



Foothill has amazing faculty, staff, administrators, and programs. Program Review is about documenting the discussions and plans you have for sustaining and improving student success in your program. It is also about linking your plans to decisions about resource allocations. Thank you for taking the time to review your program and sharing your findings with the college community!

Program Review Committee Members for 2017-18:

- Administrators { Andrew LaManque
Paul Starer
Teresa Ong
Carolyn Holcroft
- Classified Staff { Craig Gawlick
Jackie Brown
Melia Arken
Elaine Kuo (Ex Officio)
- Faculty { Bruce McLeod
K Allison Meezan;

Let us know how we can help you!

<https://foothill.edu/staff/irs/programplans/index.php>

COMPREHENSIVE INSTRUCTIONAL PROGRAM REVIEW TEMPLATE 2017

BASIC PROGRAM INFORMATION

Department Name:

Division Name:

Please list all team members who participated in this Program Review:

Name	Department	Position
Kathleen Armstrong	Chemistry	Instructor
Richard Daley	Chemistry	Instructor
Mary Holland	Chemistry	Instructor
Londa Larson	Chemistry	Instructor
Sandhya Rao	Chemistry	Instructor
Rosa Nguyen	Chemistry	Instructor
Amanda Pitts	Chemistry	Instructor
Ron Painter	Chemistry	Instructor

Number of Full Time Faculty: **Number of Part Time Faculty:**

Please list all existing Classified positions: *Example: Administrative Assistant I*

Anna Wu - Chemistry Lab Technician
 Sherman Lee - Chemistry Lab Technician

List all programs covered by this review and indicate the program type:

Chemistry	<input type="checkbox"/> Certificate	X AA / AS	<input type="checkbox"/> AD-T	<input type="checkbox"/> Pathway
General Studies-Science	<input type="checkbox"/> Certificate	X AA / AS	<input type="checkbox"/> AD-T	<input type="checkbox"/> Pathway
	<input type="checkbox"/> Certificate	<input type="checkbox"/> AA / AS	<input type="checkbox"/> AD-T	<input type="checkbox"/> Pathway
	<input type="checkbox"/> Certificate	<input type="checkbox"/> AA / AS	<input type="checkbox"/> AD-T	<input type="checkbox"/> Pathway
	<input type="checkbox"/> Certificate	<input type="checkbox"/> AA / AS	<input type="checkbox"/> AD-T	<input type="checkbox"/> Pathway

Not sure? Check: <https://foothill.edu/programs/> and click to sort using the "Areas of study/Divisions" button
 Current pathways at Foothill College include: ESLL, NCEL, ENGL pathways (ENGL 209-110-1A; ENGL 209-1A; ENGL 1S/1T); MATH pathways (NCBS 401A/B; MATH 235-230-220-105; MATH 217-57).

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SECTION 1: PROGRAM ENROLLMENT, PRODUCTIVITY, AND COMPLETION

Data for certificates and degrees will be posted on Institutional Research’s [website](#) for all measures except non-transcriptable completion.

1A. Analysis of Transcriptable Program Completion Data: Please use your data to complete the following table.

Transcriptable Program	Five-year trend in degrees/certificates awarded	Comments
e.g. Associate Degree for Transfer	The number AD-Ts awarded has been steadily increasing each year, up to a high of 39 degrees awarded in 16-17	We are pleased to see this trend and believe it will continue as more students pursue AD-Ts
Associate in Science-Chemistry	4 in '12-'13, 0 in '13-'14, 2 in '14-'15, 6 in '15-'16, 3 in '16-'17 Total in past 5 years: 15	We are pleased to see an increase in students receiving an AS degree in Chemistry, since our courses are generally in support of students pursuing other degrees or transfer.
Associate in Science-General Studies: Science	20 in '12-'13, 17 in '13-'14, 35 in '14-'15, 24 in '15-'16, 31 in '16-'17 Total in past 5 years: 127	We are pleased to see an increase in students earning a AS degree.

*according to CCCApply data

1B. Non-Transcriptable Program Data: If your program offers any non-transcriptable programs, please complete the following table. Institutional Research does not track this data; each program is responsible for tracking its own data.

Non-Transcriptable Program	Comments	Five-year trend	Rationale for program
e.g. Certificate of Proficiency in xx	We anticipate that this trend will continue because enrollment in the core classes for this certificate is holding steady	The number of completers has remained steady at around 9 per year	This credential boosts potential for job advancement in the xx industry. We receive positive feedback from employers (link to advisory committee minutes)
N/A			

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The 2017-18 College Strategic Objectives (E²SG) operationalize the college's 3 EMP goals and include:

Equity– Develop an integrated plan; identify goals for alignment with equity, student success, and basic skills; and focus on efforts to integrate with enrollment strategies (access, retention, and persistence) to close equity gaps while increasing enrollments at the same.

Enrollment Growth – Achieve more than 1.5% FTES growth at 500 productivity (+/- 25) with attention to integrating equity efforts related to enrollment, CTE, and Sunnyvale Center.

1C. Course Enrollment: Enrollment is a count of every student who received a final grade (A, B, C, D, F, P, NP, W) in your program's courses. It also serves as an indicator for program viability. Please use your program review data to examine your course enrollment trends and check the appropriate box below.

The link to the program review data tool can be found on the Employee tab of the portal: myportal.fhda.edu (Program Review Application).

5-year Enrollment Trend: Increase Steady/No Change Decrease

Our college goal is to increase enrollment by 1.5% FTES this year. What steps might you take to increase the numbers of students enrolling in your courses? Steps might include cross department collaborations, actions to increase retention, service learning projects, support for student clubs, participation at recruitment events, examination of pre-requisites, review of assessment results, etc.

Our enrollment steadily increased from 2012-2013 to 2015-2016 with a decline between 2015-16 and 2016-17 academic year. Our 5-yr % Inc is 4.9%.

2013-14: 3201

2014-15: 3144 (-1.78%)

2015-16: 3176 (+1.02%)

2016-17: 3243 (+2.10%)

Steps to increase enrollment:

1. Homeschool/Dual Enrollment

Participate in recruitment events with homeschool and dual enrollment students. We have a unique opportunity to work with these populations, as many students are looking to fulfill their GE requirements (Chem 25 or 30A) or take our courses in substitution of an AP course (General Chemistry). Our department currently offers Chem 25 at Eastside prep during late spring/early summer session.

2. Online Courses

Beginning Winter '18 we will begin to offer **Chem 30A** as a hybrid course. We are also looking to serve students who work, have challenges to get to campus, or prefer to learn through an online medium. Our hope is that we will be able to capture the students who would have taken a Saturday class.

3. Multiple Measures for Chem Placement

The math department is working with the testing center to use a state validated Multiple Measures placement to place students into Math classes. Since Math 220 (Elementary Algebra) and 105 (Intermediate Algebra) are prerequisites for some Chemistry courses, our department have agreed to accept the Math Multiple Measures placement for Chemistry. This does not substitute for the Chemistry placement exam into Chem 1A, it only allows for students to take Chem 25 or 30A if they meet the Math Multiple Measures for placement. Our department is hopeful that by removing barriers in placement it will allow for more students to take our introductory level courses.

4. Increase Retention/Review of Chem 25-Chem 1A-Chem 1B Pathway with Equity Researcher

The population of latino and african american students has grown in our college, and we have observed the same growth in the Chemistry department. We sought to examine data to better understand our student populations by looking at success and persistence rates in Chem 25-Chem 1A-Chem 1B sequence in order to close the achievement gap in our department, and improve access.

Initial findings found that only 42% of Chem 25 completers enrolled in Chem 1A at Foothill. These numbers are surprising since it indicates a non-trivial number of students not persisting through the chemistry sequence. It is not clear how many of the missing students are not required to take CHEM 1A, but since this course is intended as a pre-requisite to CHEM 1A, the number may represent students who are shifting their focus away from STEM. If we can retain these students and help them persist, it would make a positive impact on enrollment in our courses. The study also found that 55% of students who did not pass Chem 25 on their 1st attempt stopped taking Chem 25, while 47% of students stopped taking Chem 1A after not passing on their 1st attempt. We would also increase our enrollment if we can

1. Increase the success rates among this population of students or
2. Identify the reasons that caused non-success, address them and encourage students to retake a course under different circumstances.

5. Pathways/ Improved Scheduling

Our department continues to work with the Biology department to prevent overlap between our course offerings. We are looking to use data from Institutional Research to learn more about the pathways our students take to achieve transfer. An early report from IR show students are concurrently enrolled in Chem 12A with Bio 1B and Phys 2A which is not the pathway recommended historically. We would like to provide students with a year-long schedule so they can plan their schedules accordingly. We intend to work with other departments to prevent overlap in course offerings.

6. Support for student clubs

Faculty in our department serve as advisors for the Foothill American Chemical Society Club, and the Future STEM leaders of America Club.

1E. Productivity: Productivity is a measure of students served per full-time equivalent faculty and is a factor in program viability. Please use your program review data sheet to examine your productivity trends and check the appropriate box below.

5-year Program Productivity Trend: Increase Steady/No Change Decrease

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The college productivity goal is **500 (+-25)**. There are many factors that affect productivity (i.e. seat count/facilities/accreditation restrictions, curriculum, etc.). Please discuss factors that may be affecting your program's productivity trends and any plans you have for addressing the trends, especially if they are declining.

2012-2013: 476

2013-2014: 465

2014-2015: 466

2015-2016: 455

2016-2017: 456

(-4.1% over 5 years)

The seat counts in Chemistry classes are limited to the lab space available, which are in turn determined by safety considerations. With that in mind, we are always evaluating ways to increase our productivity. A few changes we have made since the last cycle to increase productivity are:

1. Cancellation of Saturday Course Offerings

Our department began offering Saturday courses in 2014-2015 to accommodate our working students, which reflected in growth of our program. Since those sections are typically single sections, offering them have decreased our productivity. With this in mind, coupled with the cost of additional staffing requirements needed for these offerings, we have cancelled our Saturday courses beginning Winter 2018.

2. Cancellation of Single Sections

Our department plans to offer fewer single sections in hopes of increasing our productivity.

SECTION 2: COURSE COMPLETION & STUDENT ACHIEVEMENT

2A. Institutional Standard: This percentage represents the lowest course completion (success) rate deemed acceptable by the College's accrediting body (ACCJC). The institutional standard during the year for which this program review is being written (2016-17) is **57%**.

Please check the appropriate box:

Program Level Course Completion: **X Above Standard** At Standard Below Standard

If your program's course completion (success) rates are below the institutional standard (see above), please discuss your program objectives aimed at addressing this.

2013-14: 71%

2014-15: 67%

2015-16: 69%

2016-17: 71%

Our program completion rates are above the institutional standard.

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2B. Institutional Effectiveness (IEPI) Goal: This percentage represents an aspirational goal for course completion (success) rates; all programs should strive to reach/surpass this goal. The IEPI goal for which this program review is being written (2016-17) is **77%**.

Please check the appropriate box:

Program Level Course Completion: Above Goal At Goal **X Below Goal**

If your program's course completion (success) rate is **ABOVE** the IEPI goal, please share your thoughts about why/how this is so (we hope to learn from your effective practices!).

N/A

2C. Course Success Demographics: Please examine the "Disproportionate Impact data by year" shared with your department and discuss actions you are taking, or plan to take, to address any achievement disparities identified in your program. If you are uncertain about actions faculty can take, please take a look at Appendix A.

<https://foothill.edu/staff/irs/programplans/docs/appendix-a.pdf>

The achievement gap for Chemistry is significant (58% success rate for targeted group versus 74% for others). This is a 9% increase over last year, correcting a downward trend noted in last year's Program Review. On average over the past five years, the achievement gap stands at 18%, with non-targeted success rates in Chemistry averaging 73±1%, compared to targeted success rates of 55±3%. This is reflective of a disparity between Baccalaureate degrees awarded nationwide. (NCES)

Our department was surprised to see that the Decline to State group has the highest success rates in Chem 25 and Chem1A. Faculty agreed that it would be worthwhile to understand the characteristics of this group and what contributes to their success.

While the gap remains a major priority for the Chemistry department, the 9 percent increase in targeted student success over last year is an encouraging change. The Chemistry department is engaged in a number of activities that are aimed at addressing the achievement gap and improving success for all students. These include: (1) implementing active learning practices, (2) reworking written materials including syllabi, (3) encouraging a growth mindset (4) incorporating student feedback to improve communication and inclusion of all students, (5) adopting alternate assessment strategies, and (6) offering regular workshops outside of class.

Active learning practices have been demonstrated to address the achievement gap by benefiting those students at the bottom- half of the grade distribution the most. "We find that exam performance in the two sections (*traditional vs active*) is statistically different only for the bottom third, as measured by pretest score or percentile rank; here improvement was seen in the flipped class across all five exams. Following this trend was a significant (56%) decrease in DFW percentage (Ds, Fs, withdrawals) in the flipped courses as compared with the control." (Michael D. Ryan and Scott A. Reid, *J. Chem. Educ.* 2016, 93, 13–23). Full-time faculty in the Chemistry department are working on increasing active learning in all of our courses. We are engaged in Professional Development to help us in that effort, and will continue to put energy into improving the implementation of this valuable pedagogical approach. All eight full-time faculty employ group work as a regular practice during their class time.

Chemistry faculty have made smaller changes in their course design as well. Several report adopting new language in their course syllabi meant to encourage participation, reduce fear and eliminate the possibility of

perceived bias. Many Chemistry faculty explicitly discuss the importance of adopting a growth mindset with their class, and most solicit feedback from students as a means of assessing their understanding and in an effort to reach even the most reticent of students. For example, FT Chemistry faculty member Ron Painter regularly solicits student feedback in individual blue-books that he distributes to students at the start of the quarter. Others distribute surveys or collect and grade in-class problem sets. Chemistry faculty understand the importance of multiple assessment measures, and while examinations remain a dominant form of grade assessment, most courses have reduced the weight of their exams, and have increased the weight of point rewards for homework and class participation. In addition, Chemistry exams are written with a wide range of question styles, and are generally lower stakes than they were in the past, with most faculty offering several quizzes and exams throughout the quarter, lessening the pressure associated with a given exam, and giving students multiple opportunities to show what they know.

Several Chemistry faculty hold workshops in addition to scheduled office hours. As PT faculty member Brendan Mar writes, "conducting or arranging regular workshops, typically adjacent to class time, for students to get extra practice with course material, helps to ensure that they are not falling behind. The success rates of students who attend the workshops has generally been quite good, with several students ultimately passing who I strongly suspect would have ended up withdrawing if they had not attended."

We are also working to develop a sense of community within our classroom and within our department by encouraging inclusive group interactions and facilitating study groups. We have supported our students in the formation and growth of an American Chemical Society Student Affiliate club, which in turn collaborates with a number of other clubs on campus. FT Chemistry faculty member Kathleen Armstrong and Chemistry Lab Technician Sherman Lee serve as club advisors to this vibrant group. Along these lines, the Chemistry department plans to offer Chem 25 as part of the STEM Core learning community. STEM Core program is focused on expanding the pipeline of students for engineering and computer science careers. Since Chem 25 and Chem 1A are requirements for most engineering and computer science majors it would be a good fit for our department.

In an effort to improve success and narrow the achievement gap, FT Chemistry faculty have engaged in a number of professional development activities as outlined below:

1. Faculty Learning Group

In collaboration with Prof. Amy Strage, Director of the Center for Faculty Development at SJSU, FT Chemistry instructor Kathleen Armstrong participated in a three-semester discussion group which aimed to address Active Learning strategies in higher education STEM classrooms. Kathleen was able to plan and implement some of the strategies discussed into her CHEM 12 classroom.

2. Foothill Faculty Teaching and Learning Academy

Full-time Chemistry instructor Rosa Nguyen participated in the 2-week intensive Foothill Faculty Teaching and Learning Academy. The FTLA program encourages the development of institutional cultures and environments that are learning-centered and technologically advanced. She will continue to be apart of the cohort in the 2016-2017 academic year. The training included a syllabus redesign, teaching philosophy statement, first day welcome video, reading apprenticeship, culturally responsive pedagogy, peer teaching observations and reflections, and a student service project.

3. Reading Apprenticeship Workshop

Sandhya Rao attended a 3-day Reading Apprenticeship Workshops in order to be trained on how RA can be employed to help students engage more with the text. Sandhya has implemented different reading apprenticeship techniques in lab.

4. Stanford PFP Mentoring Program

During the Winter and Spring of 2016, Kathleen Armstrong participated in a mentoring program offered through Stanford's graduate program aimed to match aspiring faculty in STEM fields with experienced faculty at Foothill College, San Jose State University, or the University of San Francisco. Amy Calgaro, a Stanford fourth-year PhD candidate in Chemical Engineering, joined Kathleen's Organic Chemistry class. This program is not merely beneficial to the mentee. Ms. Calgaro enlivened classroom discussions by delivering short application-based modules relevant to the course material and by addressing individual questions during groupwork.

5. Student Equity Workgroup Grant

As part of a Student Equity Workgroup grant, FT instructors Sandhya Rao and Rosa Nguyen completed a literature review on chemistry curriculum, researched other programs, conferences and workshops. We presented to Student Equity Workgroup suggestions for program-level, curriculum, and classroom changes that can be implemented the current and future academic years.

6. Collaboration within and with other Divisions

Members of the chemistry department attend Annual Biology Teaching and Learning Summit to learn more about the active learning techniques that the biology department employs in their classes. Some of the strategies that were discussed include: becoming familiar with financial aid services to help students obtain textbooks; allowing time in class to read/reflect on a mindset article; switching lab groups/partners during lab time; and a syllabus redesign. By meeting with other departments that share the same student population we can discuss and put in effect techniques that help the success rates in both disciplines.

7. Equity Professional Development Activities

Rosa Nguyen participated in courageous conversations Part 1 and 2 in order to learn the skills necessary to learn about and communicate the issues that face under-represented, first generation college students at Foothill College. Rosa also attended Integrating Cultural Competence into Instruction, Assignments & Assessment, Northern California Equity Institute and the RP Group Student Success Conference to learn more about statewide equity initiatives.

Beyond professional development, the chemistry department is making a number of changes to its introductory Chemistry courses. Data solicited by the Chemistry department from Institutional Research has revealed that the success gap is greatest for the introductory courses. The gap narrows as the students progress through the course sequences, but that is largely a reflection of the fewer numbers of targeted students in the higher level courses. The success gap in Chem 30A (which is as high as -20%) is the highest amongst the courses offered in the department. This has prompted faculty to take the following actions:

1. Improved communication with students

Many of the students in the introductory courses (Chem 25 and Chem 30A) are recent high school graduates and may be unable to manage the challenges and expectations they encounter at college. In order to ensure success in our course and beyond, some faculty write emails/newsletters/slides that provide tailored guidance on what to do after each lecture. Tips on improving study and time management skills are incorporated in these communications with students to develop skills that can be transferred to their other courses.

All FT Chemistry instructors provide customized websites which allow students to access all relevant course documents, the slides presented in class, review and practice worksheets targeted to specific skills and links to useful video tutorials and other web resources.

2. Classroom changes in Chem 30A and Chem 30B

The course curriculum in Chem 30A include syllabus redesign, implementation of active learning, growth mindset, and stereotype threat exercises. Instructors have re-evaluated grading policies to allow for authentic assessment and give students opportunities to demonstrate growth and improvement. On the first day of Chem 30A lab, students are invited to a walking tour of the foundations lab, TLC, and Stem Center. Later in the quarter financial aid is invited to present to students and answer any questions.

3. Embedded Tutors in Chem 1A and 30A

The chemistry department worked with with Eric Reed at the STEM Center to provide embedded tutors in some Chemistry 1A and 30A classes in order to provide more peer student support in the classroom and at the STEM Center.

4. Chem 1A Final Review Session

The chemistry department worked with STEMWay to hold a final exam review to be held at the end of every academic quarter. These review sessions are similar to Calculus 1A sessions held in the Math department. The review sessions are used to build community amongst all Chem 1A students since many of them are currently in the same class or might be enrolling in the same Chem 1B/1C courses in the future. The review sessions provides an opportunity for students work in a collaborative group-learning environment and for students to see course material presented by a different instructor.

Further actions that our department plans to take in the next few years falls in the following two categories: curriculum/program development and professional development

1. Program development

The Chemistry Department wants to create a culture of equity that will promote student success, particularly for the targeted groups that are forming a larger percentage of our chemistry enrollment. Our department recognizes that many of these students have numerous family or work responsibilities that may limit their study time. Because of this constraint on their time, we would like to provide special support for these students within the structure of our courses in order to make a definitive impact and tie student support structures directly to the faculty teaching the course.

1a. Curriculum Development in Existing Courses

The "Atoms First" approach to teaching chemistry has been integrated into general chemistry sequence this academic year. We have migrated to a new textbook that specially teaches to this style of learning and have had great success with the implementation. Oral feedback from the students has been overwhelmingly positive. Students have commented that they understand the underlying concepts of chemistry more and therefore are memorizing less and truly learning more. Due to this change in our core curriculum in Chemistry 1A we believe that our success rates will increase throughout the year while our achievement gap will shrink.

1b. Develop a corequisite course to Chem 25

For Chem 25, special sections which require mandatory co-requisite in a supplementary problem solving and remedial skills course (envisioned as P/NP grading and taught by the section instructor) are being explored. The supplemental course will need to be developed and approved through the curriculum process, which will require substantial faculty time.

1c. Develop a 2-quarter Chem 25 course

We are also considering whether it would be potentially beneficial to develop a 2-quarter general chem preparatory course taught at slower pace to focus on basic, critical thinking and mathematical skills necessary to be successful in the chemistry sequence.

1d. Introduce Chemistry Modules developed by FT Chemistry instructor Londa Larson meant to support STEM major preparation in CHEM 1A and 1B.

A series of teaching modules has been developed using Canvas for Chemistry 1A and 1B. Each module contains a quiz to assess the readiness/mastery of essential skills. Each quiz consists of a series of targeted questions. Once the student submits a quiz, they are provided with feedback. The feedback informs the student which questions they answered correctly, which ones were answered incorrectly, and what the correct answers are. In addition, hints, explanations, or step-by-step video lessons are provided within each module for questions that are answered incorrectly; these are intended to help the student master the material.

These Modules include:

A. Preparatory Skills for CHEM 1A

(Math Review (algebra skills), Percent and Proportions, Graphing (linear and non-linear functions) Metric System and Dimensional Analysis, The Periodic Table, Simple Stoichiometry)

B. Mastery of essential Chemistry 1A skills (Solution Concentration, Dilution, Advanced Stoichiometry, Solution Stoichiometry)

C. Preparatory Skills for CHEM 1B (Initial readiness for the course:, Solution Concentration, Dilution, Advanced Stoichiometry, Solution Stoichiometry)

D. Mastery of essential Chemistry 1B skills (Intermolecular Forces, Equilibrium, Acid/Base Equilibrium, Acid/Base Properties of Salts, Chemical Kinetics, Thermodynamics)

The project is ongoing and still under development, with further topics that need to be included. Also still undetermined is the logistics around how the modules will be delivered (ie as mini-courses or other).

1e. Teaching courses in sequence

Encourage faculty to teach 2 classes in sequence at the same time every quarter (Chem 25 to Chem 1A, or Chem 1A to Chem 1B) to develop a more meaningful relationship with students and build community among students.

2. Professional Development

The chemistry department understands the importance of professional development's role in a instructor's lifelong growth and improvement. We acknowledge that in order to close the achievement gap we need to think about what we can do differently in the classroom then what we have done in the past.

2a. Active Learning in Classroom

We will continue to look for professional development opportunities that are equity-focused. Faculty will continue to explore strategies that will nurture an inclusive atmosphere and community in the classroom with collaboration and active learning.

2b. New Model for Mentoring of Part-Time Faculty

In the past our faculty have mentored PT faculty in an informal manner related to the program the PT faculty is teaching. Our department would like to present a new idea to develop a non-credit teaching course for our PT faculty to participate in. The course can be similar to previous PSE courses offered through our division. FT faculty members interested in working with PT faculty can be compensated for teaching the course, and use it as an opportunity to mentor PT faculty. PT faculty would be exposed to effective practices for increasing student success and compensated for their time and participation.

Be sure to include the resources you need to implement or sustain your action plans in Section 3.

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2E. Faculty Discussion: Course-Level Outcomes: Please share examples of how assessment and reflection of course-level Student Learning Outcomes (CL-SLOs) has led to changes in curriculum or teaching.

Chem 1A/1B/1C (General Chemistry)

Three years ago discussions about how students can understand key chemistry topics on a deeper level began. The faculty saw a disproportionate number of students that were continuing to struggle with basic, qualitative, chemistry topics even while they progressed through the general and organic sequences. As this discussion grew, FT faculty members Richard Daley and Amanda Pitts developed a plan to move to an "Atoms First" curriculum in the general chemistry sequence. The department has now made the change and fully implemented this style of teaching chemistry in our general chemistry sequence. As the students move through this academic year and proceed into the organic sequence we will be able to analyze their understanding and retention of key concepts and be able to adjust the curriculum as necessary.

Chem 25

In Chem 25, more resources for review and practice have been made available to students on the course website. Additionally, more in class activities have been incorporated to increase student engagement during lecture. In lab, in person real-time feedback and correction to lab partners on each lab has been established rather than detached collection and grading of papers.

Chem 30A/30B

Students are given many opportunities to demonstrate learning throughout the quarter. In Chem 30A we use various forms of assessment for SLO that include postlab assignments, homework and in class active learning assignments. Reflection of SLO have changed the grading criteria in Rosa Nguyen's Chem 30A to reflect what she values in the course.

Brendan Mar a PT instructor who has taught Chem 30A reflects "I tend to view SLOs as a reminder of the broad aims of teaching a particular course, beyond the specific details of the immediate course content. They provide, for instance, an impetus to be intentional about presenting material in a way that emphasizes the development of transferable reasoning skills, rather than simply the mastery of specific information sets for their own sake. I can't necessarily point to specific objectives as the precise causes of particular changes in my overall approach, but rather the objectives as a whole help me to remember to consider the courses I teach in the context of the broader educational goals of the college for its students, rather than in isolation."

CHEM 12A/12B/12C (Organic Chemistry)

Students completing Organic Chemistry courses must exhibit laboratory skills, and yet these are hard to assess using our existing assessment instruments. A review of our laboratory-related SLO's led faculty to make a number of changes in the laboratory component of the courses. For example, faculty increased the point allocation for laboratory work at the expense of laboratory written examinations. In addition, laboratory examinations now include a greater number of questions that require students to identify the error in a procedure, or in the set-up of an apparatus. Greater emphasis is now given to having students analyze and identify the rationale behind experimental design.

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2E. Faculty Discussion: Program-Level Outcomes: Please provide examples of what is being done at the program-level to assist students in achieving your Program-Level Learning Outcomes, degree/certificate completion, and/or transferring to a four-year institution (e.g. review of progress through the program, “career days”/open houses, mentoring, education pathways (clear, structured academic program maps (suggested courses for each term) for all academic programs), etc.). If your program has other program-level outcomes assessments (beyond SLOs and labor market data), discuss how that information has been used to make program changes and/or improvements.

Our Program-level outcomes center around enabling students to apply the skills they learn during our course sequences to any future endeavor, although they are defined as Outcomes for Chemistry AS degree recipients. Faculty in Chemistry do the following to encourage achievement of the Program-Level Outcomes:

1. Communication between General Chemistry and Organic Chemistry instructors those skills that must be reinforced for success at the higher level.
2. Scheduling courses with common enrollment patterns (e.g. in Biology or Physics) in mind.
3. Contribute to Division-wide activities aimed at supporting and encouraging community among our students (e.g. STEM DAY, S-STEM Scholars, STEM Social, Club advisors)
4. Evaluate and continually update our courses in order to ensure that our course-level outcomes are being met, since our success as a Program can be limited by the weakest elements in our course sequence.
5. Promote opportunities for our students by disseminating information about internships, conferences and student seminars.
6. Support the FACS Chemistry club and its activities (e.g. National American Chemical Society meetings, field trips to Lawrence Berkeley Labs, NASA, SLAC National Accelerator)

**Please attach Course and Program-Level Outcomes (Four Column Report from TracDat).
Contact the Office of Instruction if you need help.**

If your department has a Workforce/CTE program, please complete Section 2F.
If your department does not have a Workforce/CTE program, please skip to Section 3.

2F. Workforce/CTE Programs: Refer to the program review [website](#) for labor market data.

What is the regional five-year projected occupational growth for your program?

N/A

What is being done at the program-level to meet/adjust to the projected labor market changes?

N/A

What is being done at the program-level to assist students with job placement and workforce preparedness?

N/A

Be sure to include the resources you need to implement or sustain your action plans in Section 3.

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SECTION 3: SUMMARY OF PROGRAM OBJECTIVES & RESOURCE REQUESTS

3A. Past Program Objectives: Please list program objectives (not resource requests) from past program reviews and provide an update by checking the appropriate status box.

Introduce Math Workshops	Year: 16-17	Completed	Ongoing	No Longer a Goal
Develop Online teaching Modules	Year: 16-17	Completed	Ongoing	No Longer a Goal
Provide students exposure to hands-on experience with key Instrumentation and Software; maintain existing instrumentation	Year: 16-17	Completed	Ongoing	No Longer a Goal
Ensure quality of Laboratory Experience by updating and Purchasing New Equipment	Year: 16-17	Completed	Ongoing	No Longer a Goal
Curriculum Development in Existing Courses	Year: 16-17	Completed	Ongoing	No Longer a Goal
Improve Pedagogical Discussion	Year: 16-17	Completed	Ongoing	No Longer a Goal
Develop Chemistry Honors Courses for Science Majors	Year: 15-16	Completed	Ongoing	No Longer a Goal
Adaptive Learning Homework Systems in General and Introductory Chemistry	Year: 15-16	Completed	Ongoing	No Longer a Goal
Include Embedded Tutors in Chem 1A	Year: 15-16	Completed	Ongoing	No Longer a Goal
Adopt Atoms-First Approach in General Chemistry	Year: 15-16	Completed	Ongoing	No Longer a Goal

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Study of Chemistry Placement Exam effectiveness and possible improvements	Year: 15-16	Completed	Ongoing	No Longer a Goal
Student Equity Discussion and Development of Programs	Year: 15-16	Completed	Ongoing	No Longer a Goal
Improve Safety in the laboratory	Year: 15-16	Completed	Ongoing	No Longer a Goal
Bring % Full-time faculty close to compliance (currently at 38%)	Year: 15-16	Completed	Ongoing	No Longer a Goal
Update spectroscopic capabilities in general chemistry and organic chemistry labs	Year: 15-16	Completed	Ongoing	No Longer a Goal
Improve thermodynamic experiment capabilities	Year: 15-16	Completed	Ongoing	No Longer a Goal
Improve lab safety by stocking drawers with appropriate eye protection and providing sanitation capability	Year: 15-16	Completed	Ongoing	No Longer a Goal
Develop Research Methods Integrative Laboratory Course	Year: 15-16	Completed	Ongoing	No Longer a Goal
Saturday Chemistry Classes	Year: 14-15	Completed	Ongoing	No Longer a Goal
Maintain existing high standards of laboratory experience	Year: 14-15	Completed	Ongoing	No Longer a Goal
Create Honors Course offerings	Year: 14-15	Completed	Ongoing	No Longer a Goal

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Introduce research experience to advanced students prior to transfer	Year: 14-15	Completed	Ongoing	No Longer a Goal
Improve consistency of course standards and assessment results among full and part-time faculty	Year: 14-15	Completed	Ongoing	No Longer a Goal

Please comment on any challenges or obstacles with ongoing past objectives.

New Curriculum

We have developed 3 new courses (Chem 9, Chem 20 and Honors Chemistry) to broaden appeal and meet the needs of students campuswide. Enrollment in those courses is a continuing challenge as we are unable to meet enrollment and productivity goals for these courses. We need to better understand how to communicate our course offerings to students in a relevant timeframe to influence their enrollment decisions.

Chemistry Modules:

As described above (Section 2C), a series of teaching modules has been developed in Canvas for Chemistry 1A and 1B. A challenge that is being faced in implementing this project is technical support on how best to provide storage of and access to the instructional videos. Technical needs and advice have been asked for and discussed with Foothill's support services, with no tangible results thus far.

Maintain existing standards of laboratory experience:

Maintaining our existing instrumentation continues to be a challenge for the Chemistry department. Chemistry has not been given maintenance contracts for our more complex instrumentation, nor have they been granted a budget to deal quickly with problems as they develop. While we have mostly been granted resources to fix essential instruments when they break, the existing approval process means long delays. In addition, faculty are finding it increasingly difficult to find time to devote to troubleshooting problems with instrumentation even when there are maintenance issues that are within their control.

Please provide rationale behind any objectives that are no longer a priority for the program.

Saturday classes did not receive sufficient enrollment as to justify the additional cost inherent in running them (i.e. additional laboratory technician staffing)

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3B. Current Program Objectives and Resource Requests: Please list all new and ongoing program objectives based on discussion in Sections 1 and 2, including your objectives to eliminate any achievement disparities in course success for student subgroups (Section 2A). If additional resources are needed, indicate them in the table below. Refer to the Operations Planning Committee (OPC) [website](#) for rubrics and resource allocation information.

Resource Request	Program Objective	Implementation Timeline	Progress Measures	Resource Type Requested*	Estimated cost
	<i>Example: Offer 2 New Courses to Meet Demand</i>	<i>Winter 2016 Term</i>	<i>Course Enrollment</i>		
Annual Equipment Budget	Provide students exposure to hands-on experience with key Instrumentation and Software; Maintain quality of Laboratory Experience	This is an ongoing request and is a top priority for the Chemistry department	Program Level Learning Outcomes met	Ongoing B-budget	\$2000
Maintenance Contract for GCMS	Provide students exposure to hands-on experience with key Instrumentation and Software	Winter 2018	Exit survey to graduating students; Program Level Learning Outcomes met	Ongoing B-budget	\$1100 (assuming a single visit)

*Resource type should indicate one of the following: One-time B-budget; Ongoing B-budget augmentation; Facilities/Equipment; New faculty/staff.

3C. Faculty/Staff Position Requests: Please describe the rationale for any new faculty or staff positions your program is requesting:

None

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3D. Unbudgeted Reassigned Time: Please list and provide rationale for requested reassign time.

Permanent Chemistry Chair/ Coordinator position

Coordinator position formally reinstated to ensure adequate attention to essential administrative departmental needs. Operationally, the chemistry program is struggling because full-time faculty have committed extra time to fulfilling administrative roles for the department without adequate compensation or release time. These duties include course scheduling, course coordination, hiring of adjunct faculty, and coordination of department activities such as meetings and program reviews. Historically speaking, the administrative demands within the department have increased over the last several years: more in-depth program reviews and the oversight of SLO activities are now required, the chemistry program has grown substantially, and so there is now more time required for scheduling and hiring of adjunct faculty. Currently, faculty who take on these roles receive a stipend. Given the substantial time commitment required, the faculty member's time to focus on course-related activities and pedagogical improvements is negatively impacted. The current stipend does not adequately cover the time spent on these additional duties. Ideally, a faculty member who takes on administrative duties should receive adequate release time to do so, thus enabling them to have sufficient time to act as effective administrators without impacting their effectiveness as classroom instructors.

Release time or Compensation for Instrument Maintenance/ Troubleshooting/Training

Improve reliability of Instrumentation for student use

Release time or Compensation for SLO Course Coordination/Mentoring PT Faculty

Support part-time faculty and improve course-wide consistency

3E. Please review any resource requests granted over the last five years and whether it facilitated student success.

Over the last five years our resource requests were funded primarily through capital equipment allocations from Bond Measure C. Chemistry department purchases included the new instrumentation and equipment acquired over several years, beginning in early 2013. Most recently (as shown in Table below), we have been granted requests for new UV-Vis Spectrometers, a new Rotary Evaporator, and new Computational Chemistry software.

Last year we requested and purchased six spectronic-200 VIS spectrometers and four Vernier UV-VIS spectrometers. These spectrometers are used in the introductory through organic chemistry course sequences. They facilitate student success by allowing us to investigate new systems with much greater detail, and demonstrating for students the importance of instrumental resolution and precision in obtaining accurate measurements. The Vernier spectrometers are also being used in the astronomy program.

The new Rotary Evaporators are currently in use in the Organic Chemistry sequence, in which volatile organic solvents are frequently removed through evaporation in order to isolate an organic compound. The rotary evaporators allow these solvents to be removed without releasing them to the environment, thereby lessening the environmental impact of the Chemistry experiment and emphasizing for students the importance of Green Chemistry in establishing safe experimental procedures. Students were excited to see this new equipment in the lab. Not only do they appreciate the health and safety benefit, but they are able to observe first-hand the effects of reduced pressure on boiling point.

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The Computational Chemistry software (recently approved for purchase) will help students to visualize the shapes of organic compounds and to probe the structure-energy relationships that provide insight into the reactivity of organic molecules. The software will be used by students throughout the Organic chemistry sequence, and will open up the possibility for individual student research projects.

TABLE: PRIOR RESOURCE REQUEST STATUS

Request	Program Review Year	Granted/ Not Granted
Maintenance Contract for GCMS	2016-17; 2014-15	No
Contingency Funds for Critical Instrumentation	2016-17	No
UV-Vis portable spectrometers	2016-17; 2015-16	Yes
RSpec Classroom Video Spectrometer	2016-17	No
Bomb Calorimeter	2016-17; 2015-16	No
15 Copper Calorimeter Sets	2016-17; 2015-16; 2014-15	
Ice Maker	2016-17	Yes
Rotary Evaporator	2016-17; 2015-16	Yes
Protective Eyewear and Sanitizing Stations	2015-16	No
Vacuum Pumps for CHEM 30B to avoid contamination of house vacuum line	2014-15	Yes

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Replace broken spectroscopy accessories; GC Syringes, NMR tubes, IR salt plates	2016-17	No
Replace broken 19/22 standard taper glassware	2014-15	Partial- B budget
Replace broken polarimeter cells	2014-15	Partial- B budget
Online Journal Access	2015-16;	Yes- Library has provided funds for one year only
Release time for coordinator position	2016-17; 2015-16 2014-15	No
Release time or compensation for Instrument Maintenance/Troubleshooting/Training	2016-17	No
Release time or Compensation for Mentoring PT faculty /SLO Course Coordination/	2016-17	No
Safety and Hazmat Training for Faculty and Staff		Limited

SECTION 4: PROGRAM SUMMARY

4A. Prior Feedback: Address the concerns or recommendations made in prior program review cycles, including any feedback from the Dean/VP, Program Review Committee (PRC), etc.

Concern/Recommendation	Comments
Success Rates	As described in depth above (Section 2C), our success rates are relatively constant at 69% overall. There is evidence that the achievement gap in our Chemistry courses is narrowing.
Enrollment	Enrollment in Chemistry is up slightly from last year, with WSCH up 1.6% over five years. This stable enrollment in a declining enrollment trend may be due in part to our holding open more sections in order to capture the greatest numbers of students. This comes at a cost to productivity. Chemistry is adding a hybrid version of its popular Allied Health introductory class CHEM 30A, and will examine the addition of more of these if successful. We are also piloting a one-quarter CHEM 1A-CHEM 1B course, which will be taught in late spring and summer in hopes of capturing local students returning for the summer from their four-year universities.

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PT/FT Faculty Ratio	Sitting at about 50%.
Safety Training	Not implemented by Dean.
Chemistry Coordinator/Chair Position	Stipend reduced to \$5k. This is less than half the stipend needed to sufficiently compensate the coordinator for the time spent.
Maintenance of laboratory equipment	Currently there is no reserve funding upfront to address loss of equipment. In addition, no maintenance contracts have been funded. This results in significant instrument downtime when they occur and potentially higher repair costs for the college. It also puts our program at risk because our articulation agreements are made with the understanding that our instrumentation is up and running.
Curriculum: Develop strategies to increase enrollment in new courses like Chemistry of Cooking	To encourage students to enroll in science courses the Chemistry of Cooking course is going to be migrated to an online course. There has been discussion of decreasing the total units from 5 to 4 to better accommodate student academic pathways and still satisfy the science GE credit that is required for transfer. Offering an online GE Chemistry class could also help remove the stigma associated with chemistry courses and help foster growth mindsets in our students.

4B. Summary: What else would you like to highlight about your program (e.g. innovative initiatives, collaborations, community service/outreach projects, etc.)?

Self-evaluation through program review provides our department an opportunity to have meaningful conversations regarding our progress in achieving objectives, addressing barriers to success, and implementing innovative changes to our program. We valued the opportunity to present the work to the campus as well as highlight the following other aspects of our department.

Our department has expanded our collaboration outside the college:

Faculty have met with several universities in the area to discuss the relevance of Chem 20, which is an introductory environmental course, to their chemistry or environmental science programs. There was broad interest, with SJSU and UCSC, in particular, willing to consider used Chem 20 as an acceptable course for the chemistry requirement for their environmental studies majors.

Our department has a collaboration with Eastside Prep to offer Chem 25 on their high school campus. Brendan Mar who has taught the class there for the past 3 years reflects “my experience teaching there has been very positive. In addition to helping to build ties between the college and the communities that it aims to serve, working at Eastside has given me a chance to see in practice a model of intensive student support leading to strong student outcomes. While it isn't possible to import the Eastside model of mandatory supervised work sessions in the context of a college campus, the success of Eastside's students does highlight the extent to which having strong support available to students outside of official classroom hours can have a large effect on outcomes if students can be induced to make use of that support.”

The faculty members of the department should be commended for their commitment to multiple activities outside of the classroom, including the College Curriculum Committee, tenure review committees, hiring committees, as well as efforts to establish new curriculum. Of major importance is the mentoring and support of our part-time faculty, which is work that faculty are not currently compensated for. This work includes

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meeting and training part-time faculty on lab instrumentation and procedures as well as providing lab manuals with instructor notes and course documentation, support for online homework course implementation and often other background materials for each course taught.

SECTION 6: FEEDBACK AND FOLLOW-UP

This section is for the Dean/Supervising Administrator to provide feedback.

6A. Strengths and successes of the program as evidenced by the data and analysis:

The following are some strengths of the program:

1. Overall student success is above that of national student success data in chemistry.
2. Several faculty are engaged in various professional development activities and incorporating active learning methods in their classrooms.
3. Enrollment and productivity are strong. In the current quarter (Winter 2018), enrollment is slightly higher than previous quarters and productivity is significantly higher.
4. The teaching modules developed for CHEM 1A and 1B will be an excellent tool to enable student success in these classes.
5. The department is experimenting with hybrid delivery. This could attract a unique student population and help with increased enrollment.
6. The department has developed a successful dual enrollment relationship with Eastside prep school. The population in this class is entirely from underrepresented student groups. The success rate in this course tends to be > 90%.

6B. Areas of concern, if any:

The following are some areas of concern:

1. While student success has been somewhat steady at around 70%, which is above the national average for success scores in Chemistry, there exists a significant equity gap between targeted and non-targeted student populations. However, the department has identified several initiatives in this document to address this equity gap. These initiatives include curriculum development, professional development, and part time faculty mentoring. These are all promising initiatives and should yield results over the new few years. One noteworthy factor is that the success percent among the "Decline to State" population is significantly higher and the department has rightfully pointed out the need to understand this group of students more.
2. The chemistry department is home to several sophisticated instrumentation such as the GC-MS. However, no mechanism seems to exist to have such equipment under a long-term service contract. As a result routine maintenance and repair is an expensive process.
3. Personnel in chemistry departments in every academic institution are required to attend annual hazardous materials safety training. But, no such training exists in our district. This is a serious compliance issue and could have detrimental effects. The online haz-mat training provided by the district does not qualify to replace a mandatory in-person training that should be in place.
4. Enrollment in recently developed GE classes and honors classes is low. Despite the fact that the GE classes such as CHEM 20 also meet pre-requisite requirements for the General Chemistry course sequence, it seems the class is not widely promoted. The department should work closely with counselors to increase visibility for these classes. Likewise, despite a rigorous curriculum in the honors classes, there is not a significant enrollment in those classes. A more robust advertising mechanism is needed to promote enrollment in the honors classes.

6C. Recommendations for improvement:

Here are some recommendations for improvement:

1. The department should work towards implementing the measures that they have identified to

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- improve the success scores for targeted student groups (such as alternate pathways, increased support through workshops etc.).
2. Technical difficulties have been identified with regards to dissemination of the modules developed for CHEM 1A/1B. The department (along with the dean) should work with ETS to explore solutions for this.
 3. Work with counseling and marketing departments to promote and increase visibility for the newly developed classes. Reexamine the model for the honors classes in order to attract more students into these classes.
 4. Continue and perhaps expand the partnership with Eastside Prep and perhaps explore other dual enrollment models by working with the dual enrollment coordinator.
 5. Conduct a thorough study of sections with higher success rates and lower equity gaps, using the Student Inquiry tool.

6D. Recommended Next Steps:

- Proceed as Planned on Program Review Schedule
 Further Review / Out-of-Cycle In-Depth Review

This section is for the Vice President/President to provide feedback.

6E. Strengths and successes of the program as evidenced by the data and analysis:

6F. Areas of concern, if any:

6G. Recommendations for improvement:

6H. Recommended Next Steps:

- Proceed as Planned on Program Review Schedule
 Further Review / Out-of-Cycle In-Depth Review

Upon completion of Section 6, the Program Review document should be returned to department faculty/staff for review, then submitted to the Office of Instruction and Institutional Research for public posting. Please refer to the Program Review timeline.