A. ASSESSMENT OF INTERNAL AND EXTERNAL FACTORS AND STUDENT SUCCESS: Perform a SWOT analysis of your program, indicating the STRENGTHS, WEAKNESSES, OPPORTUNITIES, and THREATS in relation to program goals and available resources, including an evaluation of the curriculum in terms of student needs. Analyze the external factors affecting program goals and performance, e.g., changes in demographic, educational, social, economic, workforce, or global trends; evolving technology; demand (based on enrollment trends or other factors); linkage with other related campus programs, services, or committees; local availability of similar programs; availability of auxiliary funding. Include supplemental survey results and other data whenever available. (References: Educational Master Plan; Curriculum Sheet; Department and All-College Program Review Data (Retention, Success); 1999-2000 Program Planning Summary; Other _____________)

1. Internal Factors
The Chemistry faculty at Foothill College is committed to providing an optimal learning environment for its students. The curriculum is continually revised and updated to incorporate new pedagogy and technology. Care is taken to assure that the program is in accordance with American Chemical Society (ACS) curriculum guidelines in order that matriculation agreements are met. As a part of these guidelines, ACS recommends a class size no greater than 24 students. Unfortunately, most Chemistry courses we offer (CHEM 25, CHEM 30A, CHEM 30B) have 32 students, a 33% overload. In the general chemistry series (1A, 1B, 1C) there are 28 students, 17% larger. Only the organic series (12A, 12B, 12C) follows the recommended size of 24 students. Because the labs comprise “hands on” experiments, having the instructor available to help students with the setup of the experiment is important not only from an instructional point but also from a safety point of view.

Despite our best efforts to keep the Chemistry curriculum current, we are unable to provide some key instrumentation. Our budget constraints prohibit the purchase of new equipment and instrumentation, but some of our old equipment is outdated and/or broken and must be replaced. We have applied to the National Science Foundation for a Course, Curriculum and Laboratory Improvement (CCLI) grant for the purchase of the most expensive and most critical of these instruments. Acquisition of the Nuclear Magnetic Resonance Spectrometer would revitalize our organic chemistry program and enable us to meet ACS guidelines.

The laboratories themselves are badly in need of repair. They are old, and have not been remodeled or renovated for 45 years, except for new linoleum on the floors. As part of the Measure E project, the chemistry building is slated for a complete remodeling in the next couple of years. The building will be shut down for 6-8 months while walls are removed and relocated, piping and electrical wiring reworked, fume hoods removed and relocated, multi-media installed, etc.

The chemistry department will continue to have four laboratories, and for the most part these are sufficient for our needs. Currently 85% of our laboratory sections are offered in the afternoon. However, if enrollment continues at our current rate we will need to schedule more lab sections in the morning hours, which would maximize our usage of lab spaces. Since lab sections meet for three hours, morning labs have not been popular with the students. However, a good number of years ago, when we had huge enrollments, we did offer morning labs and they were filled, so we know that it is workable. Moreover, DeAnza College has offered a fair number of morning labs in its chemistry schedule, and they have been successful.

2. External Factors
Last year (2002) chemistry experienced 18% increase in enrollment over 2001. The specific data for the current year is not available, but the increase in enrollment is continuing. Except for one section, all sections in 2003 had a waiting list. The one exception was a fourth CHEM 1A section that was added as a morning lab. Although enrollment in that section was light, it still made. There were enough students on the wait list for CHEM 25 that we would have added another section, except we did not have the lab space to accommodate it.

The surge in enrollment is due to the economy. This has occurred a number of times in the past. Whenever there is high unemployment, we experience an influx of workers who want to update their education or to retrain for a new career. We are also aware that there will be a fall-off when the economy picks up again.
B. **STUDENT SUCCESS EVALUATION:** Briefly discuss how the program is performing relative to program and college projections for student success. Comment on specific student success programs or services provided by the college that you perceive to be particularly valuable to your students. Identify unmet needs related to student success.  *(References: Educational Master Plan; Curriculum Sheet; Department and All-College Program Review Data (Success); 1999-2000 Program Planning Summary; Other ___)*

The success rate for the chemistry department is approximately 78%. For the college as a whole the success rate is 84%. However, for transfer courses (e.g. chemistry courses) the students’ success rate is 73 %, so the department is actually doing really well. It has been the norm for most colleges that science courses have lower success rates than the rest of the college.

To enroll in CHEM 1A a student must take a placement test and pass it with a score of 19 or higher, or take CHEM 25 (our preparation course) and pass it with a C or better. In a recent report (October 2003) the Assessment Office evaluated this chemistry placement test. Their findings were: With a cut score of 19-20, the success rate is 46%; with a cut score of 21-22, the rate jumps to 61%, and with a cut score of 23-24 it goes to 70%. In order to increase the success rate, the chemistry department has requested to the Assessment Office to change the cut score to 22, beginning with Winter Quarter 2004, for entry to CHEM1A. This should increase the success rate for chemistry beyond 78%.

Another area for improving the success rate is to provide more personal help. To this end, the department wants to set up a chemistry study room, similar to the Math Center. In the plans for the renovation of the chemistry building is a study center, staffed by instructors and tutors. We are also considering independent study credits for students who have completed a chemistry course with an A grade and who would be willing to tutor and mentor students in subsequent quarters.

C. **STUDENT EQUITY/DIVERSITY ANALYSIS:** Student equity may already be defined as a factor in the above assessments. Use this section to offer additional observations and to specify other needs related to bringing your program into alignment with college or program goals for student equity. *(References: Educational Master Plan; Division and All-College Program Review Data (Success by Ethnicity, Gender, Age); Other __________________)*

For the 2001-2002 year, the enrollments in chemistry for the various ethnic groups were: 2% black, 8% Hispanic, 32% Asian, 26% white. In contrast, the school as a whole is: 3% black, 10% Hispanic, 22% Asian and 35% white. Obviously the Hispanic and particularly the blacks tend to shy away from chemistry. One reason is that these minority groups consider chemistry to be a tough subject (comments like “it’s so abstract”), and they feel that they are inadequately prepared to take a chemistry course.

Recruiting more minorities into taking chemistry will be a formidable task. This is especially true for the college transfer program, as they realize how many difficult science courses they have to take. However, this is not true for the vocational programs. For example, to enter the Allied Health Radiation program, or the Respiratory Therapy program, a student only needs to take CHEM 30A, which is an introductory chemistry course. These vocational programs are very appealing in that a student can be finished and out working in two years. Yet the number of blacks enrolled in CHEM 30A is about 2%.

D. **ACTION PLANS AND PROPOSED PROGRAMMATIC CHANGES:** Review the Education Master Plan (EMP), Partnership for Excellence (PFE) goals, Curriculum Sheet, and Department Program Review Data. Using measurable terms, describe the program’s goals related to these documents. *(Examples: “The number of students issued a Career Certificate will increase by five over last year’s figure.” “The program will initiate an advisory board.” “Faculty will examine learning goals for their programs and courses.” Etc.)*

1. **Program Goals Related to Educational Master Plan and Partnership for Excellence**
   The chemistry department needs to improve student success and retention for all students and especially the underrepresented groups. Even though the success rate in chemistry is good (78 %), we would like to make it better, maybe to the 80+ %. We hope that the chemistry study center, when it’s completed in a year or so, will help us accomplish this goal.

2. **Other Program Improvement Plans**
   To keep technologically current, we are hoping to acquire a Fourier Transform Nuclear Magnetic Resonance Spectrometer (FTNMR).
E. ENROLLMENT AND PRODUCTIVITY GOALS  
(References: Program Review Data Sheet (Enrollment and Productivity); Other_______________)

For the last year and a half the department has been increasing enrollment by opening one or two more sections each quarter. This amounts to a 17% increase in enrollment from the 2001 to the 2002 year. As long as unemployment remains high in Santa Clara County there will be demand for our courses. We could possibly have another 5-10% increase in the near future, but to handle the new sections we would need to offer more morning labs.

F. SUMMARY OF RESOURCES REQUESTED: Summarize resources needed to reach program goals and describe the expected outcomes for program improvement. (Specifically what will be the outcome of receiving these resources? What will happen if the resource requests aren’t granted?) Complete any of the following sections that apply to your current program needs.

1. FULL-TIME EQUIVALENT FACULTY OR STAFF NEEDS
   Currently there are 4.3 full-time instructors (Sierra is assigned a .33 load in chemistry). The staff has been unusually understaffed the last couple years, due primarily to sabbatical leaves. For example, in the 2001-2002 year, 33% of the chemistry load was taught by full-timers. In the 2002-2003 year, 46% of the load was taught by full-timers. To achieve the 75:25 ratio of full-time to part-time instructors as mandated by law, the chemistry department would have to hire 2.5 full-time members.
   Because of the budget cutbacks, the department was forced to release the evening stockroom technician and replace the person with a student helper. This is neither healthy nor safe. One, the person should not be working unless he/she is supervised by a Foothill employee, yet the person is alone in the stockroom. Two, the student has no chemical knowledge or skill, and there are times when certain chemicals or solutions are needed. Three, student helpers come and go easily and it takes a while to train a person to do the mediocre labor of handling equipment. Four, because of student help, the burden of prepping the evening chemistry classes falls on the daytime technician. With all the extra sections being added, it is no wonder the day technician feels like he is overworked. One of the department’s first tasks, when money can be found, is to hire a qualified evening technician.

2. FACILITIES NEEDS: (Include all aspects of the physical setting, e.g., room size, seating type and arrangement, multimedia equipment, lab stations, etc., that might provide a more effective student learning environment.)
   With the Measure E money the chemistry building is finally being renovated. Walls are removed and offices are relocated to create a large chemistry study center. Presently the laboratories can only be used for laboratory work. The noise from the fume hoods and the lack of chairs/writing space preclude them from being used for lectures. In the renovation each laboratory will be converted to lecture quality, with stools, writing surface and multi-media capabilities. Fume hoods will be expanded in the Organic Laboratory in order to minimize exposure to potentially harmful chemicals.

3. MATERIALS AND SUPPLIES BUDGET AUGMENTATION
   Chemistry is an experimental science and as such requires equipment and instrumentation. Our most pressing need currently is a Nuclear Magnetic Resonance Spectrometer. Hands-on use of such an instrument is specified in the ACS curriculum guidelines for Organic Chemistry. We are hoping that our application for a matching grant from the National Science Foundation is approved so that this critical piece of equipment can be acquired.

Evaluation of academic year 2002-03.  
List names of participants assisting in this program review.  
Primary program contact person: Don Pon  
Full-time faculty: Don Pon, Angel Sierra, Richard Daley, Kathy Armstrong  
Part-time faculty:  
Administrators: Chuck Lindauer  
Classified staff: Ruyu Chen  
Students:

DATE OF EVALUATION: ____________________________
PROGRAM NAME: CHEMISTRY
Degree/certificate options available: A.S. Degree in Chemistry

PROGRAM MISSION AND OUTCOMES
The chemistry department has several functions. Its courses: (1) fulfill the chemistry requirement for science majors going on to four year institutions, (2) fulfill chemistry requirements for the various vocational programs, and (3) fulfill the science requirement for the general education degree. The department also offers an A.S. degree in chemistry, but less than 2% of the chemistry students are in this program.

### DIRECT OUTCOMES: Program-Specific Outcomes and Attributes Desired of Program Graduates

| PROGRAM CONTENT PROFiciencies/ COMPETENCIES | BEHAVIORS: What should a student be able to do upon graduation? | REQUIRED PROGRAM COURSES related to this outcome: Where do students acquire experience? | OUTCOME MEASURES — Evidence or Sample Demonstrating Deep Learning: How do we know what a student has achieved?
---|---|---|---|
Knowledge of the basic terms and nomenclature used in chemistry | Be able to define and understand chemical terms, such moles, equations, heat of reactions and do calculations with them. | CHEM 25, CHEM 30A | Direct Measures: Successful completion of the proficiencies/competencies is indicated by a grade of a “C” or better in the course.
Recognizing chemical compounds and chemical reactions. Understand stoichiometry. | Be able to write and balance a chemical reaction. Be able to calculate the quantities involved in a chemical equation. | CHEM 25, CHEM. 30A | Direct Measures: Successful completion of the proficiencies/competencies is indicated by a grade of a “C” or better in the course.
Understand solutions, acids, and bases | Be able to explain the preparation of a solution. Recognize acids, bases and be able to calculate pH. | CHEM 25, CHEM 30A | Direct Measures: Successful completion of the proficiencies/competencies is indicated by a grade of a “C” or better in the course.
Understanding organic compounds and their reactions. | Be able to draw the structures of organic molecules. Expand on their physical and chemical properties. Explain their reactions. | CHEM 30A, CHEM 30B | Direct Measures: Successful completion of the proficiencies/competencies is indicated by a grade of a “C” or better in the course.
Knowledge of organic and biochemical molecules, as related to a person's health. | Be able to recognize certain organic molecules, such as alcohols, aldehydes, ketones, carbohydrates lipids, proteins, etc. Be able to explain the functions of these molecules in the metabolism of the body. | CHEM. 30B | Direct Measures: Successful completion of the proficiencies/competencies is indicated by a grade of a “C” or better in the course.
Understanding genetics and metabolism | Be able to explain the DNA and genetic. Know the mechanism for metabolizing carbohydrates, lipids and proteins. | CHEM 30B | Direct Measures: Successful completion of the proficiencies/competencies is indicated by a grade of a “C” or better in the course.
CHEMICAL REACTIVITY Recognize structural types within Molecules including identification of “functional groups” and correlate their structure with reactivity | Classify organic/ biological molecules according to structural types. Predict general reactivity of simple molecules. Predict function of reactive sites within an organic molecule. | CHEM 1A, 1B, 1C, 12A, 12B, 12C | Exam performance reflects (by design) students ability to apply knowledge and think critically.
ATOMIC/ MOLECULAR STRUCTURE Understand current models of electronic structure as they relate to three dimensional atomic structure | Recognize role of chirality in biological systems. Identify chiral portions of large molecules. Predict three-dimensional structure of simple organic molecules. Relate three dimensional structure to reactivity | CHEM 12A, 12B, 12C | Exam performance
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<tr>
<th>PROGRAM CONTENT PROFICIENCIES/ COMPETENCIES</th>
<th>BEHAVIORS: What should a student be able to do upon graduation?</th>
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<th>OUTCOME MEASURES — Evidence or Sample Demonstrating Deep Learning: How do we know what a student has achieved?</th>
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<tr>
<td>MEASUREMENT</td>
<td>Possess skill in acquiring measurements of weight, volume and distance. Understand precision and accuracy of measurements</td>
<td>CHEM 12A, 12B, 12C</td>
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<tr>
<td>THERMOCHEMISTRY: Thermodynamics</td>
<td>Understand application of general Thermodynamic functions including Free Energy, Enthalpy and Entropy to Chemical systems</td>
<td>CHEM 1B, 1C</td>
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<td>THERMOCHEMISTRY: Chemical Equilibria</td>
<td>-Understand concept of chemical equilibrium and its consequences (predict quantities of reactant and product; understand variables affecting position of chemical equilibrium -Understand Energy requirements of Organic reactions -Predict step-wise structural changes undergone in chemical reactions whose mechanisms are understood. -Apply Thermodynamic principles to predict magnitude and direction of Electrochemical reactions</td>
<td>CHEM 12A, 12B, 12C</td>
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<td>CHEMICAL KINETICS</td>
<td>-Interpret data on Rates of Chemical reactions -Predict variables which influences Chemical reaction rates</td>
<td>CHEM 1B, 1C</td>
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<td>OPERATE SCIENTIFIC INSTRUMENTS including UV-Vis Spectrometer, FTIR Spectrometer, FTNMR Spectrometer, GC</td>
<td>-Apply skills to operation of similar instruments -Understand applications and theoretical principles behind these same Instruments -Facility with the interpretation of Spectrometer signals for concentration measurement, structural elucidation, or other purpose</td>
<td>CHEM 12A, 12B, 12C</td>
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<td>MODERN LABORATORY METHODS for preparation, purification, isolation and identification of chemical compounds</td>
<td>Apply skills in industrial laboratory setting</td>
<td>CHEM 12A, 12B, 12C</td>
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<td>COMPUTER DATA ANALYSIS</td>
<td>Statistical Interpretation of Data including error analysis</td>
<td>CHEM 12A, 12B, 12C</td>
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<td><strong>CORE COMPETENCIES</strong></td>
<td><strong>CORE COMPETENCIES:</strong> Outcomes and Attributes Distinct to This Program</td>
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<td>Communication</td>
<td>-Articulation of Ideas in written form. -Verbal articulation using expanded vocabulary in formulation and interpretation of questions</td>
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<td>Computation</td>
<td>-Chemical Equations/Stoichiometry -Application of Mathematical Functions -Significance of Numbers -Statistical Analysis of Data</td>
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<td>Creative, Critical &amp; Analytical Thinking</td>
<td>-Devising alternative experimental approaches</td>
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<td>-Troubleshooting during Laboratory Exercise</td>
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<td>-Application of knowledge in new setting</td>
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<td>Community/ Global Consciousness &amp; Responsibility</td>
<td>-Environmental Hazards</td>
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<td>-Green Chemistry</td>
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<td>-Waste Handling and Disposal</td>
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