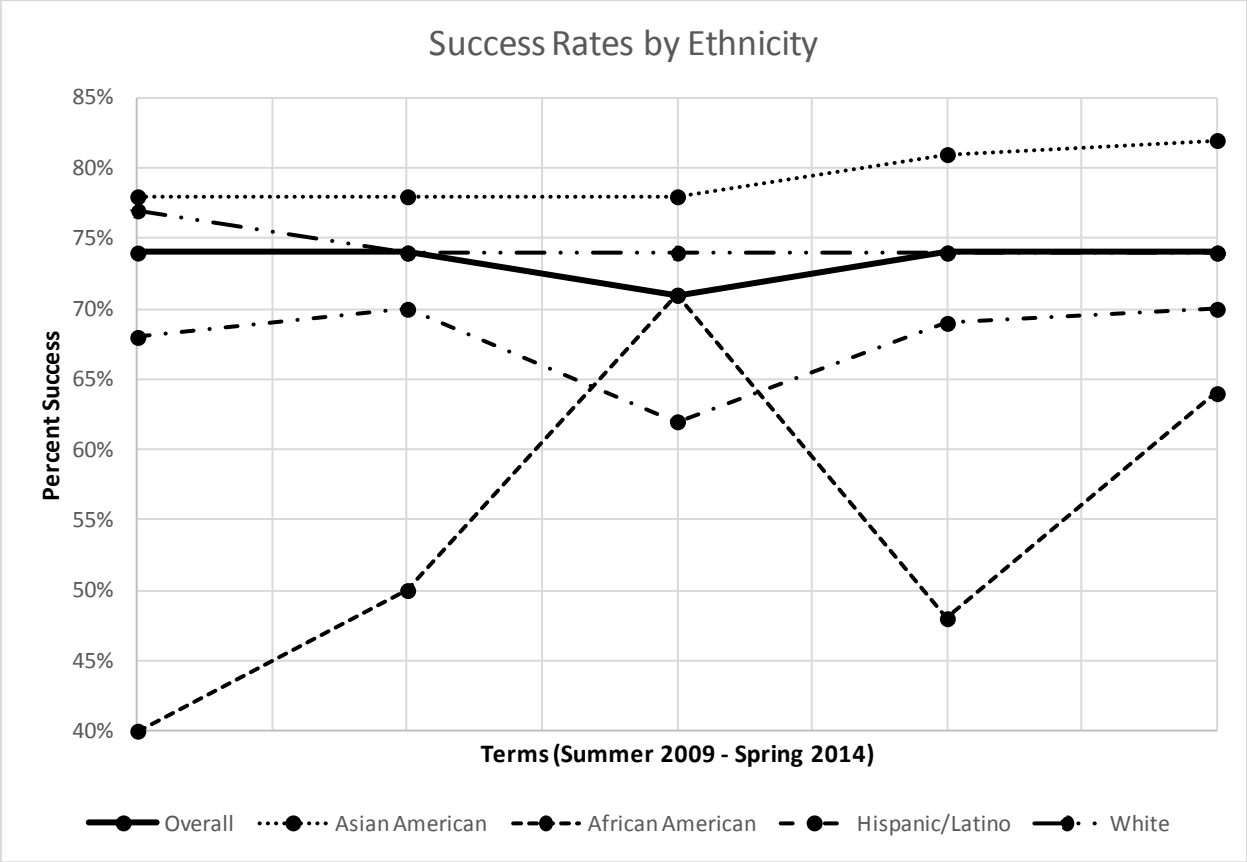

Figure 2.3: Success rate by ethnicity for Fullerton College (annual). The success rates for the major ethnicities (Asian-American, Hispanic/Latino, and White) are relative constant over the five-year period examined. Note the significant fluctuation of the African-American success and the Hispanic achievement gap.

Table 2.8: Achievement Gap (by % Success) for Select Ethnicities*

Ethnicity / Academic Year	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Asian-American	4%	4%	7%	7%	8%
African-American	-34%	-24%	0%	-26%	-10%
Hispanic	-6%	-4%	-9%	-5%	-4%
White	3%	0%	3%	0%	0%

* A negative value implies a success rate below the Overall (all ethnicities) success rate.

As seen in Figure 2.3, the achievement gap of Hispanic students compared to the overall success rate has been relatively constant over the five-year period examined. Additionally, while White students have a success rate that is comparable to that of the overall success rate, Asian-American students are achieving an average success rate that is 6% greater than the overall success rate. It is likely the success rates being observed in the program for Hispanic, White, and Asian-American students have less to do with program constraints but, rather, more to do with the cultural importance that is placed on education.

2.4 Program Effectiveness

Since the last Program Review, the effectiveness of the program has been affected by significant changes in State funding and demand for chemistry courses. The data provided by the OIRP clearly shows a decrease in both the retention and success rates at the height of the reductions during the 2011 – 2012 academic year. The variation in the retention and success rates can be attributed to two factors: student population and the number of adjunct instructors.

The registration procedures in existence over the last five years has given priority to students with a larger number of completed units regardless of their retention and success and specifically the number of attempts to complete a course. It was common to see students either not pass or drop from a course and then re-enroll during a subsequent term only to repeat the previous performance. While every student should be given the opportunity to succeed, this policy ensures that any given class would contain a greater number of students that were more likely to be unsuccessful. It is possible that a larger proportion of these students, given their higher registration priority, were enrolled into courses in the program during the 2011 – 2012 academic year, thus leading to a drop in both the retention and success rates.

In the years following the 2011 – 2012 academic year, funding was restored to the College and therefore, additional sections were placed onto the schedule to meet the large demand that followed the recession. However, the rapid increase in sections required the use of many more adjunct instructors. Historically, student performance decreases when courses are taught by adjunct instructors and therefore, it is likely that the program suffered. With the retirement of Ms. Betty Huck in the spring of 2001, and the release from teaching obligations of two other full-time faculty members (Dr. Janice Chadwick and Dr. Samuel Foster) the Chemistry Department has relied on more adjunct instructors than ever before in the history of the program. For the 2014 – 2015 academic year, the number of adjunct faculty will be twice the number of full-time faculty. There is little doubt that the large dependence on adjunct instructors has reduced the effectiveness of the program. It is likely that the program will produce success rates that are greater than all of its peer institutions (as identified in this review) once Ms. Huck's position is filled and both Dr. Chadwick and Dr. Foster return to teaching.

2.5 Influences on Program

Internal Influences

There have not been any internal policies/procedures that have had an impact on the effectiveness of the program, but movement from to a sixteen-week calendar was expected to decrease success rates. With the movement from an eighteen-week to a sixteen-week calendar, the faculty of the Chemistry Department have had less time in their schedules to participate in activities that benefit student success. Specifically, students in the program have had less access to Supplemental Instruction since the change in the length of the academic term. Whereas the success rates have not fallen with the change, it is likely the success rates for the last few years would have been higher had the College remained on an eighteen-week calendar. Although the change to a sixteen-week calendar may also have had the net effect of increasing the retention rates, it is important to note that the retention of poorer performing students does not lead to improved success rates but, rather decreased success rates for the program.

External Influences

The Chemistry Department and the chemistry program are dependent on a number of external factors. As previously discussed, the effectiveness of the program is clearly dependent on the financial health of the State (and North Orange County Community College District). In addition, the program is dependent on the facilities and computing support provided by the College, and is also dependent on external program requirements, e.g. nursing requirements, which have the potential to effect student enrollment.

The College continues to provide support for the maintenance and operation of the facilities; however, regular and proactive efforts by Academic Computing Technologies (ACT) are needed. The two computers laboratories available to the Chemistry Department require continuous attention including software updates. Currently, updates must be requested through the Service Request System (SRS) and although requests are addressed, they sometimes are not installed quickly enough. For instance, updates to Adobe Flash Player and Java are required on a regular basis for the online tool: *MasteringChemistry* used in Elementary Chemistry (CHEM 107) and Introduction to Chemistry (CHEM 101). If the updates to Adobe Flash Player and Java are not made automatically, students are prevented from completing online problems and assessments. This interferes with the instructional process. If ACT were either capable of performing automatic updates remotely or tasked with performing updates without an SRS request, student instruction and possibly, student success, would be improved.

2.6 Additional Data

When the 2011 – 2012 and 2014 – 2015 academic years are compared, the Chemistry Department has increased the total number of sections offered by more than 31%. Over the same time period, the Chemistry Department has seen a reduction in the total number of full-time faculty from nine to eight with the retirement of Ms. Betty Huck and an increase of the number of Division- and College-wide professional obligations. Since the last Program Review (2011), the faculty members in the Department have assumed the following positions: Division Representative on the Student Success Committee (Dr. Annie Bianchino), Chair of the Program Review Committee and Coordinator for the SLO Committee (Dr. Jan Chadwick), Division Representative on the Curriculum Committee (Mr. Guy Dadson), and President of the Academic Senate (Dr. Sam Foster). The reduction in the number of full-time faculty, coupled with the near, full-time release of two full-time faculty members from their teaching obligations has resulted in the use of more adjunct faculty than would otherwise be needed. The Chemistry Department currently employs close to 40% of all adjunct faculty in the Natural Science Division, yet is responsible for staffing only 16% of all available sections with the Division.

The fall 2014 ratio of part-time faculty to full-time faculty (PT/FT) for the Chemistry Department is 1.8. This ratio is nearly double the average PT/FT ratio (0.94) for all of the remaining departments in the Natural Sciences Division. The spring 2015 PT/FT ratio for the Chemistry Department is predicted to reach 2.4, a value that is about 20% greater than the PT/FT ratio for all credit faculty in the North Orange County Community College District. The increase in course offerings and decrease in full-time faculty, coupled with the Department's participation in professional activities have resulted in a precipitous decline in the percentage of courses taught by full-time faculty (Table 2.9):

Table 2.9: Percentage of Courses Taught by Faculty

Academic Year	Section Count	Full-Time Faculty	Part-Time Faculty	Overload
2010 – 2011	58	76%	17%	7%
2011 – 2012	57	68%	30%	2%
2012 – 2013	60	63%	30%	7%
2013 – 2014	65	54%	40%	6%
2014 – 2015	76	48%	47%	5%

3.0 Strengths, Weaknesses, Opportunities, Challenges (SWOC)

The program strengths, weaknesses, opportunities and challenges presented below are based on the analysis of the program in Sections 2.1 through 2.6.

3.1 Program Strengths

The strengths of the chemistry program are found in the physical and financial resources of the Chemistry Department, the availability of technologies to benefit the instructors and students and the involvement of the Department faculty in a number of College and community activities:

1. The Chemistry Department has been fortunate to have several opportunities during the last three years to obtain equipment/instrumentation for the laboratory curriculum. The Office of Special Programs recently purchased a nuclear magnetic resonance (NMR) spectrometer for the Chemistry Department through the ENGAGE in STEM[6] grant project. The NMR spectrometer completes the instrumentation needs for the organic chemistry curriculum. The students enrolled in the organic chemistry courses now have access to all instrumentation that is common to this course: FT-IR spectrometry, NMR spectrometry, and gas chromatography. In addition to the NMR spectrometer, the Chemistry Department has purchased Vernier data acquisition equipment and laboratory probes. The additional Vernier equipment and probes allows for the modernization of the laboratory curriculum. This improves the experience for the students.

2. The recent addition of multiple sections to the spring 2015 schedule upon request from the President's Office resulted in an increase to the Instructional Supplies & Materials budget. The increase to the Instructional Supplies & Materials budget (to $26,500) represents the first increase since the 2011 – 2012 fiscal year, with an increase of approximately $5,400 to the 2014 – 2015 fiscal year. The increase in financial resources was essential to the health of the Chemistry Department since the number of section offerings for the 2014 – 2015 academic year amounts to an increase of 31% when compared to the 2011 – 2012 academic year. Until this term, the annual budget for the Chemistry Department had decreased by about 14%. Due to the increase, the Chemistry Department can accommodate the recent growth, although it may need additional funding with any additional growth.

3. The availability of technologies to support instruction and improve student retention and success has increased since the last program review:

[6] Encouraging New Graduates and Gaining Expertise in Science, Technology, Engineering and Math is funded through a U.S. Dept. of Education Hispanic Serving Institutions (HSI) STEM and Articulation Programs cooperative arrangement grant project.

a. The request for funding to purchase iPads and software presented in the Chemistry Department's last Program Review was granted. With that funding, the Department purchased four iPads and Doceri software packages. An iPad (with Doceri) was used this last summer to produce a series of instructional videos. These videos were posted online (YouTube) for viewing by the students, and were met with positive results.[7]

b. Funding from the last Program Review along with Lottery and Department monies, were used to purchase data acquisition probes and software to improve the experience and quality of results obtained in laboratory experiments. The Chemistry Department has begun to incorporate the probes (and software), and expects to see an improvement in the quality of results obtained by the students in the laboratory curriculum of the preparatory and general chemistry courses.

c. Many instructors within the Chemistry Department have made a commitment to use clickers in the classroom as a means of improving student success. The ability to assess student understanding as new concepts are introduced allow the instructors to alter the delivery of the lecture material to the benefit of the students in the classes.

4. Throughout the last three years, the Chemistry Department has been engaged in multiple activities for the benefit of the students in the program. These programs have been offered to improve students' skills prior to entry into the program, performance and success rates as well as success in related STEM courses upon transferring to a four-year institution:

    a. In an effort to better prepare students and improve student retention and success rates, chemistry instructors Dr. Annie Bianchino, Mr. Theodore Chan, Dr. Samuel Foster, and Dr. Bridget Salzameda have begun offering Science Boot-Camps prior to the start of each term. The Science Boot-Camps are intended to prepare students as they transition from preparatory chemistry to general chemistry. The Science Boot-Camps provide students with conceptual knowledge, problem solving skills, and laboratory techniques that are expected of students moving forward into the preparatory or general chemistry courses. In a survey of students completing the Science Boot-Camp prior to entry into General Chemistry I (CHEM 111A), the following results were obtained:

        i. Of the participants surveyed, 92% were completely satisfied with the review session.

        ii. More than half (67 %) of participants surveyed felt the hands-on laboratory experience (chemical solution preparation) was the most helpful part of the review session.

        iii. Participants who completed the post semester survey indicated an average anticipated grade of 80%.

[7] A brief discussion of the results and student comments about the use of iPad (using Doceri) in the classroom appear in Appendix F.

b. Although lessened over the last few years due a lack of funding from the last Program Review cycle, faculty of the Chemistry Department have been engaged in offering Supplemental Instruction (SI). In particular, Dr. Janice Chadwick and Dr. Annie Bianchino have either led SI sessions for the preparatory and general chemistry courses or have guided students through a student-centered SI program. The regular offering of the SI sessions by these instructors (or student instructors) have been widely popular, well attended and have undoubtedly kept the success rates constant when compared to the peer institutions.

c. The Chemistry Department is dedicated to improving the retention and success of students in the program, yet efforts are continually made to improve student success beyond the (chemistry) classroom. Since joining the Department in fall 2012, Dr. Bridget Salzameda has taught the preparatory and general chemistry courses being offered specifically to students in the "First Year Experience" (FYE) program. The FYE program has been created to improve efficiency and success for student wishing to pursue STEM degrees.

d. A mentoring program, Peer Undergraduate Mentoring Program (PUMP), aimed to improve student retention and successful completion in STEM courses was started in the fall of 2012 by Dr. Bridget Salzameda. PUMP will pair first year FC STEM students with academically outstanding STEM students from California State University, Fullerton (CSUF). Offering individualized peer mentoring has been beneficial to the STEM students at Fullerton College. This is evidenced by the positive preliminary data (Appendix G).

5. The Chemistry Department regularly participates in community events to foster interest in the sciences. Dr. Sam Foster has visited local K – 12 schools to provide short lectures topics related to the sciences and chemistry. Mr. Theodore Chan will continue to provide hands-on activities for children at the Santa Ana Zoo each year during the American Chemistry Society's annual celebration of National Chemistry Week. Additionally, Dr. Janice Chadwick has hosted events for Kindercaminata. In addition, faculty members of the Department continually involve students within the program to participate in these activities and encourage the students to become actively involved in other community events and programs.

3.2. Program Weaknesses

The weaknesses of the chemistry program results from the number of adjunct faculty that are currently teaching for the Chemistry Department, the availability of lecture and laboratory rooms, the aging computers currently used in the computer laboratories as well as the continued and significant demand for chemistry courses:

1. The strength of the Chemistry Department can be found in the full-time faculty. The knowledge and experience of the full-time faculty within the Department cannot be replaced by adjunct faculty. Therefore, the increase in the number of sections taught by adjunct faculty presents a significant weakness. Since the 2010 – 2011 academic year, the percentage of sections taught by adjunct faculty has increased from 17% to 47%. Although two full-time hires are expected for the next academic year (fall 2015), a large number of adjunct faculty are still expected to teach courses in the Department due to the expected continuation in the growth of the program. The full-time hires represent both the replacement of a previous retirement (Ms. Betty Huck) and a growth hire.

The additional growth of the program or the retirement of another member of the faculty would require an additional full-time hire.

2. The significant growth since the 2011 – 2012 academic year has resulted in the addition of many sections, both to chemistry courses and courses in other programs in the Natural Sciences Division. Although growth across all programs is wonderful for students completing courses in the Natural Science Division, it does present a problem for the Chemistry Department:

    a. The large addition of sections has resulted in a congested schedule within the 400 Building. The limited availability of lecture rooms limits the ability to add more sections of chemistry courses. Unless additional lecture rooms can be made available, it is unlikely that the Department will be able to meet an increase in the demand.

    b. The congested schedule that has arisen from the significant demand for courses in the Natural Science Division has resulted in the scheduling of chemistry laboratories in an inefficient manner. Currently, chemistry laboratories have been scheduled around the availability of lecture rooms. With the availability of additional lecture rooms, the Department would be able to schedule the chemistry laboratories more efficiently. This would benefit both the students and faculty.

3. The computer laboratories in the 400 building are using computers that are at least four years old. Usually, computers are replaced every four to five years since they become unreliable and maintenance costs increase. The computers in these computer laboratories are essential to the chemistry curriculum, the other departments in the Division of Natural Sciences and also by the Office of Special Programs. A request will be made within this Program Review for funding to replace the computers in these computer laboratories, with recognition that the loss of these computers or inability to properly and timely maintain the computers will lead to a significant impact to the curriculum.

3.3 Program Opportunities

The opportunities for the chemistry program include changes in the demographics of the College and program, future trends in STEM, an improving economy and an increase in nursing and biotechnology employment opportunities:

1. The student demographics in the program, with respect to Hispanics and White Non-Hispanic students, have been changing over the last five years. Since the 2009 – 2010 academic year, the percentage of total FTES for Hispanic students has increased from 24% to 40% (a 66% increase!) while that of White Non-Hispanic students has decreased from 28% to 22%. The observed changes in student demographics are similar to those for Fullerton College,[8] where the reported FTES for the Hispanic and White Non-Hispanic student populations changed by 12% and -7%, respectively. As a result of the large Hispanic population, Fullerton College is a member of the Hispanic Association of Colleges and Universities (HACU) and additionally, is considered to be a Hispanic Serving Institution (HSI) for purposes of federal appropriations and grants. This status has allowed the Office of Special Programs at Fullerton College to obtain funding that promotes STEM within

[8] The observed changes in student demographics are based on the FTES data produced by the California Community Colleges Chancellor's Office MIS Data Mart.

the sciences and in particular, funding opportunities for the faculty and students in the Chemistry Department. Funding from the Office of Special Programs has been used for professional development of the chemistry faculty, the purchase of laboratory equipment and Supplemental Instruction. An increase in the Hispanic student population will help to ensure that funding will continue to be made available to support the Chemistry Department.

2. The Economics and Statistics Administration of the United States Department of Commerce has stated that the growth in science, technology, engineering and mathematics (STEM) related jobs outpaced the growth of non-STEM related jobs over the last ten years; STEM related jobs generally provide greater stability and continue to play a vital role in the growth and stability of the United States economy.[9] Since STEM occupations are projected to grow at a rate nearly twice that of non-STEM occupations and potentially earn the average worker 26% more than individuals in the non-STEM occupations, it is not surprising to have seen a significant demand for courses that lead to STEM degrees over the past few years. Fullerton College represents an important and relatively inexpensive path for students to attain an advanced education in STEM; nearly 40% of all science and engineering degrees were awarded to students who completed some coursework at a community college.[10] As a result of this demand and attempts by the Chemistry Department to meet the demand, the number of sections offered by the Department has grown by 24% since the 2009 – 2010 academic year.[11] The demand for educations in STEM continues and the Chemistry Department can expect both a corresponding demand for chemistry courses as well as the availability of external funding.

3. The state of the economy in California has improved considerably since the passage of Proposition 30 in 2012. The community colleges in California received $210 million in additional funding for the 2012 – 2013 academic year, allowing for approximately 3,300 classes to be added to the state-wide community college system for the spring 2013 term.[12] The increase in funding and addition of courses coincides with the rapid addition of sections for chemistry courses at Fullerton College. The funds that have become available as a result of the passage of proposition 30 have allowed for the significant growth of the Chemistry Department's offerings. Since the proposition will continue to provide additional funding for the community colleges in California, there will be a stabilization of community college budgets and the Department may begin planning for the future. Specifically, thought can be given to the expansion of the chemistry program, the purchase of equipment to maintain the strength of the chemistry program and the hiring of full-time faculty to replace the retirement of full-time faculty.

4. The importance of nursing and biotechnology related fields to the chemistry program cannot be understated. Both fields have seen a significant uptick in demand to meet ever increasing employment opportunities. The Bureau of Labor Statistics under the United States Department of Labor has stated that employment of nurse anesthetists, nurse midwives and nurse practitioners is expected to grow by more than 30% from 2012 to 2022; this growth rate exceeds all other occupations.[13] The projected increase in employment for biological technicians is expected to grow

[9] http://www.esa.doc.gov/Reports/stem-good-jobs-now-and-future
[10] http://www.nsf.gov/nsb/sei/edTool/explore.html
[11] The number of sections offered for the 2009 – 2010 and 2014 – 2015 academic years are 61 and 76, respectively.
[12] http://californiacommunitycolleges.cccco.edu/PolicyInAction/KeyFacts.aspx
[13] http://www.bls.gov/ooh/healthcare/nurse-anesthetists-nurse-midwives-and-nurse-practitioners.htm#tab-6

by 10% over the same time frame.[14] Chemistry courses are essential to students pursuing employment in health care or biology-related industries. Students interested in nursing and the biological sciences will take chemistry courses as a part of their education and therefore, the demand for these occupations is most likely will further increase the demand for chemistry courses over the next decade.

3.4 Program Challenges

Chemistry program challenges include the lack of external funding opportunities, Academic Computing Technologies and the availability of a STEM advisor for the students in the Natural Sciences Division:

1. The Chemistry Department has been fortunate to have received funding from the President's Office to accommodate the addition of four sections to the spring 2015 schedule as well as support from the Office of Special Programs. However, there is no reliable external funding source. The Department is wholly dependent upon internal funding. The costs associated with the procurement of chemicals (including de-ionized water for the entire 400 Building) associated with experiments and demonstrations, the disposal of chemical waste and the purchase and repair of equipment that are essential to laboratories and experiments, require significant support and commitment from the College. Recognizing that the College may not be able to afford or support every endeavor that the Chemistry Department wishes to pursue, it is important that the Department begin looking for a funding stream.

2. The Chemistry Department frequently relies upon the computer laboratories for experimental data analysis, preparation of laboratory reports and online problem solving. It is critical that the computers used in the computer laboratories not only be replaced every four to five years--as is usual in both academia and industry--but they must also receive regular or automated updates by Academic Computing Technologies (ACT). The success of the chemistry program is dependent on receiving regular support from ACT. Specifically, ACT must be able to provide software updates upon request and without delay, unless automatically installed when updates become available. Without this service, the success of the chemistry program and the ability of the faculty to provide quality instruction will be compromised.

3. The students and faculty of the Chemistry Department and Natural Sciences Division are impacted by the lack of a Campus STEM Resource Center with a dedicated full-time classified staff member and a dedicated full-time counselor. With a Campus STEM Resource Center, it would be possible to 1) identify, recruit and track STEM majors, 2) assist STEM majors with educational planning, résumé development and access to research and scholarship opportunities and 3) provide STEM majors with access to counselors and faculty for guidance with employment and internships, transfer to four-year institutions and volunteer and community service opportunities. The lack of a Campus STEM Resource Center has limited the ability of the faculty of the Chemistry Department and the Natural Sciences Division to pursue relationships with neighboring community colleges, local four-year institutions and related industries. Without access to a dedicated classified full-time staff member and a dedicated full-time counselor, it would not be possible to pursue the creation of a Campus STEM Resource Center, given the financial cost and time constraints that exist for faculty.

[14] http://www.bls.gov/ooh/life-physical-and-social-science/biological-technicians.htm#tab-6

4. The faculty are hampered by the temperature in the laboratories. The thermostats are located on the outer wall of the laboratory rather than in inner wall, near the stockroom. As the building heats up in the summer and the sun radiates on the outer walls, the thermostats register the heat and the air conditioners turn on. Sometimes the air conditioners are on most of the night and the rooms are extremely cold the next morning. Relocating the thermostats would rectify this situation.

5. The faculty in the program have less time to prepare for the courses since they are required to perform more administrative work. Activities such as program review and SLO assessments consume an inordinate amount of time and prevent proper preparation for course instruction. Data "mining" should be supported by the Office of Instructional Research and Planning (OIRP) and not faculty in the program. Additionally, some of the data presented in this Program Review is questionable and cannot be validated. The faculty has spent a total of over 50 hours on this self-study alone; some of this time could be shortened by additional support in OIRP.

4.0 Student Learning Outcomes (SLO) Assessment

4.1 Program-Level Student Learning Outcomes

The Chemistry Department currently offers an Associate of Arts (A.A.) degree in Chemistry. Two chemistry courses are required for the completion of the A.A. in Chemistry: General Chemistry I (CHEM 111A) and General Chemistry II (CHEM 111B). The course-level student learning outcomes (CSLOs) for these courses, as identified in Appendix H, were used in the assessment of the program-level student learning outcomes (PSLOs) for these courses. The PSLOs, the dates of assessment and data analysis along with date of recent efforts to improve the program appear in Table 4.1 (pg. 22). Multiple assessments have been performed in both chemistry courses over the last three years. The data obtained from these assessments was analyzed immediately (during the same term) and aggregated with data from pervious terms. The Department has engaged in discussions of the results obtained from the analysis of the assessments and began making improvements to the courses at the start of the current term (fall 2014).

4.2 Program-Level Student Learning Outcome Assessments

The assessment of the PSLOs was accomplished using the assessment data of the CSLOs for General Chemistry I and II. A template demonstrating how the CSLOs from these courses were used to assess the four different PSLOs appears in Appendix I. The intended outcomes that were assessed, the means of assessment and criteria for success, the summary of data collected and success rates and discussion regarding the use of the results appears in Table 4.2 (pg. 23). The intended outcomes that appear in Table 4.2 illustrate the abilities and experiences of students upon completing the general chemistry courses in the program and represent the newly approved (effective fall 2014) PSLOs for the program.

Table 4.1: Program-Level Student Learning Outcomes (PSLOs)

PSLOs	Assessment Completed	Data Analyzed	Improvement	Cycles Completed
1. Upon successful completion of courses leading to the Chemistry AA, the student will be able to demonstrate safe and proficient use of chemistry laboratory equipment and techniques.	Several Terms Fall 2011 – Spring 2014	Continuously*	Present (08/22/2014)	One Cycle
2. Upon successful completion of courses leading to the Chemistry AA, the student will be able to evaluate experimental methodology using the scientific method.	Several Terms Fall 2011 – Spring 2014	Continuously*	Present (08/22/2014)	One Cycle
3. Upon successful completion of courses leading to the Chemistry AA, the student will be able to perform common chemical calculations and analyses.	Several Terms Fall 2011 – Spring 2014	Continuously*	Present (08/22/2014)	One Cycle
4. Upon successful completion of courses leading to the Chemistry AA, the student will be able to produce molecular level interpretations for chemical phenomena.	Fall 2011 Fall 2013	Fall 2011 Fall 2013	Present (08/22/2014)	One Cycle

*Data was analyzed each term between Fall 2011 and Spring 2014.

Table 4.2: Program-Level Student Learning Outcomes Assessment for Instructional Programs at Fullerton College

Intended Outcomes	Means of Assessment	Summary of Data Collected	Use of Results
1. The student will be able to demonstrate the use of proper procedures and regulations for safe handling and use of chemicals.	Common questions or problems. Participation points in laboratory section for safety and proper handling of chemicals and equipment. Lab practicum at the end of the semester. Criteria for Success: 65%	The assessments to date have focused primarily on the use of laboratory equipment and techniques during the CHEM 111B practicum. The success rate is significantly greater than the Department's criteria for success. Success Rate: 87%	The success rate is in excess of the Department criteria by nearly 20%. The assessments demonstrate that the successful student is using laboratory equipment properly. Future assessments will need to examine the students' ability to properly use chemicals.
2. The student will be able to demonstrate the ability to conduct experiments, analyze data and interpret results, while observing responsible and ethical scientific conduct.	Laboratory skills assessed against a course standard and/or rubric common to all faculty for laboratory notebook and/or laboratory skill. Criteria for Success: 65%	The assessments were based on the evaluation of an entry in the students' laboratory notebooks from CHEM 111B. The success rate is significantly greater than the Department's criteria for success. Success Rate: 92%	The success rate is in excess of the Department criteria by slightly less than 30%. The assessments demonstrate that students are generally able meet the outcome. Future assessments may rely on a different experiment, or require students to submit a formal (typed) laboratory report.
3. The student will be able to demonstrate knowledge of inorganic chemistry appropriate for general chemistry and have the ability to articulate this chemical knowledge in verbal, written, and/or computational form.	Common questions or problems. Pre- and post-testing in sections and/or American Chemical Society (ACS) National Standardized Examination will be administered by all sections and will be assessed based on section by faculty. Criteria for Success: 65%	The assessment is based on the average performance of students in CHEM 111A and 111B. The success rates for CHEM 111A and 111B were 49% and 91%, respectively. The CHEM 111A success rate was significantly lower than the Department criteria due to a poor performance on three of the selected questions. Success Rate: 71%	The success rates for the items assessed in CHEM 111A are incredibly low. Whereas the assessments provide a path towards improvement (identifying topics which require further instruction), they also illustrate the inherent limitations associated with adjunct faculty. Adjunct faculty are more heavily relied upon for CHEM 111A than CHEM 111B, and are likely a significant source for the low success rate.

4.3 Ongoing Program-Level Student Learning Outcome Assessments

The Chemistry Department has made great progress towards the assessment of the PSLOs. As of the start of the fall 2014 term, the Chemistry Department has completed one cycle for each of the PSLOs with the implementation of efforts to either maintain high student success rates or, where needed, improvements in student success rates. In hopes of improving the assessment of student understanding and ultimately, the education and experience of students in the program, the Chemistry Department revised the CSLOs in the general chemistry sequence and the PSLOs for the Associate of Arts degree in Chemistry.[15] The Department has completed one assessment cycle for all PSLOs and has revised the PSLOs for the purpose of beginning a second assessment cycle and therefore, has ongoing assessments for 100% of the PSLOs.

4.4 Program Improvements in Student Learning and Achievement

The faculty members of the Chemistry Department have discussed the results from the CSLO assessments that were used to assess the PSLOs. The assessment of the PSLOs should lead to improvements in student learning and achievement through the analysis and interpretation of data obtained through the CSLO assessments. Though the Chemistry Department has completed an assessment cycle for all PSLOs and has made some changes to the curriculum in response to the assessment results, it is still too early in the assessment process to identify whether there were improvements in student understanding and achievement. Although additional assessment cycles will be necessary to identify improvement, the assessment process of the CSLOs and PSLOs have already guided the faculty towards changes in course pedagogy and Department policies.

As identified in the previous Program Review (2011), the Chemistry Department began using an "atoms first" approach in the general chemistry sequence. The intent of the change from a traditional to "atoms first" approach was to place a greater emphasis on molecular level interpretations and therefore, improve student success as it related to molecular-level phenomena. However, as can be seen in Table 4.3, the student success rates significantly decreased for three different question types in General Chemistry I (CHEM 111A). While the decrease in student success may be attributable to an increase in the number of adjunct instructors (to be discussed further in Section 4.6), it is likely that the textbook being used was not written for the rigors of the course. As a result of the regular assessments being performed in the program, it has been possible to identify the decrease in student success and take appropriate action. With the start of the fall 2014 term, the Department began using a different textbook for the general chemistry sequence.

[15] The CSLOs were changed (improved) for all courses offered by the Chemistry Department in the spring term of 2014. These CSLOs and a new set of PSLOs were approved by the curriculum committee on April 30, 2014 and May 7, 2014, respectively.

Table 4.3: Student Success Rates in General Chemistry I

Question Type	Fall 2011 Success Rates (43% Adjunct Faculty*)	Fall 2013 Success Rate (50% Adjunct Faculty*)
Stoichiometry	91%	76%
Electron Configurations	61%	22%
VSEPR‡	79%	45%

*These values reflect the percentage of CHEM 111A sections taught by adjunct faculty.

‡VSEPR ≡ Valence Shell Electron Pair Repulsion

The assessment of the CSLOs and PSLOs have also identified barriers to student success and achievement in General Chemistry II (CHEM 111B). As was the case in CHEM 111A, the use of adjunct faculty in CHEM 111B has resulted in lower student success rates. The student success rates for laboratory-related assessments in CHEM 111B have decreased; this is most likely due to the lack of knowledge and experience that the adjunct faculty may have teaching in a laboratory environment. In particular, the adjunct faculty generally have difficulty instructing students with the use of Microsoft Excel and the creation of graphs for the presentation and analysis of experimental data.

The identification of a decline in student success and achievement has allowed the Chemistry Department to begin the process of seeking solutions to improve the program. Aside from the selection of appropriate materials for the courses, the Department intends on counseling the adjunct faculty beginning at the start of the spring 2015 term. Individual meetings between course coordinators and adjunct faculty will hopefully improve student success and achievement by communicating the expectations of the Department, providing appropriate background information to hardware and software used in laboratory experiments and relating general comments towards improving the effectiveness of classroom instruction and evaluation.

4.5 Improvements in Transfer or Certificate/Degree Awards

While the number of degrees awarded to students has more than tripled over the last five years[16] and assessment of CSLOs and PSLOs may have led to improvements in transfer or degree awards, it is still too early in the assessment process to identify the existence of improvements with any level of certainty. The Chemistry Department has seen a steady increase in the number of degrees awarded; it is entirely possible that the increase may be due to a number of influencing factors. These factors may include an improving economy, growth in the size of the chemistry program (number of sections) and the importance of STEM related careers upon students' decisions to obtain a degree in chemistry.

4.6 Challenges to Improve Effectiveness of Program-Level SLO Assessments

The Chemistry Department recently rewrote the CSLOs and PSLOs, hoping to outcomes that are better correlated. The newly developed outcomes should be easier to assess and more importantly, have been written for the average student so as to better assess student success in the program. However, the recent decision by the College to include D and F students in all course- and program-level assessments

[16]As identified in Section 2.2, the number of Associate of Arts degree in Chemistry awarded steadily increased from 9 to 33 between the 2009 – 2010 and 2013 – 2014 academic years.

has the potential to increase the difficulty of interpreting the results and therefore, decrease the effectiveness of the CSLO and PSLO assessments. Often, students earn a final grade of D or F as a result of a lack of effort, rather than a lack of conceptual understanding or instructional effectiveness. Regardless of the effort that is placed into instruction, students that do not complete the homework assignments or regularly attend class, for example, are not expected to do well in the course. As the Chemistry Department moves forward with course- and program-level assessments, consideration will have to be given to those students who are not likely to succeed as a result of a failing to properly participate in the course. Only after consideration is given to this subset of the student population can the Chemistry Department examine the effectiveness of its efforts and the assessment of the PSLOs.

The ability of the Chemistry Department to improve student success and achievement through improvements to the PSLO assessment process will also be hindered by the large number of adjunct faculty currently being employed. As indicated in Section 4.4, there seems to be a strong correlation between the number of adjunct faculty that are utilized and student success rates. The correlation between student success rates and number of adjunct faculty is best seen from CSLO assessment of the preparatory chemistry course, Elementary Chemistry (CHEM 107). The number of adjunct faculty employed by the Chemistry Department is greatest in CHEM 107, where the percentage of sections taught entirely by adjunct faculty can reach as high as 67%. The CSLOs for CHEM 107 have been assessed every term (spring, summer and fall) since the start of 2012. As can be seen in Figure 4.1 (pg. 27), the success rates for three of the four CSLOs clearly decreases as the number of adjunct faculty increases. While CHEM 107 is not a required course for the Associate of Arts in Chemistry, it does represent a prerequisite course for CHEM 111A and more important to the discussion, it demonstrates the limitations associated with having adjunct faculty. Regardless of the efforts being made by the full-time faculty of the Department, the ability to utilize the assessment of the PSLOs will be limited by the quality of the adjunct faculty who are teaching the required program courses, General Chemistry I and General Chemistry II.

Finally, the ability of the Chemistry Department to improve the effectiveness of the PSLO assessments is limited by the ability to disaggregate student achievement by gender, ethnicity and other factors that may contribute to student success. Currently, the Chemistry Department does not disaggregate the results; adjunct and full-time faculty are limited by both time and technology. However, the North Orange County Community College District has recently obtained eLumen software for the purpose of collecting, storing and reporting the data obtained from course-level assessments for program- and institutional-level assessments. With the implementation of eLumen it should be possible for the Chemistry Department to examine the success rates (by outcomes) for various groups, e.g. African-American and Hispanic students.

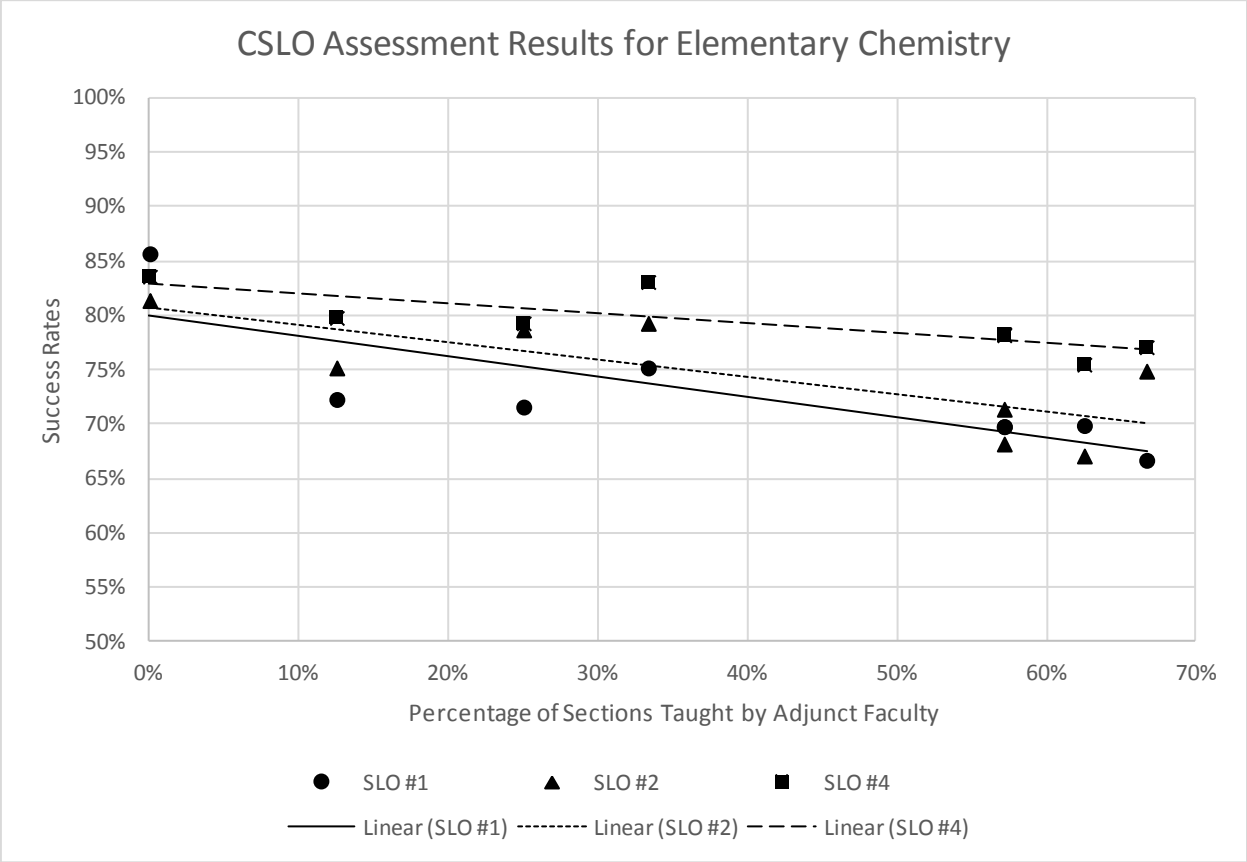

Figure 4.1: The decrease in student success, as measured by the CSLO assessments in Elementary Chemistry, CHEM 107. Note the obvious downward trend in success rate with increasing percentage of sections taught by adjunct faculty. The decrease in student success is observed to be between 5% and 13% for the maximum number of adjunct faculty.

5.0 Evaluation of Progress toward Previous Goals/SAP's

5.1 Previous Goals from 2011 Program Review

The previous short-term goals identified in the 2011 Program Review to improve the program over a two-year period were:

1. Adjust instruction in the chemistry courses to accommodate the change from an eighteen-week calendar to a (compressed) sixteen-week calendar, while continuing to provide a student-centered schedule with quality instruction to maintain student retention.

2. Continue to offer and expand offerings for Supplemental Instruction (SI) sessions for students in select chemistry courses (CHEM 101, 107, 111A, 111B, and 201) to improve student success.

The previous long-term goals identified in the 2011 Program Review to improve the program over a six-year period were:

1. Improve skills of our students through the incorporation of data acquisition hardware and software.

2. Increase both the number of class offerings and the number of full-time faculty members.

5.2 Success and Progress Achieved toward Previous Goals

The Chemistry Department was successful in achieving the short-term goals identified in Section 5.1:

Though not without compromise, the curriculum in all of the chemistry courses has been adjusted to the sixteen-week calendar. Accommodating the reduction in class meetings required the adjustment of the lecture and laboratory schedules. The adjustment in the lecture schedule required that the topics be presented more quickly, often before students could attain a full level of understanding. The adjustment to the lecture schedule also required the splitting of topics between lecture periods to make full use of the additional time allotted per lecture period. Though these changes have been made, there has not been significant reduction in student success. Most likely, students are either accommodating the faster delivery of material or student assessments do not involve deeper- or higher-levels of topic understanding and comprehension.

The adjustment to the lecture schedule was relatively straightforward. However, the change to a sixteen-week calendar required significant efforts for courses with laboratory components. As the Chemistry Department did not want to sacrifice experiments which would otherwise affect the quality of the program, less time was allotted for discussion and problem solving. As discussion and problem solving sessions are critical to developing the critical thinking and problem solving skills, the Department expected that the movement to a sixteen-week calendar would reduce retention and success rates. Though not readily apparent in the retention and success rates presented in Section 2.2, it is not realistic to believe that the movement into a sixteen-week calendar did not have any effect on these rates. Students may have replaced their participation in extracurricular activities with the additional out-of-class preparation time to account for the lost in-class preparation time afforded through discussion and problem solving sessions. Interestingly, the compressed sixteen-week calendar has made it more difficult for full-time faculty to participate in professional activities outside of the classroom.

Though the Chemistry Department intended on expanding offerings for Supplemental Instruction (SI) sessions, this did not occur. While faculty have continued to offer SI sessions for select courses (CHEM 101, 107, and 111B), the demand placed onto faculty schedules as a result of the compressed sixteen-week calendar has limited additional involvement in this important activity. Had the Chemistry Department received funding for SI, as requested in the previous Short-Term Goal #2, it may have been possible to create more free time in the faculty schedules, thereby allowing them to participate in SI. Additionally, the reduction in full-time faculty with the retirement of Ms. Betty Huck, as well as the increased participation of full-time faculty in College-wide activities, as described in Section 2.6, has decreased the time available for SI sessions. The ability to continue to offer and expand the SI program for chemistry courses, as identified as a short-term plan in the previous Program Review, will require that the faculty either commit more time to SI or rely on student-led SI sessions. With the start of the spring (2015) term, the chemistry program will rely on a student to lead an SI session for one of the CHEM 107 sections. This will be a pilot program for the Chemistry Department and the Department hopes that more students can be identified as SI leaders for future SI sessions in other chemistry courses.

The Chemistry Department has been very successful in achieving the long-term goals identified in Section 5.1:

The technology skills of our students have been improved through the purchase and commitment to incorporate laboratory equipment. The purchase of a nuclear magnetic resonance (NMR) spectrometer and multiple Vernier laboratory probes (e.g. SpectroVis and pH probes) and LabQuest 2 data acquisition device pH probes have greatly improved the capacity of the Chemistry Department to conduct experiments in the preparatory, general and organic chemistry courses. As of fall 2014, the Chemistry Department has been able to incorporate all of the equipment purchased and is currently examining the results from the use of this equipment. In addition to the purchase of the laboratory based equipment, the Chemistry Department was able to purchase iPads and Doceri software using funding provided from the last Program Review. With the Doceri software, a faculty member of the Department was been able to produce videos to enhance the instruction of students and therefore, potentially increase success rates (Section 3.1 and Appendix F).

The number of class offerings, as described in Section 2.1, has been increased to meet the significant demand over the last three years. The significant growth in the number of sections offered by the Chemistry Department, 14% since the 2011 – 2012 academic year, has led to a total number of sections being offered for the academic that exceeds any other year in the Department's history. However, the number of full-time faculty members was not increase over the last three years to meet the significant increase in section offerings. The Department was placed in a compromised position as the result of the increase, along with a retirement that was not replaced. Fortunately, the Department was granted two additional full-time hires (to begin in fall 2015). With these two full-time hires, the Chemistry Department will now be better positioned to improve student success and achievement.

5.3 Measurement of Success and Progress Achieved toward Previous Goals

To measure the success of the adjustment in the chemistry courses instruction to accommodate the change from an eighteen-week calendar to a (compressed) sixteen-week calendar, a comparison of was made between the retention rates before and after the switch in the calendar. As can be seen in Table 2.6, the retention rates either remained relatively constant, with slight increases for the major ethnic groups at Fullerton College. The changes in average retention rates upon moving to the sixteen-week calendar are 4.5%, 4.3%, and -0.5% for Asian-American, Hispanic, and White, respectively. The average retention rates for African-American students increased by 6.2% upon changing to a sixteen-week calendar, though this may be a poor measure of the total program success since that population represents only 2% of the total FTES (Appendix D). In addition to increasing retention rates, the average success rates increased for Asian-American (3.5%), African-American (2.3%), and Hispanic (2.8%) students. The success rates for White (-1.0%) students decreased; however the KPI data suggest the Chemistry Department was remarkably successful in transitioning from the eighteen-week to sixteen-week calendar.

The intended measure of success and/or progress achieved in the Department's efforts to expand Supplemental Instruction (SI) was the evaluation of retention and success rates for students attending SI versus those that did not attend. Unfortunately, the retention and success rates are not available for students that were and were not involved in SI. Additionally, it may not be possible to establish any cause-effect relationship of the outcome due to a number of uncontrolled variables that contribute to both the retention and success. Given the lack of reliable data, the Chemistry Department examined the success of

its efforts according to the number of SI sessions that were offered to students. As the number of SI sessions has waned over the last two years, it is likely that the Chemistry Department did not meet its intended goal.

The Chemistry Department will examine the success rates for various experiments with and without the use of the data acquisition hardware (Vernier LabQuest 2 and probes) and software to measure the improvement of the technology skills of the students in the chemistry program. As the Chemistry Department is still in the process of incorporating the technology in the classroom, it is not yet possible to quantitatively assess the success of this long-term goal. Once the Vernier LabQuest 2 and data probes are fully implemented the Chemistry Department will collect the student results and compare them to those obtain prior to the implementation of the technology. Additionally, the Chemistry Department will consider the time that is saved though the use of the (efficient) LabQuest 2 and data probes.

The final long-term goal was an increase in both the number of class offerings and the number of full-time faculty. This goal was easily measured by examining the increase in the number of sections and full-time faculty over the last three years (since the last Program Review). As stated in Section 2.6, the Chemistry Department has seen a significant growth in the number sections over the last few years. When compared to the current academic year, the number of sections that are offered increased by over 30%. Unfortunately, the increase in section offerings was accompanied by the retirement of Ms. Betty Huck, reducing the total number of full-time faculty from nine to eight.

5.4 Examples of Continuous Quality Improvement in Program

The Chemistry Department is continually engaged in efforts to improve the quality of the education provided to students in the program. This is demonstrated by the Department's efforts to adjust instruction to the new sixteen-week calendar, to continue offering Supplemental Instruction (SI) and to incorporate technology for both the instructors and students. Whereas, the increase in the number of sections offered to the students may not have improved the quality of the program, it most certainly aided each student's completion of their education at Fullerton College (degree and/or transfer).

The consensus of the faculty in the Chemistry Department, as expressed in the previous Program Review (2011), was that the compressed schedule would produce lower retention and success rates. Generally, as students would be required to learn the same amount of material in a shorter amount of time, the Department faculty feared that students would be unable to successfully address the greater rate at which lecture material was delivered. However, as identified in Section 5.3, both the retention and success rates of the students were increased. The efforts of the chemistry faculty to modify the delivery of lecture material and possibly, greater emphasis on problem solving strategies may have helped avoid the expected reduction in student performance.

Though the Chemistry Department intended on expanding the offering of SI sessions, this did not occur. However, faculty members of the Department still made an effort to continue offering SI sessions for various classes (i.e. CHEM 101, 107, and 111B). It is likely that the effort to continue assisting students outside of the classroom--as is typically the case for chemistry faculty--improved the retention and success of students in the program. It is because of the success that is normally seen through these additional efforts that the faculty of the Chemistry Department continues to offer our assistance to students beyond the classroom. It is hoped, that with a growth in the offering of SI sessions, that the faculty of the

Chemistry Department will be able to continue to assist students in the program, leading to the success of the students and the program.

The incorporation of the data acquisition hardware and software was not limited to funding from the previous Program Review (2011). The Chemistry Department is committed to purchasing additional equipment to improve the quality of the laboratory experience for students in the program. Additional equipment has been purchased with Lottery monies in spring 2014, and additional equipment will be purchased in spring 2015 with monies for the Office of the President. The purchase of SpectroVis, conductivity, pH, and temperature probes and the LabQuest 2 interfaces allow the Department to utilize this technology in multiple courses. With the new probes, the Chemistry Department can begin to consider changes to the laboratory curriculum that may both improve the results students obtain and increase the opportunity to conduct more experiments. The Chemistry Department pursued the purchase of an NMR spectrometer for many years and was finally able to secure funding through the Office of Special Programs. This instrument is critical to a successful two-year chemistry program and represents a significant accomplishment for all faculty involved in its acquisition.

The continuous efforts of the faculty to improve the quality of the program is reflected in the ability of the Chemistry Department to rapidly add more than twenty sections in three years while meeting the incredible demand at the start of the academic term. The average fill rate for chemistry courses over the last five years exceeds 101% and was 104% for the last year (2013 – 2014). Although the numbers are not yet available, there is little doubt that the chemistry courses will have a similar fill rate for the 2014 – 2015 academic year.

5.5 Resource Contribution toward Improvement of Program

The most recent Program Review cycle resulted in the allocation of $6,398 to help meet previous goals outlined for the Chemistry Department. The awarded funds were used to meet Short-Term Goal #1 – "Technology to Enhance Active-Learning Techniques" and Short-Term Goal #2 – "Continue to Offer and Expand Supplemental Instruction."

<u>Short-Term Goal #1 – "Technology to Enhance Active-Learning Techniques"</u>

The intended use of technology associated with the first short-term goal was enhancement of active learning techniques in the classroom. This request included the purchase of appropriate equipment ($4,198) and funding for relevant training ($1,000). With this award, three iPads (with Doceri) and thirty student response systems ("clickers") were purchased for use by the Department faculty. As the funding associated with this short-term goal did not become available until the end of the fall 2013 term, neither the iPads nor the "clickers" were purchased until mid-spring 2014. The "clickers" were not received until the end of the spring 2014 term and therefore, have not yet been used. Similarly, by the time the Chemistry Department received the iPads from Academic Computing there was no time to utilize the technology for the spring 2014 term. A member of the faculty, Mr. Theodore Chan, developed techniques for the use of the iPad (with Doceri) in his summer course, CHEM 101 Introduction to Chemistry (see Section 3.1). Given the successful use of the iPad (with Doceri) in the classroom, Mr. Chan prepared training presentations on its use for the remaining faculty of the Chemistry Department. The Chemistry Department anticipates the use of both the iPads (with Doceri) and the "clickers" in the spring 2015 term. The student-centered use of both the iPads (with Doceri) and the "clickers" will enhance active learning, improving the quality of student instruction and will likely lead to improved success rates.

Short-Term Goal #2 – "Continue to Offer and Expand Supplemental Instruction"

The second short-term goal was to continue offering and expand offerings for Supplemental Instruction (SI) sessions for students in select chemistry courses to improve student success. However, the bulk of the funding for personnel ($22,080) was not awarded, limiting the ability of faculty to participate in SI. The funding that was awarded ($1,200) was allocated to the purchase of two molecular modeling kits and one iPad (with Doceri). Both the modeling kits and iPad (with Doceri) are expected to both improve the experience in SI and the success rates of students in attendance.

5.6 Program Impacts

Although the Chemistry Department received nearly $6,400 to improve the quality of the program, the vast majority of the requested resources were not awarded. In particular, the Chemistry Department did not received funding for either personnel to expand SI offerings ($22,080) or laboratory equipment to improve the technology skills of students in the program ($62,095). As mentioned in Section 5.5, the lack of funding for personnel significantly impacted the ability of the Chemistry Department to increase the number of Supplemental Instruction (SI) sessions. While the absence of support to increase faculty involvement in the SI program was not very detrimental, the same cannot be said about the lack of funding to improve the technology skills of the students in the program.

As mentioned in the last Program Review (2011), acquisition of the Vernier probes and an NMR spectrometer was essential to general chemistry and organic chemistry curricula, respectively. The Vernier probes are increasingly being used for data collection and analysis in general chemistry experiments. Implementation of the probes in the general chemistry curriculum is important for the Chemistry Department, as it allows the Department to remain current and stay competitive with local institutions. The NMR spectrometer is recognized as one of the more important analytical tools in chemistry, and is the only piece of instrumentation that is mandated for an approved chemistry program by the American Chemical Society. Given the importance of having Vernier probes and the NMR spectrometer and the lack of funding, the Chemistry Department was forced to rely on additional funding: Lottery money and the Office of Special Programs. As the Chemistry Department was forced to use the Lottery money and the Office of Special programs to purchase these essential items, this resulted in less money/funding for other purchases that are essential to the lecture and laboratory offerings in the chemistry program.

6.0 Strategic Action Plans

The tables below list the strategic action plans (SAPs) for the Chemistry Department. The SAPs are presented for the following three-year cycle.

Strategic Action Plan #1

Statement of SAP:	Create a Campus STEM Resource Center, as discussed in Section 3.4.
College Goal(s) and Objective(s) the plan meets:	College Goals: Goal #1: Fullerton College will promote student success. Goal #3: Fullerton College will strengthen connections with the community. Objectives: 1.1: Address the needs of under-prepared students. 1.2: Increase course retention and success. 1.3: Increase the number of degrees and certificates awarded. 1.4. Increase the number of transfers. 1.5: Increase the persistence rate of students. 3.1: Strengthen our contacts with Alumni. 3.2: Strengthen partnerships with local feeder high schools and universities. 3.3: Strengthen partnerships with local business and industry. 3.4: Increase funding capabilities of the college. 3.5. Increase engagement of the college with the community through college events, community service, and other partnerships.
Description of SAP:	The proposed Campus STEM Resource Center will need a suitable facility to house it. There are several possible locations for the Center, which include the land adjacent to the native plant garden and the former Math Lab in the 600 building. Additionally, the STEM Center will require the services of a full-time dedicated counselor and a full-time classified staff member to run the Center. The Center's staff would have the following duties: – Identify STEM majors and develop database for tracking – Develop contact folder and meet with STEM majors once a semester – Identify potential majors and recruit them – Counsel STEM majors – Assist STEM majors with educational plan, resume, and statement of purpose

Description of SAP Cont'd:	– Coordinate with Institutional Research and Basic Skills offices to identify trends and opportunities – Match STEM majors with faculty mentors for increasing connectivity to college – Identify scholarship, internship, and employment opportunities in STEM fields – Develop "environmental scan" (job market) in LA/OC – Identify, promote, and assist undergraduate research opportunities – Assist STEM majors with applications for scholarships and internships – Update STEM calendar of events – Develop/Maintain/Update STEM website – Manage STEM tutors hiring/scheduling – Assist with tutoring and supplemental instruction – Develop and assist with STEM-experience activities – Act as liaison between STEM programs – Act as liaison with CSU/UC STEM departments – Coordinate STEM seminar series – Develop funding opportunities for STEM – Communicate/market STEM programs to campus and community
Measurable Outcomes anticipated for the SAP:	– Increased number of STEM degrees/certificates – Increased number of STEM majors transferring – Increased recruitment of underrepresented groups to STEM majors – Increased success rate of STEM students – Increased persistence and retention of STEM students – Increased number of students attending tutoring and SI sessions – Creation of a STEM Alumni Network – Increased placement of students in research and internship programs – Increased opportunities for students to participate in community service – Increase the amount of grant money to support student/faculty research opportunities – Greater connectivity and partnerships with area STEM industries – More interdisciplinary coordination among STEM departments
What specific aspects of this SAP can be accomplished without additional financial resources?	This plan is highly dependent on funding and facilities.

Additional financial resources required to accomplish this SAP are identified below:

Type of Resource	Requested Dollar Amount	Potential Funding Source
Personnel	$200,000/yr. ongoing	General Fund
Facilities	$150,000	Measure J Bond or Carryover
Equipment	$10,000	Instructional Equipment
Supplies	-	-
Computer Hardware	-	-
Computer Software	-	-
Training	-	-
Other	-	-
Total Requested Amount	$360,000	

Strategic Action Plan #2

Statement of SAP:	Facilities and faculty for the continued growth of the Chemistry Department, as discussed in Section 3.2.
College Goal(s) and Objective(s) the plan meets:	College Goals: Goal #1: Fullerton College will promote student success. Goal #2: Fullerton College will reduce the achievement gap. Objectives: 1.1: Address the needs of under-prepared students. 1.2: Increase course retention and success. 1.3: Increase the number of degrees and certificates awarded. 1.4. Increase the number of transfers. 1.5: Increase the persistence rate of students. 2.2: Increase the retention rate of Hispanic and African-American students by at least 2%. 2.3: Increase the success rate of Hispanic and African-American students by at least 2%.
Description of SAP:	The continued increase in demand for chemistry courses can only be met through an increase in the number of available lecture and laboratory rooms. Currently, chemistry course (lectures and laboratories) offered in multiple rooms in the 400 Building (412, 414AB, 416A, 416B, 417, 420, 421, 423, 425, 432, 433, 434, 435, 436, 439, 441). In addition to retaining access to these rooms, the Chemistry Department requests the use of an established lecture room (or "portable") and funding for the installation of a portable laboratory in Staff Parking Lot B-2 East. Access to a single lecture room and single laboratory would allow the Chemistry Department to efficiently use existing lecture and laboratory space and serve many more students. Additionally, the Chemistry Department requests additional office space, either in the 400 building (preferable) or elsewhere on campus for the two additional full-time hires starting in fall 2015. Lastly, as discussed throughout this Program Review, the Chemistry Department is continually weakened through the use of adjunct faculty. With the hiring to two faculty members for fall 2015, the Chemistry Department is closer to having enough full-time faculty. However, with the potential for greater growth and future retirements, it is important that an additional full-time faculty hire be granted next year.
Measurable Outcomes anticipated for the SAP:	– Increased number of chemistry courses – Increased student enrollment in chemistry courses – Increased number of students in chemistry program transferring – Increased retention rate of students in chemistry program

Measurable Outcomes anticipated for the SAP Cont'd:	– Increases success rate of students in chemistry program – Increased persistence of students in chemistry program – Increased number of Associate of Arts in Chemistry degrees – Increased number of students attending tutoring and SI sessions
What specific aspects of this SAP can be accomplished without additional financial resources?	With exception to the purchase of a new portable laboratory space and full-time hire, all aspects of this SAP can be accomplished without additional funding.

Additional financial resources required to accomplish this SAP are identified below:

Type of Resource	Requested Dollar Amount	Potential Funding Source
Personnel	$56,764 - $78,254	District
Facilities	$400,000	General Fund
Equipment	-	-
Supplies	-	-
Computer Hardware	-	-
Computer Software	-	-
Training	-	-
Other	-	-
Total Requested Amount	$456,764 - $478,254	

Strategic Action Plan #3

Statement of SAP:	Support for the Chemistry Department laboratories and Chemical Stockroom, as discussed in Section 3.4.
College Goal(s) and Objective(s) the plan meets:	College Goals: Goal #1: Fullerton College will promote student success. Goal #2: Fullerton College will reduce the achievement gap. Goal #3: Fullerton College will strengthen connections with the community. Objectives: 1.2: Increase course retention and success. 1.3: Increase the number of degrees and certificates awarded. 1.4. Increase the number of transfers. 1.5: Increase the persistence rate of students. 2.2: Increase the retention rate of Hispanic and African-American students by at least 2%. 2.3: Increase the success rate of Hispanic and African-American students by at least 2%. 2.4: Increase the persistence rate of Hispanic and African-American students by at least 2%. 3.1: Strengthen partnerships with local feeder high schools and universities 3.5: Increase engagement of the college with the community through college events, community service, and other partnerships.
Description of SAP:	The Chemical Stockroom is an essential component of the Chemistry Department. The Chemical Stockroom is responsible for the procurement and preparation of chemicals for use in the chemistry laboratories, and the maintenance and purchased of equipment that are also commonly used in the chemistry laboratories. Additionally, every community event in which the Chemistry Department is engaged (e.g. National Chemistry Week, Kindercaminata, and Open House celebrations) requires support from the Chemical Stockroom. To ensure that the Chemical Stockroom is capable of providing the Chemistry Department with support required for the courses that are offered and participation in community events, the following resources are required: – Gas Chromatograph, Thermal Conductivity Detector (1 @ $6,517 each) – Refrigerator, Explosion Proof (2 @ $4,130 each) – Flatbed Recorded, GOW-MAC (3 @ $2,858) – Analytical Centrifuge (3 @ $2,562 each) – Abbe 5 Refractometer (1 @ $2,000 each) – Mel-Temp Capillary Melting Point Apparatus (4 @ $1175 each)

Description of SAP Cont'd:	– Corning Heavy Duty Stirrer (2 @ $700 each) – PicoSpin-45 Capillary Cartridge (1 @ $600 each) – Corning Hot Plate (10 @ $461 each) – Class A Burets (60 @ $177 each)
Measurable Outcomes anticipated for the SAP:	– Purchased items (from list above, "Description of SAP") – Increased number of students in chemistry program transferring – Increased retention rate of students in chemistry program – Increased success rate of students in chemistry program – Increased persistence of students in chemistry program – Increased number of Associate of Arts in Chemistry degrees – Increased participation in community events
What specific aspects of this SAP can be accomplished without additional financial resources?	The Corning Hot Plates and Class A Burets can be purchased with Lottery monies. All other items must either be purchased with Program Review or Instructional Equipment funding.

Additional financial resources required to accomplish this SAP are identified below:

Type of Resource	Requested Dollar Amount	Potential Funding Source
Personnel	-	-
Facilities	-	-
Equipment	$54,967	Instructional Equipment
Supplies	-	-
Computer Hardware	-	-
Computer Software	-	-
Training	-	-
Other	-	-
Total Requested Amount	$54,967	

Strategic Action Plan #4

Statement of SAP:	Support to improve student success through a Peer Undergraduate Mentoring Program (PUMP), as discussed in Section 3.1.
College Goal(s) and Objective(s) the plan meets:	College Goals: Goal #1: Fullerton College will promote student success. Goal #3: Fullerton College will strengthen connections within the community. Objectives: 1.2: Increase course retention and success. 1.3: Increase the number of degrees and certificates awarded. 1.4. Increase the number of transfers. 1.5: Increase the persistence rate of students. 3.2 Strengthen partnerships with local feeder high schools and universities.
Description of SAP:	The intent of the Peer Undergraduate Mentoring Program (PUMP) is to improve the study strategies of first-year college students through a student/peer-mentoring program. Through PUMP, selected students of Fullerton College (FC) are given tools to: – Improve retention rates in STEM courses – Improve completion rates in STEM courses – Improve degrees in STEM majors – Improve transfer rates into four-year universities in STEM majors. – Improve student success in STEM post-graduate school and/or STEM careers. The essential elements of the PUMP program include: – Selection of FC STEM students – Selection of California State University, Fullerton (CSUF) STEM mentors – Mentor training workshop – Mentor/Student introduction luncheon – Advisor/Mentor/Student Meetings – Assessment Survey

Description of SAP Cont'd:	Individuals in the PUMP program will have well-defined roles: – FC Faculty Advisor: will provide a training workshop for mentors; is responsible for the initial preparation to start-up the program; will meet weekly with FC students; will meet weekly with mentors; and is responsible for preparation, administration, and program assessment – CSUF Faculty Advisor: will select and invite outstanding CSUF undergraduate STEM students to participate; will meet weekly with mentors; and will collaborate with FC Faculty Advisor regarding meeting preparation and program progress – CSUF Mentors: will meet weekly with FC students; will meet weekly with FC Faculty Advisor; and preparation – FC Students: will meet weekly with mentor; and will meet weekly with FC Faculty Advisor As an estimate of the resource request, one semester of PUMP will require the following effort/time: – FC Faculty Advisor: 32 hours ($55/hour) – CSUF Faculty Advisor: 32 hours ($55/hour) – CSUF Mentor: 60 hours (for each of the approximately 15 mentors, $11/hour)
Measurable Outcomes anticipated for the SAP:	– Pre- and post-surveys of student's perspective on program – Increased number of students in chemistry program transferring – Increased retention rate of students in chemistry program – Increased success rate of students in chemistry program – Increased persistence of students in chemistry program
What specific aspects of this SAP can be accomplished without additional financial resources?	The PUMP program is incredibly dependent on external funding. With exception to funding for the CSUF Mentors, the PUMP program is not currently supported with financial resources.

Additional financial resources required to accomplish this SAP are identified below:

Type of Resource	Requested Dollar Amount	Potential Funding Source
Personnel	$26,840 per year	Office Special Programs
Facilities	-	-
Equipment	-	-
Supplies	$1500 per year	(None Currently)
Computer Hardware	-	-
Computer Software	-	-
Training	-	-
Other	-	-
Total Requested Amount	$28,340 per year	($85,020 for three years)

Strategic Action Plan #5

Statement of SAP:	Support to improve student success in the program: Science Boot-camps, as discussed in Section 3.1.
College Goal(s) and Objective(s) the plan meets:	College Goals: Goal #1: Fullerton College will promote student success. Goal #2: Fullerton College will reduce the achievement gap. Objectives: 1.1: Address the needs of under-prepared students. 1.2: Increase course retention and success. 1.3: Increase the number of degrees and certificates awarded. 1.4. Increase the number of transfers. 1.5: Increase the persistence rate of students. 2.2: Increase the retention rate of Hispanic and African-American students by at least 2%. 2.3: Increase the success rate of Hispanic and African-American students by at least 2%. 2.4: Increase the persistence rate of Hispanic and African-American students by at least 2%.
Description of SAP:	Prior to the start of the academic term, students are invited to participate in intensive review sessions for the CHEM 107, 111A, and 111B courses. The topics covered in these courses include the entry skills and laboratory techniques essential to success in each respective course. Each Science Boot-camp lasts a few days with several hours of instruction each day, providing students with individualized instruction by one or more chemistry instructors. The Science Boot-camps will require a total of 33 hours of instruction per semester, at a rate of $55 per hour: – CHEM 107 (6 hours per semester) – CHEM 111A (9 hours per semester) – CHEM 111B (12 hours per semester) – CHEM 201 (6 hours per semester) The Science Boot-camps will be offered each term (fall and spring) for the next three years, for a total estimated cost of $10,890.
Measurable Outcomes anticipated for the SAP:	– Pre- and post-surveys of student's perspective on program – Increased number of students in chemistry program transferring

Measurable Outcomes anticipated for the SAP Cont'd:	– Increased retention rate of students in chemistry program – Increased success rate of students in chemistry program – Increased persistence of students in chemistry program
What specific aspects of this SAP can be accomplished without additional financial resources?	The Science Boot-camps are dependent on the existence of external funding for the instructor salaries. Although the Science Boot-camps are currently supported through funding from the Office of Special Programs, they would require external funding should the funding through the Office of Special Programs cease.

Additional financial resources required to accomplish this SAP are identified below:

Type of Resource	Requested Dollar Amount	Potential Funding Source
Personnel	$3,630 per year	Office of Special Programs
Facilities	-	-
Equipment	-	-
Supplies	-	-
Computer Hardware	-	-
Computer Software	-	-
Training	-	-
Other	-	-
Total Requested Amount	$3,630 per year	($10,890 for three years)

Strategic Action Plan #6

Statement of SAP:	Expansion of Supplemental Instruction sessions for chemistry courses, as discussed in Sections 3.1 and 5.
College Goal(s) and Objective(s) the plan meets:	College Goals: Goal #1: Fullerton College will promote student success. Goal #2: Fullerton College will reduce the achievement gap. Objectives: 1.1: Address the needs of under-prepared students. 1.2: Increase course retention and success. 1.3: Increase the number of degrees and certificates awarded. 1.4. Increase the number of transfers. 1.5: Increase the persistence rate of students. 2.2: Increase the retention rate of Hispanic and African-American students by at least 2%. 2.3: Increase the success rate of Hispanic and African-American students by at least 2%. 2.4: Increase the persistence rate of Hispanic and African-American students by at least 2%.
Description of SAP:	The Chemistry Department would like to expand and institutionalize Supplemental Instruction (SI) sessions for the CHEM 101, 107, 111A, 111B, 201 courses. Peer (student) facilitators will be identified to lead the CHEM 101 and 107 review sessions, while faculty will lead the CHEM 111A, 111B, and 201 review sessions. Faculty will be responsible for identifying and training students to work as peer facilitators. The majority of the resources required to accomplish this SAP will be used for salaries and training. The remaining resources being requested will be used for the purchase of iPads (with Doceri) to enhance the learning environment and provide for additional online instructional resources.
Measurable Outcomes anticipated for the SAP:	– Pre- and post-surveys of student's perspective on SI – Increased retention rate of students in chemistry program – Increased success rate of students in chemistry program – Increased persistence of students in chemistry program
What specific aspects of this SAP can be accomplished without additional financial resources?	Although the Chemistry Department may be able to rely on funding through the Office of Special Programs, the grant is unlikely to support SI completely. Whereas (Instructional Equipment) funding exists for the purchase of the iPads (with Doceri), there does exists any other funding source for SI.

Additional financial resources required to accomplish this SAP are identified below:

Type of Resource	Requested Dollar Amount	Potential Funding Source
Personnel	$18,240 (for three years)	Office of Special Programs
Facilities	-	-
Equipment	-	-
Supplies	-	-
Computer Hardware	$3588	Instructional Equipment
Computer Software	$384	Instructional Equipment
Training	-	-
Other	-	-
Total Requested Amount	$22,212	

7.0 Long Term Plans

The long-term goals presented in the previous Program Review (2011), were to 1) increase the technology skills of the students in the program and 2) increase both the number of class offerings and number of full-time faculty. As these goals were, the Chemistry Department has identified additional strengths and weaknesses over the last three years that will guide its direction in the next four to six years. Over the next two Program Review cycles, the Chemistry Department hopes to accomplish the following:

1. The Chemistry Department will complete a six-year curriculum review with a proposed start of fall 2016. Where possible, the Chemistry will seek consistency between its curriculum and that offered the Chemistry Department at Cypress College. The six-year review will also include the creation of an Associates of Science degree in Chemistry and should transfer model curriculum be available, the creation of an Associates of Science for Transfer degree in Chemistry.

2. The Chemistry Department will develop a regular assessment cycle for the course- and program-level student learning outcomes (CSLOs and PSLOs). During the last spring term (2014), the Chemistry Department wrote new CSLOs and PSLOs for all courses and the Associate in Arts degree in Chemistry. These CSLOs and PSLOs were approved by the Curriculum Committee and have been introduced into eLumen for future assessments. Integral to future evaluations of the Chemistry Department's strengths and weaknesses will be the assessment of all chemistry CSLOs, particularly those of the general chemistry sequence (Appendix J) and, ultimately, the assessment of the new PSLOs:

    a. Upon successful completion of courses leading to the Associate of Arts degree in Chemistry, the student will be able to demonstrate the use of proper procedures and regulations for safe handling and use of chemicals.

    b. Upon successful completion of courses leading to the Associate of Arts degree in Chemistry, the student will be able to demonstrate the ability to conduct experiments, analyze data, and interpret results, while observing responsible and ethical scientific conduct.

    c. Upon successful completion of courses leading to the Associate of Arts degree in Chemistry, the student will be able to demonstrate knowledge of inorganic chemistry appropriate for general chemistry and have the ability to articulate this chemical knowledge in verbal, written, and/or computational form.

3. The Chemistry Department will continue to grow the number of sections that are offered to meet an increase in demand. Requisite to this long-term plan will be the need for additional lecture and/or laboratory space, and full-time faculty to ensure that students are presented with a high-quality education in chemistry. As discussed in Section 3.2, any continuation in the growth to meet the demand created by interest in STEM (Section 3.4) will require additional lecture and/or laboratory space due to the relative congestion in the 400 Building. Essential to the Chemistry Department is the ability to keep current space that has been allocated to the Department for the courses (sections) that are being offered. As also identified in Section 3.4, any continuation in the growth of the number of sections offered by the Chemistry Department will require an additional full-time faculty hire.

4. The Chemistry Department will continue to engage in and where possible, seek the institutionalization of programs and activities to improve student retention and success. Aside from weekend and summer research projects and bridge programs with local universities (CSUF and UCI), which are supported by external funding, there are a number of student-centered programs the faculty are involved in that requires long-term funding. Many of the chemistry faculty are engaged in programs to improve student performance in the classroom and upon transfer, e.g. Science Boot-camps, SI, and PUMP. These programs are highly dependent on financial support from the Office of Special Programs and will only survive as long as they can be supported by this office. These programs are essential to the improvement of retention and success rates for students in the program and therefore, the Chemistry Department will continue to seek long-term funding through their institutionalization. Additionally, the Chemistry Department would like to see the return of a 400 Building Open House and possibly, "Science Night" as an outreach to the community, increasing both awareness and interest in the sciences.

5. With the development of a Campus STEM Resource Center, it would be appropriate for the Chemistry Department to consider the creation a capstone (research) project that may be completed by students upon graduation with an associate's degree in chemistry and before transfer to a local university such as California State University, Fullerton. In partnership with a local university, students from the program could participate in a summer research project, providing a transition from the community college to the university, while at the same time, providing an opportunity to satisfy undergraduate research requirements.

8.0 Self-Study Summary

The Chemistry Department currently consists of eight full-time faculty, fourteen adjunct faculty, a laboratory clerk and laboratory technician. Since the previous Program Review (2011), the Chemistry Department has seen a significant growth in the number of sections offered. This growth is best represented in the change of full-time equivalent students (FTES); from 2011 – 2014 an increase of 48 FTES (13% increase) was observed, with a predicted growth of 60+ FTES for the 2014 – 2015 when compared to the 2013 – 2014 academic year. The average retention and success rates for the last five years are $83 \pm 4\%$ and $73 \pm 2\%$, respectively, and are within the ranges for the peer institutions selected. Of the peer institutions selected the Fullerton College produced the greatest number of Associate in Arts degree in Chemistry for each of the last five years. With the incredibly high demand for chemistry courses, supported by fill rates of nearly 100%, it is clear that the Chemistry Department is making every effort possible to support the students of Fullerton College.

The faculty members of the Chemistry Department are heavily involved in both professional matters at the Division and College level and activities to further the success of the students. The faculty of the Chemistry Department have assumed roles at multiple levels on the campus: Student Success Committee, Program Review Committee, SLO Committee, Curriculum Committee, and President of the Academic Senate. Additionally, the faculty of the Chemistry Department are engaged in community activities (National Chemistry Week and Kindercaminata) and in several activities supported by the Office of Special Programs: First Year Experience, Supplemental Instruction, Science Boot-camps, and the Peer Undergraduate Mentoring Program. Each of these activities supports the community relations with the campus and the retention, success, and transfer of students in the program. These latter efforts may explain why there is no apparent gender gap, and a Hispanic achievement gap that is less than the State-wide average.

The Chemistry Department has assessed the program-level student learning outcomes (SLOs), completing one cycle for each outcome with the assessment and analysis of the data and implementation of new methodologies. The course- and program-level SLOs have been modified and the new outcomes will appear in eLumen. Assessment of the new course-level SLOs and therefore, program-level SLOs will begin with this term (fall 2014).

The faculty of the Chemistry Department have completed an evaluation of 1) the statistical evidence collected by the Office of Instructional Research, 2) the needs of the Department and Natural Science Division and 3) faculty activities to improve student success. With consideration to the significant growth that has been seen in the last few years, the Department is requesting support for the:

- Creation of a Campus STEM Resource Center
- Facilities and faculty for continued growth of the program
- Laboratories and Chemical Stockroom
- Peer Undergraduate Mentoring Program (PUMP)
- Science Boot-Camps
- Supplemental Instruction

These strategic action plans will improve the chemistry program and will "promote excellence in learning."

Chemistry is a central science. It is an essential component in the education of science, technology, engineering and mathematics (STEM) students while forming the basis for many of the remaining sciences. Chemistry is critically important to all science related curricula in community colleges and higher-level institutions and is fundamental for all students who desire to major in the life or physical sciences, medicine, engineering and other disciplines that require technical knowledge. The study of chemistry stimulates technical and scientific experiences and fosters the development of well-informed scientific citizens in our community. The chemistry program supports and promotes scientific literacy benefiting the community, state and nation. At the same time, chemistry classes require a large amount of available resources which include availability to classroom and laboratory technology, laboratory maintenance, replacement of consumable items (e.g., chemicals) and disposal of hazardous waste. The ability to offer chemistry courses is inherently expensive, but is an essential discipline at Fullerton College that is in need of continual support.

Division Deans' or appropriate Immediate Management Supervisor (IMS) Response Page

☐ *I concur with the findings contained in this Program Review.*

☐ *I concur with the findings contained in this Program Review with the following exceptions (include a narrative explaining the basis for each exception):*

Area of exception:

_____

_____

_____

_____

☐ *I do not concur with the findings contained in this Program Review (include a narrative exception):*

_____

_____

_____

_____

Appendix A: Key Performance Indicator Report 2013 – 2014, Chemistry

Key Performance Indicator	2009-2010				2010-2011				2011-2012				2012-2013				2013-2014			
	Su	Fa	Sp	An	Su	Fa	Sp	An	Su	Fa	Sp	An	Su	Fa	Sp	An	Su	Fa	Sp	An
Course Information																				
Courses Offered	5	9	9	9	4	9	9	9	4	8	9	9	4	8	9	9	4	9	9	9
Sections Offered	8	26	27	61	4	27	27	58	4	23	30	57	4	24	32	60	6	27	32	65
Student Information																				
Majors		135	158	188		165	170	206		138	153	184		150	177	204		156	214	185
New Majors		34	16	50		36	14	50		26	18	44		29	19	48		78	20	98
Enrollments	207	650	666	1,523	102	670	687	1,457	92	560	683	1,335	96	593	745	1,434	139	675	771	1,585
FTES	47	179	176	403	29	186	182	397	25	156	181	363	26	161	199	386	35	174	202	411
WSCH	1,414	5,383	5,283	12,080	865	5,580	5,454	11,900	1,969	4,692	5,442	12,103	2,052	5,285	6,494	13,832	3,177	5,952	6,751	15,880
Program Resources																				
FTE Faculty	3.7	11.5	11.2	26.4	2.1	12.0	11.5	25.6	2.1	11.7	14.6	28.4	2.1	12.2	15.3	29.6	3.0	12.7	14.6	30.3
Program Efficiency																				
Ave Section Size	25.9	25.0	24.7	25.0	25.5	24.8	25.4	25.1	23.0	24.3	22.8	23.4	24.0	24.7	23.3	23.9	23.2	25.0	24.1	24.4
Fill Rate (Census)	104%	101%	100%	101%	102%	104%	107%	105%	98%	99%	96%	97%	102%	101%	98%	100%	98%	107%	104%	104%
WSCH per FTEF	380	468	473	458	419	463	474	465	933	401	374	427	972	434	424	467	1,047	469	462	524
Program Outcomes																				
Degrees Awarded				9				16				27				26				33
Certificates Awarded																				
Transfers				15																
Course Retention Rates																				
Overall	90%	82%	81%	83%	80%	84%	81%	82%	87%	78%	80%	80%	94%	84%	83%	84%	85%	84%	84%	84%
Females	91%	80%	84%	84%	82%	84%	82%	83%	89%	80%	80%	81%	98%	85%	82%	85%	83%	86%	82%	84%
Males	89%	85%	78%	82%	80%	85%	80%	82%	85%	77%	81%	79%	90%	83%	84%	84%	87%	82%	86%	84%
African American	71%	80%	50%	70%	100%	73%	38%	56%	100%	79%	89%	85%	100%	81%	54%	71%	100%	93%	71%	82%
Asian American	92%	85%	87%	87%	85%	85%	81%	83%	95%	82%	84%	85%	95%	88%	89%	89%	91%	89%	89%	90%
Filipino	86%	88%	75%	81%	78%	97%	85%	89%	80%	84%	79%	81%	80%	94%	92%	91%	92%	89%	89%	89%
Hispanic/Latino	90%	78%	76%	78%	74%	83%	82%	82%	64%	73%	75%	73%	96%	83%	79%	82%	82%	82%	82%	82%
Native American	100%	33%	100%	71%	100%	71%	100%	86%	100%	100%	100%	100%		100%	100%	100%		0%	70%	58%
Other Non-White	100%	75%	50%	72%	100%	70%	73%	74%		83%	71%	77%		33%	100%	50%	0%	50%	50%	40%
Pacific Islander	100%	100%		100%	50%		100%	75%		0%	100%	80%		25%	100%	50%		100%		100%
White	91%	82%	85%	84%	84%	84%	84%	84%	94%	77%	83%	81%	100%	83%	82%	83%	86%	80%	83%	82%
Unknown	85%	94%	74%	85%	67%	89%	70%	79%	100%	87%	82%	86%	83%	77%	90%	83%	33%	85%	71%	73%
Course Success Rates																				
Overall	79%	74%	72%	74%	78%	75%	71%	74%	84%	70%	70%	71%	85%	73%	73%	74%	78%	74%	73%	74%
Females	81%	72%	74%	75%	80%	74%	72%	73%	84%	73%	68%	71%	87%	75%	72%	75%	75%	77%	72%	74%
Males	78%	77%	71%	74%	78%	77%	70%	74%	83%	67%	72%	71%	84%	71%	73%	73%	80%	71%	74%	73%
African American	29%	40%	50%	40%	100%	73%	25%	50%	100%	64%	72%	71%	50%	63%	31%	48%	100%	80%	47%	64%
Asian American	80%	78%	77%	78%	85%	77%	78%	78%	95%	76%	75%	78%	89%	79%	80%	81%	88%	76%	85%	82%
Filipino	79%	81%	70%	76%	78%	94%	72%	81%	80%	81%	71%	76%	80%	79%	85%	82%	83%	71%	77%	76%
Hispanic/Latino	79%	69%	65%	68%	70%	73%	67%	70%	59%	63%	61%	62%	89%	70%	66%	69%	70%	72%	68%	70%
Native American	100%	33%	100%	71%	100%	57%	100%	79%	100%	100%	100%	100%		50%	67%	60%		0%	60%	50%
Other Non-White	100%	63%	50%	67%	100%	70%	73%	74%		67%	57%	62%		33%	100%	50%	0%	50%	50%	40%
Pacific Islander	100%	100%		100%	50%		50%	50%		0%	75%	60%		25%	100%	50%		100%		100%
White	81%	75%	78%	77%	80%	74%	74%	74%	89%	70%	75%	74%	77%	75%	74%	74%	79%	74%	73%	74%
Unknown	77%	92%	65%	79%	67%	77%	59%	69%	86%	77%	71%	75%	83%	69%	86%	77%	33%	77%	65%	67%

Appendix B: Retention and Success Data for Fullerton College and Peer Institutions from California Community Colleges Chancellor's Office MIS Data Mart (Fall Term Only)

Retention Data – Fall Terms

	2009	2010	2011	2012	2013
Fullerton College	82%	84%	77%	81%	84%
Los Angeles City College	74%	74%	73%	86%	74%
Modesto Junior College	72%	80%	81%	80%	78%
San Diego Mesa College	85%	85%	85%	90%	88%
Santa Barbara City College	88%	83%	90%	87%	88%

Success Data – Fall Terms

	2009	2010	2011	2012	2013
Fullerton College	74%	74%	75%	68%	68%
Los Angeles City College	65%	65%	63%	63%	77%
Modesto Junior College	57%	51%	55%	58%	60%
San Diego Mesa College	76%	73%	74%	75%	77%
Santa Barbara City College	75%	71%	66%	71%	71%

Appendix C: Total FTES Summary Report for the Chemistry Programs at Fullerton College and Peer Institutions from California Community Colleges Chancellor's Office MIS Data Mart

	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Fullerton College					
Asian	126.49	116.47	70.22	69.83	111.63
African-American	6.82	6.87	5.67	4.33	9.20
Hispanic	102.60	128.39	88.13	90.31	181.32
White Non-Hispanic	121.80	122.19	65.30	56.81	98.08
Unknown	46.23	25.91	11.96	7.45	13.58
Los Angeles City College					
Asian	48.89	50.90	52.50	41.15	46.96
African-American	12.83	17.15	13.12	11.25	14.75
Hispanic	65.10	75.00	90.29	75.60	106.62
White Non-Hispanic	66.01	68.29	79.74	61.10	62.91
Unknown	66.01	68.29	79.74	61.10	62.91
Modesto Junior College					
Asian	25.37	27.09	26.34	23.12	30.63
African-American	3.79	5.42	3.73	3.75	2.47
Hispanic	63.28	75.87	72.53	78.80	107.54
White Non-Hispanic	93.30	87.10	92.46	88.49	106.91
Unknown	62.56	45.14	28.59	20.05	13.05
San Diego Mesa College					
Asian	125.29	133.76	103.23	82.01	94.31
African-American	24.89	25.27	21.67	24.01	24.50
Hispanic	98.09	129.18	126.19	144.07	158.20
White Non-Hispanic	233.80	256.16	218.73	191.74	198.64
Unknown	73.60	57.95	35.86	28.93	16.48
Santa Barbara City College					
Asian	23.47	25.82	23.03	25.88	18.63
African-American	2.87	4.71	3.01	2.96	4.72
Hispanic	62.17	71.56	93.85	97.17	119.30
White Non-Hispanic	141.80	160.16	173.65	162.69	165.48
Unknown	27.52	15.70	8.34	3.02	24.20

Appendix D: Percentage of Total FTES Summary Report for the Chemistry Programs at Fullerton College and Peer Institutions from California Community Colleges Chancellor's Office MIS Data Mart

	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014
Fullerton College					
Asian	29%	27%	27%	28%	24%
African-American	2%	2%	2%	2%	2%
Hispanic	24%	30%	34%	36%	40%
White Non-Hispanic	28%	28%	25%	23%	22%
Unknown	11%	6%	5%	3%	3%
Los Angeles City College					
Asian	20%	20%	19%	19%	18%
African-American	5%	7%	5%	5%	6%
Hispanic	27%	29%	33%	35%	41%
White Non-Hispanic	27%	26%	29%	28%	24%
Unknown	11%	10%	7%	7%	4%
Modesto Junior College					
Asian	10%	11%	11%	10%	11%
African-American	1%	2%	2%	2%	1%
Hispanic	24%	30%	30%	34%	38%
White Non-Hispanic	36%	34%	39%	38%	38%
Unknown	24%	18%	12%	9%	5%
San Diego Mesa College					
Asian	20%	20%	18%	16%	17%
African-American	4%	4%	4%	5%	4%
Hispanic	16%	19%	22%	27%	28%
White Non-Hispanic	38%	38%	39%	36%	36%
Unknown	12%	9%	6%	5%	3%
Santa Barbara City College					
Asian	9%	9%	7%	8%	5%
African-American	1%	2%	1%	1%	1%
Hispanic	23%	24%	29%	31%	34%
White Non-Hispanic	53%	55%	54%	53%	47%
Unknown	10%	5%	3%	1%	7%

Appendix E: Credit Course Retention and Success Rate Summary Report for all Students in California Community Colleges from California Community Colleges Chancellor's Office MIS Data Mart

Retention Rates by Ethnicity – All California Community Colleges, Fall 2009 – Summer 2014

Ethnicity	Average
Overall	82%
African-American	75%
American Indian/Alaskan Native	79%
Asian	85%
Hispanic	79%
Multi-Ethnicity	82%
Pacific Islander	78%
Unknown	82%
White Non-Hispanic	83%

Success Rates by Ethnicity – All California Community Colleges, Fall 2009 – Summer 2014

Ethnicity	Average
Overall	68%
African-American	55%
American Indian/Alaskan Native	63%
Asian	74%
Hispanic	61%
Multi-Ethnicity	69%
Pacific Islander	60%
Unknown	70%
White Non-Hispanic	73%

Achievement Gap by Ethnicity – All California Community Colleges, Fall 2009 – Summer 2014

Ethnicity	Average*
African-American	-13%
American Indian/Alaskan Native	-5%
Asian	6%
Hispanic	-7%
Multi-Ethnicity	1%
Pacific Islander	-8%
Unknown	2%
White Non-Hispanic	5%

* Reported values given are relative to the overall average.

Appendix F: Student Comments – Classroom Use of iPad/Doceri

Students in CHEM 101 Introduction to Chemistry were surveyed following the use of instructional videos produced with an iPad and Doceri software. Of the twenty-two students that viewed the instructional videos, all were surveyed and all found the videos helpful. The following comments represent a sampling of the comments provided by students in the survey:

"Videos on homework help was very efficient and effective."

"The video for the labs were helpful. They communicated what to complete and how to complete it."

"Helpful"

"The videos on helping us work out problems were very helpful."

"Put more videos on You Tube."

"Videos were awesome and helped a lot! Thank you!"

"Yes, very helpful thank you!"

"I found the videos put on the website helpful because it showed every step to get to the answer and I found that helpful because then you can see the process."

"I was able to name the first and second one with the help of your videos which are great."

"I did see the video and understand why the OH and H change to water."

"Hi professor, the videos were helpful."

"By the way, the lecture video you did for part A and part B were very helpful."

"Hello professor, thank you very much for the videos, they helped a lot!"

"Thank you, by the way the video on my course material was extremely helpful. Really grateful for that."

Appendix G: Peer Undergraduate Mentoring Program – Preliminary Data

Statement	Average Rating (0 – 5)
FC faculty advisor provided support throughout the experience.	4.86
I was provided with relevant information from my mentor.	5.00
My questions were answered by my mentor in a timely manner.	4.86
My PUMP mentor could relate to me.	4.43
PUMP has encouraged me to do succeed as a STEM major.	5.00
I learned a lot from this experience.	4.86
I would recommend my peers to become a mentee for this program.	5.00
My mentor had a good attitude throughout the program.	5.00
Communicating with my mentor once per week was sufficient.	4.86
PUMP has had a positive impact on my own academic performance as a STEM major.	4.86
How satisfied are you with PUMP?	4.86
How would you rate your overall experience with your mentor?	5.00

Selected FC STEM student comments:

“I would have been completely lost if it weren't for this program.”

“I find it to be very helpful and I would not know half of the things I have gained if it wasn't for my mentor.”

“Not only am I getting help for educational problems, but it allows me to communicate directly with someone who understands the situation instead of a counselor or teacher.”

“I think this is a great program. I find it to be very helpful and I would not know half of the things I have gained if it wasn't for my mentor. “

“It's helped me become a better student. I enjoy school now.”

“PUMP enabled me to change my perspective of a student’s life - I became more aware of the hard work needed to study/pass a class. “

“It helped me a lot with adjusting to college and most of all organization.”

“This program provided me with a small and connected group of individuals going through the same experiences as me. We all had/have a great amount of support for each other.”

Appendix H: Course-Level Student Learning Outcomes and Assessment Methodology for Courses in Program (Associate of Arts in Chemistry)

General Chemistry I (CHEM 111A)

1. Upon successful completion of CHEM 111AF General Chemistry I, students will be able to 1) apply principles of modern atomic theory to chemical phenomena and 2) use qualitative and quantitative analysis to explain chemical phenomena.

   Assessment Methodology: Common questions or problems. Pre- and Post-testing in sections and/or American Chemical Society (ACS) National Standardized Examination will be administered by all sections and will be assessed based on section by faculty.

2. Upon successful completion of CHEM 111AF General Chemistry I, students will be able to prepare an experiment in a laboratory notebook following scientific protocol.

   Assessment Methodology: Project assessed against a department standard. Rubric common to all faculty for laboratory notebook assessment.

3. Upon successful completion of CHEM 111AF General Chemistry I, students will be able to employ safe and proper handling of chemicals and equipment in the laboratory.

   Assessment Methodology: Common questions or problems. Participation points in laboratory section for safety and proper handling of chemicals and equipment. Lab practicum at the end of the semester.

General Chemistry II (CHEM 111B)

1. Upon successful completion of CHEM 111BF General Chemistry II, the student will be able to recognize patterns, formulate estimates, perform calculations, devise spreadsheets, employ graphical analyses and design web searches to solve problems involving course topics.

   Assessment Methodology: Common questions or problems. Quizzes, tests, research project, final exam.

2. Upon successful completion of CHEM 111BF General Chemistry II, the student will be able to demonstrate competence as an experimentalist, able to conduct laboratory experiments, operate scientific instruments, evaluate data utilizing computer technology and maintain a laboratory notebook.

   Assessment Methodology: Project assessed against a department standard. Rubric common to all faculty for laboratory notebook assessment, lab practicum, written laboratory exams, and identification of laboratory unknowns.

3. Upon successful completion of CHEM 111BF General Chemistry II, the student will be able to employ safe and proper handling of chemicals and equipment in the laboratory.

   Assessment Methodology: Common questions or problems. Laboratory practicum.

Appendix I: Alignment of Course Outcomes (CSLOs) to Program Outcomes (PSLOs)

Template for the alignment of Course-Level and Program-Level Outcomes

	PSLO #1	PSLO #2	PSLO #3	PSLO #4
General Chemistry I, CHEM 111A				
CSLO #1			X	X
CSLO #2		X		
CSLO #3	X			
General Chemistry II, CHEM 111B				
CSLO #1		X		
CSLO #2		X	X	
CSLO #3	X			

Appendix J: New Course-Level Student Learning Outcomes and Assessment Methodology for Courses in Program (Associate of Arts in Chemistry)

General Chemistry I (CHEM 111A)

1. Upon successful completion of CHEM 111AF General Chemistry I, the student will be able to apply principles of modern atomic theory to chemical phenomena.

   Assessment: Common questions or problems. Pre- and post-testing in sections and/or American Chemical Society (ACS) National Standardized Examination will be administered by all sections and will be assessed based on section by faculty.

2. Upon successful completion of CHEM 111AF General Chemistry I, the student will be able to use qualitative and quantitative analysis to explain chemical phenomena.

   Assessment: Common questions or problems. Pre- and post-testing in sections and/or American Chemical Society (ACS) National Standardized Examination will be administered by all sections and will be assessed based on section by faculty.

3. Upon successful completion of CHEM 111AF General Chemistry I, the student will be able to prepare an experiment in a laboratory notebook following scientific protocol.

   Assessment: Project assessed against a department standard. Laboratory notebook assessed using rubric common to all faculty.

4. Upon successful completion of CHEM 111AF General Chemistry I, the student will be able to demonstrate proficiency in assembling basic laboratory glassware, performing fundamental laboratory techniques, making and recording relevant experimental observations and interpreting the results.

   Assessment: Common questions or problems. Participation points in laboratory section for safety and proper handling of chemicals and equipment. Lab practicum at the end of the semester.

General Chemistry II (CHEM 111B)

1. Upon successful completion of CHEM 111BF General Chemistry II, the student will be able to use chemical principles to apply concepts, comprehend course topics, and develop problem-solving skills as described in the course objectives for success in subsequent courses and employment.

   Assessment: Common questions or problems. Pre- and post-testing in sections, common examination questions, and/or American Chemical Society (ACS) National Standardized Examination will be administered by all sections and will be assessed based on section by faculty.

2. Upon successful completion of CHEM 111BF General Chemistry II, the student will be able to demonstrate laboratory skills as described by the objectives for this course for success in subsequent courses and employment through the collection of data in a laboratory setting, analysis and interpretation of data, and communication of subsequent results by composing written lab reports.

   Assessment: Laboratory skills assessed against a course standard and/or rubric common to all faculty for laboratory notebook and/or laboratory skill.

3. Upon successful completion of CHEM 111BF General Chemistry II, the student will be able to employ safe and proper handling of chemicals and equipment in the laboratory.

   Assessment: Common questions or problems. Participation points in laboratory section for safety and proper handling of chemicals and equipment. Lab practicum at the end of the semester.