All Fields Report

Program Overview	
Program	PHYSICAL SCI Physical Sci
Does this program have a CTE component?	No
Academic Year	2013/2014
Review Period	6 Year
Service Areas	

Program Description and Goals

This section addresses the big picture. Prompts should help you describe your program and goals and the relationship to the institutional mission, vision and goals, and how the program is funded.

1. Describe the program and/or service area under review and how the program supports the mission of Santa Monica College.

The Physical Science Department at SMC houses three distinct disciplines: chemistry, physics, and engineering. Our course offering includes all standard first and second year course sequences commonly taught in these disciplines at colleges and universities nationwide. The vast majority of our students are fulfilling prerequisites and/or General Education science requirements in preparation for transfer into four-year university programs and/or professional programs. Our program supports the College mission very directly by maintaining a rigorous curriculum that allows our students to succeed upon transfer, in graduate and professional schools, and on into their careers. We maintain very high standards, but employ a faculty and staff deeply committed to helping students meet them. Our top quality instruction ensures that our students leave SMC with the knowledge, skills, and confidence to compete successfully with university students nationwide.

We have designed the physical science curriculum to meet the needs of a variety of student interests and goals:

Chemistry 11, 12, 21, 22 and 24 make up the first two years of university level chemistry: a year of general chemistry and a year of organic chemistry along with the accompanying laboratory work. **Chemistry 31** is an option for those who have completed organic chemistry and wish to study biochemistry as well. This course is designated as upper division at some universities, but is popular with and required for students entering many health fields. **Chemistry 10** is an introductory course popular as preparation for entry into Chemistry 11, as preparation for entry into nursing and other health professions, and as fulfillment of laboratory science GE requirements for nonscience majors. It is the most highly enrolled science course offered at SMC. We developed the **Chemistry 9** course more recently to address the needs of the nonscience majors specifically. While it covers many of the same fundamentals of chemistry taught in Chemistry 10, it places these concepts into contexts commonly encountered in modern life. The department is currently developing a third introductory level course to fulfill the chemistry requirement in pre-nursing and other pre-allied health programs. Commonly referred to as a **GOB course**, it will include aspects of general, organic, and biological chemistry.

Physics 21, 22, 23 and 24 comprise our most rigorous, calculus-based course sequence in physics and serve those planning to transfer with majors in engineering or the physical sciences. **Physics 8 and 9** comprise a one-year version of that sequence, still calculus-based, and designed to meet the needs of students striving for entry to medical school. **Physics 6 and 7** provide a similar sequence to Physics 8 and 9, but treat the principles of physics using algebra and trigonometry instead of calculus. Physics 6 and 7 serve students in various life science majors including those entering health professions that do not require a calculus-based physics background. Finally, **Physics 12 and 14** offer nonscience majors a conceptual view of the principles of physics: Physics 14 with an accompanying laboratory component and Physics 12 without.

The engineering program consists of a two-course sequence: **Engineering 12**, covering principles of static systems, and **Engineering 16**, covering dynamic systems. Entry to this sequence requires successful completion of Physics 21 and serves students transferring in Mechanical Engineering and similar programs. While the engineering course offering is serves students transferring in Mechanical Engineering and similar programs. While the engineering course offering is clearly the smallest of the department's three disciplines (we offer only one section of Engineering 12 per semester, and we are now offering a section of Engineering 16 for the first time in over a decade), it should be noted that SMC enrolls a large number of engineering students whose lower division course requirements consist primarily of math, physics, chemistry, and GE requirements. Still, many engineering students have expressed a desire for more direct exposure to their chosen fields of study earlier in their educational careers so the department is exploring possible options to address those desires.

2. Identify the overarching goal(s) or charge/responsibilities of the program or service area. If appropriate, include ensuring/monitoring compliance with state, federal or other mandates.

Goals of the Physical Science Department include:

- preparing students for successful transfer into and completion of four-year college and university programs; (*Innovative and Responsive Academic Environment, ILO 1 - Personal Attributes, GRIT*)
- providing students with a thorough foundation in the principles of science, the relevance of those principles to today's world, and their critical importance in society's quest to solve global environmental challenges; (*Innovative and Responsive Academic Environment, ILO 2 - Analytic and Communication Skills, ILO 4 - Applied Knowledge and Valuation of the Physical World, ILO 5 - Authentic Engagement, GRIT*)
- developing students' critical thinking/problem solving skills;*(Innovative and Responsive Academic Environment, ILO 2 - Analytic and Communication Skills*)
- developing students' understanding of the critical role of empirical evidence and the importance of integrity in scientific pursuits; (*Innovative and Responsive Academic Environment, ILO 1-Personal Attributes, ILO 2 - Analytic and Communication Skills*)
- increasing the rates of participation, retention and transfer of underrepresented student populations in the physical sciences; (*Supportive Collegial Environment*)
- ensuring our courses articulate with baccalaureate-granting institutions and that our curriculum prepares students for standardized admission exams (MCAT, DAT, etc) and fulfills entrance requirements for professional programs such as medical, dental, veterinary, pharmacy and other professional schools;(*Innovative and Responsive Academic Environment*)
- providing a safe laboratory environment for students, faculty, and staff that complies with OSHA and Cal OSHA mandates; (*Sustainable Physical Environment, Supportive Collegial Environment*)
- instilling respect for laboratory safety procedures in our students, faculty and staff; (*Supportive Collegial Environment*)
- maintaining high quality scientific instrumentation and laboratory facilities and maximizing student exposure to/use of those resources (*Innovative and Responsive Academic Environment, ILO 2 - Analytic and Communication Skills, Sustainable Physical Environment*);
- providing effective mentorship and professional development opportunities for all, but especially for new faculty and staff. (*Supportive Collegial Environment*)

3. If applicable, describe how the Institutional Learning Outcomes (ILOs), Supporting Goals, and/or Strategic Initiatives of the institution are integrated into the goals of the program or service area.

Please see the italicized references in question 2 above.

4. If your program receives operating funding from any source other than District funds identify the funding source. If applicable, note the start and end dates of the funding (generally a grant), the percentage of the program budget supported by non-District funding, and list any staff positions funded wholly or in part by non-District funds. Do not include awards for non-operational items such as equipment (ex. VTEA) or value added activities (ex Margin of Excellence).

The department is funded fully by the District, with the exception of two recently added activities that are funded by the HSI STEM grant. These are supplemental instruction for our “gateway” courses (Chem 10 and Chem 11 so far, with Physics 21 and Chemistry 12 being included for Spring 2014), and support for the brand new Science 10: Introduction to Scientific Research course currently offered only to SRI cohort students. SRI stands for the SMC and UCLA Science and Research Initiative, the name of the program that is funded by SMC’s STEM grant, a 5 year grant that is now in its third year.

Note also that the department has received about $400,000 for equipment from the STEM grant, as well as a number of smaller awards for equipment and supplies from Margin of Excellence and Chair of Excellence grants.

Several of our faculty and students have had wonderful opportunities to take part in summer research projects at JPL via the CSIS department’s CIPAIR grant, and others had a great experience at the 2013 Faculty Summer Institute funded by SMC’s Teaching and Learning Center grant.

Populations Served

In this section you will provide information that describes who your program or service area serves. When comparing data from different periods, use a consistent time frame (ex. Compare one fall term to another fall term)

Saved Information For Populations Served

Area/Discipline Information Pertains To

All Disciplines (answered once)

1. Describe your students in terms of ethnicity, race, gender, age, residency status, citizenship, educational goal, enrollment status, and full/part-time status. Note any changes in student or enrollment data since the last six-year program review and the possible reasons for the changes.

Below is an approximate breakdown of the student population currently enrolling in Physical Science Department courses at SMC. Our students are:

- 47% female;
- predominantly under 30 years of age;
- 78% California Residents, 6% out-of-state, and 16% international;
- 28% Asian, 5% Black, 28% Hispanic, 30% White, and 3% multiracial;
- 77% continuing students with the remainder equally distributed among first time college students, new transfer students and returning students;
- 79% planning to transfer and 10% pursuing educational development goals;
- 86% high school graduates and 11% already possessing a bachelor's degree;
- 3% at the basic skills level in math and/or English;
- 58% full-time students.

These demographics are very similar to those of our department at the time of our last program review six years ago with the following exceptions.

- Enrollment of students 19 or younger has dropped from about 32% to about 28%, presumably due to greater difficulty in getting into classes for newer students with later enrollment dates.

- Enrollment of international students has dropped from about 19% to about 15% in keeping with a college wide trend, perhaps also due to greater difficulty in enrolling in classes before they fill.

- Enrollment of Hispanic students has increased from about 17% to about 28% in keeping with the college wide trend and possibly as a result of increased efforts to recruit and retain these students as part of the college's STEM initiatives.

- Enrollment of both first time college students and transfer students have each dropped from about 13% to about 8% while that of continuing students has increased accordingly, likely for the same reasons experienced by younger aged students.

- Enrollment of students planning to transfer is up from about 70% to about 79%, while that of students fulfilling a career objective and those pursuing educational development is down from 5% to 2% and 12% to 9%, respectively. We are unsure of the reasons for these trends.

- Enrollment of students who already possess a bachelor's degree is down slightly from 13% to 11% with the difference accounted for by an increase in those possessing a high school degree as their highest degree achieved. This trend is also most likely explained by these students having a harder time successfully enrolling in impacted classes.

We are aware that significant differences in the statistics given above occur across disciplines and even across specific courses in our program. For example, physics has a much lower enrollment of female students (34%) than does chemistry (52%), and a higher enrollment of international students (about 21% in physics and 14% in chemistry). Both of these differences are reflective of differences in physics and chemistry students nationwide.

The data available to the department does not break these rates down by course, but we requested that our Institutional Research office provide breakdowns of our gender and ethnicity distributions by course or by course sequence. These data are provided in the attached file *IR Data for Physical Science, 2014, Additional*. Significant findings are addressed at the course level below.

Chem 9: Everyday Chemistry

This course has become extremely popular with our international student population, who constituted 63.8% of the course enrollment in 2012. Chemistry 9 was created to encourage more underrepresented minority student enrollment in the sciences, however the average Asian enrollment by ethnicity for the past five years is 51.4%. Although the success rate for this population has declined by an average of 16.9% since the last report, the average success rate for the African American has increased by 68.7%. The average success rate for Hispanic and White students have also declined since the last report by 37.3% and 10.5%, respectively. One possible reason for these declines is the change in textbook. The current textbook, written by the American Chemical Society, offers a much more global perspective of the course content. Unfortunately, the reading level is more difficult than the textbook used during the 2007 Report. Nonetheless, the success rates by residence status have remained high with 70.3%, 80.0% and 90.5% for California, out of state and foreign students respectively. The educational goal of 90.5% of students taking this course is to transfer to a four-year institution.

Chem 10: Introductory Chemistry

The Chem 10 program only has available the ethnicity demographics of its enrolled students over a five-year period from Fall 2008 to Fall 2012. There are a few notable trends in the data.

First, we have observed a sizable increase in the percentage of Hispanic students (20.2% up to 37.2%) in our Chem 10 cohort. The percentage of Hispanic students reported in Fall 2007 during our last program review was only 20.1 %; in our Fall 2012 data this percentage has risen to 37.2%. This large increase most likely reflects the overall shift in demographics experienced by the entire campus. It is also possible that our department's tremendous efforts in outreach to this demographic, largely in the form of our STEM initiative, is partly to account for this increase.

Second, we have observed a gradual decrease in the percentage of Asian/PI students (29.2% down to 18.2%) in our Chem 10 cohort. This is also represents a decrease from our last program review (26.4% in Fall 2007). The reason for this is most likely a re-direct of large numbers of our Asian students into our alternate Chem 9 course, for which enrollment trends show a corresponding increase in the percentage of Asian/PI students.

Third, we have observed that the percentages of Black and White students in Chem 10 show minor fluctuations, but overall no significant changes are noted.

Finally, it should be noted that that Chem 10 enrolls, on a percentage basis, slightly more under-represented minority students and slightly fewer Asian/PI and White students compared to our entire Chemistry program at SMC. The greatest discrepancy appears for our Hispanic students which show a five-year average of 29.4% enrollment in Chem 10 compared to 23.2% for all our Chemistry courses.

Chem 11/12: General Chemistry I and II

Chem 11/12: General Chemistry I and II

The overall college enrollment declined slightly between Fall 2009 and Fall 2012. In contrast the enrollment in the Physical Science Department has steadily increased between Fall 2008 and Fall 2012. The combined enrollment in Chem 11 and Chem 12 has mirrored the trend for Physical Science steadily increasing from 492 in Fall 2008 to 604 in Fall 2012.

Collegewide the percentage of Hispanic students has increased from 25.6% in Fall 2008 to 35.8% in Fall 2012. During the same period the percentage of Asian, African-American, and White students has declined slightly.

These same general trends are observed in the enrollment in Chem 11/12. Most notably the percentage of Hispanic students has increased from 18.9% in Fall 2008 to 24.0% in Fall 2012.

There has also been a significant decline in the percentage of foreign students enrolled in Chem 11/12 from 15.7% in Fall 2008 to 10.8% in Fall 2012 as opposed to collegewide enrollment where the percentage of foreign students increased from 9.1% in Fall 2008 to 10.8% in Fall 2012. We are uncertain of the reason for this change.

Chem 21/22/24/31: Organic Chemistry and Biochemistry

We have shown a modest increase in enrollment over the six-year period, mostly due to increased numbers of Hispanic students. The percentage and numbers of Hispanic students in these courses has jumped from around 10% in 2007 to about 17% currently. The initial jump was in 2010 and the numbers have continued to increase steadily. We have roughly equal numbers of men and women, unchanged since the last program review and in the interval between. About twenty percent of the students have earned bachelor's degrees. Our population of students is mostly planning to transfer or for educational development, including post-bac students meeting requirements for graduate and professional school. Very few plan to get AA/AS degrees.

These courses consist almost entirely of continuing students, since we have enforced prerequisites for the courses. Our part-time/full-time status, showing around 60% full-time students, is almost exactly flipped from the college-wide average.

Generalities for Physics as a whole:

The following refer to statistics encompassing ALL physics classes for five consecutive fall semesters from 2008 to 2012. The data was provided by the Office of Institutional Research.

There has been a nearly constant ratio for the enrollment of male:female students. That ratio is 1.7:1. (To obtain absolute figures, note that, apart from an anomalous Fall 2008, the total enrollment of students among all physics classes had held steady just above 700.) Statistically, slightly more than half of all students who take physics are between 20 and 24 years of age. The age group with the next highest level of representation is those 19 or younger, followed closely by those 25 to 29. Out of a random sample of 10 physics students, 4 are Asian or Pacific Islander, 3 are White, 1 or 2 are Hispanic, and 1 or none are Black. About 1 out of every 4 or 5 physics students are foreign citizens. Nearly 3 out of every 4 students is a continuing student who was enrolled in a previous semester at SMC. The overwhelming majority of our students are high school graduates, with only about 1 out of every 10 having a bachelor's degree. A tiny fraction of our students are considered basic skills students. The ratio of full-time:part-time students is 2:1.

A prominent trend in the data shows yearly growth in the number of transfer-oriented students taking our physics courses constrained by an approximately constant total population.

Physics 6/7: General Physics I and II

The percentages of female and male students tend to be similar in this sequence, as opposed to the statistics for physics as a whole. The enrollment by ethnicity is not that different from the physics department as a whole. In any given fall semester during the past five years, the total number of students is between 110 and 130. Of those, 30% are Asian/PI, 40% are White, about 15% are Hispanic, and about 5% are Black. About 1 out of 10 students are foreign.

Physics 8/9: General Physics I and II with Calculus

There are no significant trends in the data across one ethnicity, as the percentages remain rather constant across the five studied semesters. The majority of the students are in the Asian/PI group, averaging around 40% out of a sample size of about 70 students enrolled in each semester. The white population averages at 30%, the Hispanic population around 15%, while the black population is under 7% for all semesters, but as low as 1.5% in Fall 2009 and Fall 2012.

Although most students are residents of California, there is a marked foreign demographic, ranging from as low as 9.5% in Fall 2011 and as high as 24.3% in Fall 2012.

Our population of students is mostly planning to transfer. There are occasionally some students who enroll from four-year institutions to satisfy their degree requirements. Very few plan to get AA/AS degrees. About 10% of students taking any physics course is seeking "Educational Development," most of which are looking into post-baccalaureate programs or graduate or professional programs.

Physics 12/14: Introductory Physics

The numbers of students of different ethnicities have fluctuated with no clear trend visible, although the total number of students in the courses has remained constant. Currently the percentage of Hispanic students and Black students is far below the college-wide average. A possible reduction in the number of Asian/Pacific Islander students and a corresponding increase in Hispanic students may be happening, and should be watched. The number of CA resident students and foreign students is comparable to the P8/9 and P21-24 sequences at approximately 65% and 25% respectively.

Physics 21/22/23/24: Mechanics/Electricity & Magnetism/Fluids, Waves, Thermodynamics, Optics/Modern Physics

During the period from 2008 to 2012 the main ethnicities enrolling in this sequence intended for engineers were Asian/PI (46%), White (25%), and Hispanic (17%), with each showing roughly a 2% fluctuation over the period. The enrollment of Blacks (3.3%) continues to be quite low and shows a decrease from 5% to 1% over the five years.

Across all physics courses, women make up around 37% of enrollment. However, the representation of women within the other physics sequences is generally somewhat higher than in engineering. "Women make up less than a third of a typical course within this sequence. This figure is noticeably lower than that of across all physical sciences.

Two thirds of the students of this sequence are residents and about a quarter are international students. The figures show a fluctuation of a few percent. The most significant variation occurred during fall 2012 with a 5% increase in residents with corresponding decrease in foreign students.

Nearly three-quarters of enrollees are continuing students with the intention to transfer. This combined category has risen by 10% since the last review. Across all physics courses two-thirds are full-time students 80% of whom have completed high school. These latter figures have remained relatively stable.

Engineering 12/16: Statics and Dynamics

The numbers are too small to have robust data, but it appears that the numbers of students is roughly 33% Asian, 25% White, 25% Hispanic and 10% Black. A far smaller percentage of Asian students enroll in this class than in the engineering physics sequence which leads into it, so for some reason, Asian students frequently choose not continue into Engineering 12 at SMC. While we are unsure of the reason for this trend, we spectulate that it may be related to the fact that many of our international students are from Asia, and they may have a different pathway in mind than the US students.

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2. Compare your student population with the college demographic. Are your students different from the college population?

Chem 9: Everyday Chemistry

The Chemistry 9 student population is very different from the college population. As noted previously, the average Asian enrollment by ethnicity for the past five years is 51.4%, even though the Asian SMC population averages 18.2% during the same time period. We have noted a decline in all other populations over the past five years with Black, Hispanic and White populations decreasing to 0.9%, 12.9% and 9.5% respectively in 2012.

Chem 10: Introductory Chemistry

The percentage of White students enrolled in Chem 10 is comparable that of the college as a whole; 28.8% versus 28.1% in Fall 2012. As noted previously, we have observed a large increase in the Chem 10 Hispanic population, which reflects overall college trends. In fact, based on Fall 2012 data our proportion of Hispanic students now slightly exceeds that of the college (37.2% versus 35.8%). And while our Asian/PI student numbers have decreased somewhat (due to competition with Chem 9), the Fall 2012 data shows that their percent enrollment in Chem 10 still exceeds that of the college (18.2% versus 15.5%). However, the situation is reversed for the Black student population in Chem 10. Although our numbers of Black students have remained relatively constant, we continue to enroll a much lower percentage than the college; 5.8% versus 9.6% in Fall 2012.

Chem 11/12: General Chemistry I and II

The percentage of Hispanic and African-American students enrolled in Chem 11/12 has been consistently lower than their percentages in the college as a whole. At the same time, the percentage of Asian and White students enrolled in Chem 11/12 has been consistently higher than their percentages in the college as a whole. For example, in Fall 2012 the percentage of Hispanic students enrolled in Chem 11/12 was 24.0% as opposed to 35.8% college-wide. The percentage of African-American students was 3.8% as opposed to 9.6% college-wide. In contrast, the percentage of Asian students was 29.3% as opposed to 15.5% college-wide and the percentage of White students was 34.6% as opposed to 28.1% college-wide.

While the percentage of Hispanic students enrolled in Chem 11/12 is lower than the percentage in the college as a whole it should be noted that the percentage of Hispanic students in Chem 11/12 has been increasing at a faster rate than in the college as a whole. This is most dramatic between Fall 2010 and Fall 2012 where Hispanic enrollment in Chem 11/12 increased by 6.1% from 17.9% to 24.0% while for the college overall Hispanic enrollment increased by only 4.0% from 31.8% to 35.8%.

Chem 21/22/24/31: Organic Chemistry and Biochemistry

The increase in Latino population mirrors the college trends, or slightly exceeds the increase college-wide. The male/female ratio appears to roughly equal, compared to the college where females outnumber males. Also, although we have a larger percentage of foreign students than the college population as a whole, we have seen a small decrease in the foreign student population. Compared to the college as a whole, we also have a significantly higher percentage of students who hold bachelor's degrees. This is exaggerated especially in Chem 24 and in Chem 31, where we have recently seen increased numbers of bachelor's degree students. These are likely our "Educational Development" students who are taking post-baccalaureate courses for graduate work in the medical sciences.

Generalities for Physics as a whole

The physics male:female ratio of 1.7:1 is certainly not representative of the college-wide male:female ratio, which is just shy of one-to-one and slightly heavy on the female side. This is certainly a cause for concern, but it is an issue endemic to physics departments nation-wide. Taking a weighted average of the students' ages, a typical student taking physics is about 23 years old. Under identical assumptions, a similar weighted average over the entire college also yields the same age for the average student. However, the data clearly shows that the college-wide age distribution has heavier tails (more younger and more older students, with fewer early-twenty-somethings) than compared to physics. Indeed, there is a greater variance about the mean age for the college-wide student body than for the physics student population. In terms of ethnicity, our physics student population differs markedly from that of the entire college. Blacks and Hispanics are underrepresented. There should, roughly speaking, be nearly twice as many Black and Hispanic students taking our classes than what is being observed. The proportion of Whites taking physics classes is consistent with the enrollment of White students college-wide. Asians/PI, on the other hand, are overrepresented at twice the percentage seen college-wide. The proportion of foreign students in our classes is double that of the college as a whole. While one out of five students at SMC have basic skills status, that is not the case in physics; basic skills prerequisites do not appear to be a significant issue. The majority of physics students tend to take a full load of units, but the situation is reversed college-wide.

Physics 6/7: General Physics I and II

The population of students served by this sequence is consistent with the above general findings, except that the numbers of female and male students tend to be similar.

Physics 8/9: General Physics I and II with Calculus

The Asian/PI ethnicity, at roughly 40% in this sequence, is markedly larger than the college-wide percentage at 15.5% for the Fall 2013 semester. The black and white populations are fairly close to that of the college, while the Hispanic population (at roughly 15% in this sequence) is drastically smaller than the 35.8% college-wide value. The overall

foreign-student percentage is larger in the sequence than in the college average, but the female population (at about 37% across all of the physics classes) is much smaller than the 52.9% that exists campus-wide. Compared to 5% of the campuswide population consisting of students who are seeking "Educational Development," there is quite a presence of such students with bachelor's degrees taking physics classes (amounting to 10% of all the physics students), perhaps representative of the population attending SMC to fulfill requirements for medical school.

Physics 12/14: Introductory Physics

This is one of the few physics sequences where the gender split is not as extreme. In Physics 12, the percentage of female students is roughly 55%, and in Physics 14 approximately 45% of the students are female, which is well below the college average. The lack of female students in physics is a well known phenomenon. There is about half the percentage of Black and Hispanic students and almost twice the number of Asian students as compared to the college at large. This ethnicity split is similar to other physics courses.

Physics 21/22/23/24: Mechanics/Electricity & Magnetism/Fluids, Waves, Thermodynamics, Optics/Modern Physics

As noted above, the fraction of men in physics is notably greater (63%) than that of a typical physical science course (52%) and across the college as a whole (47%).

The proportion of whites taking this sequence (25%) is roughly that of the college (28%). However, there are significant differences for other groups. The fraction of Asian/PI (46%) is nearly three times, Hispanics 17% is one-half, and Blacks (3.3%) nearly a third of their respective representation throughout the college.

Roughly 5% fewer students of this sequence are residents and 15% more are foreigners than is typical throughout the college. These figures are likely the result of foreigners, mostly Asian, seeking to acquire the background needed to transfer into STEM related fields.

Engineering 12/16: Statics and Dynamics

Although the data is sparse, it appears that the ethnicity split is similar to the college, but this is interesting because the engineering physics sequence which leads into these classes does NOT reflect the college's demographics. As stated in the previous section, there is a smaller percentage of Asian students when compared to the physics courses.

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3. What percentage of students in your program place in basic skills and, if applicable, how does this impact your program goals and/or curriculum.

Very few physical science students (less than 3% across all of our courses) are also enrolled in basic skills classes at SMC. This rate is dramatically lower than that of the overall SMC student population (19.9%). All courses in our program include math prerequisites of college algebra or higher, with the exceptions of Chemistry 9 and Physics 12/14 which are the courses designed for nonscience majors. For this reason, we asked Institutional Research to separate our basic skills student enrollment by math and English. The results indicate that less than 2% of our students are enrolled at the basic skills level in English, and less than 1% in math.

While these numbers are all very small, they do indicate that some students are not complying with our stated math prerequisites. To address this problem, we have informed department faculty of their ability to see student's math placement/prerequisite information in their online rosters and asked them to identify students in their classes who lack the requisite math preparation and strongly advise them to drop the science class and re-enroll after successful completion of the math prerequisites. MIS has also added a component to the student enrollment system that warns students when they enroll in a class for which they lack the prerequisite, in part due to requests for this feature from our department. We gave serious consideration to the implementation of computer-enforced math prerequisites but decided against it due to a number of practical considerations, most of which relate to the very large number of students who enroll in science classes at SMC but who took the prerequisite math elsewhere and the feasibility of reviewing and processing such a large number of prerequisite waiver requests. We feel that the number of students enrolling in our courses without the necessary math skills is small enough that the impact on our program is minimal. The impact on those few individuals is, however, very significant so we continue our efforts to identify those students and advise them of our concerns.

Although we do not list any English prerequisites for our courses, we are aware that a high level of reading skill is required for students to make effective use our course textbooks. We continue our commitment to adopt common textbooks across all sections of each course and to conduct regular committee-based evaluations of all textbooks to ensure that the books we use are accessible and appropriate for the vast majority of our students. However, students at the basic skills level in English are unlikely to find these texts useful and must rely entirely on information delivered orally during class, putting them at a further disadvantage. We do not currently have any way for faculty to identify these students. Of course, our faculty do reach out to all students whose performance in our courses is less than that required to pass the class and refer them to appropriate support services.

Program Evaluation

In this section programs/units are to identify how, using what tools, and when program evaluation takes place. Evaluation must include outcomes assessment as well as any other measures used by the program. Please use Section D to address program responses to the findings described in this section.

Programs/units with multiple disciplines or functions may choose to answer the following questions for each area. If this is your preferred method of responding, begin by selecting a discipline/function from the drop down, answer the set of questions and click "Save", your answers will be added to the bottom of page. Do this for each discipline/function. If you would like to answer the questions once, choose "Answer Once" from the drop down.

How would you like to answer these questions?

Saved Information For Program Evaluation

Area/Discipline Information Pertains To

All Disciplines (answered once)

1. List the specific SLOs your program or discipline has chosen to focus on this year for discussion of program improvement.

SLOs are specific, measurable statements of 'what a student should know, be able to do, or value when they complete a course'. An SLO focuses on specific knowledge, attitudes, or behaviors that students will demonstrate or possess as a result of instruction.

Our department assesses all of our SLO's each semester as described further it item 2 below. A complete list of our course-level outcomes is given here.

Chem 9: Everyday Chemistry

1. When given a current event scenario about global warming, students will be able to analyze and discuss the data and potential solutions, using acid/base calculations and appropriate chemical formulas.

2. Students will be able to write an analysis about some of the current drugs and poisons readily available in today's marketplace.

Chem 10: Introductory Chemistry

1. The student will demonstrate the ability to solve chemical problems using logical procedures based on well-established scientific principles.

2. The student will be able to use chemical theories to explain and predict observable phenomena, using the principles developed in Chem 10.

3. When conducting an experiment, the student will follow written procedures accurately and safely, demonstrate competence with lab equipment and measuring devices, and record data clearly and precisely.

Chem 11/12: General Chemistry I and II

1. The student will demonstrate the ability to solve scientific problems by following logical procedures based on well established scientific principles.

Examples in Chem 11 include:

- A multi-step chemical stoichiometry problem involving interconversion of various physical quantities.
- A Hess's law problem requiring manipulation of three or more reactions in order to obtain the enthalpy change for the desired reaction.

Examples in Chem 12 include:

- Calculating the pH of an aqueous solution.
- Calculating the reversible cell potential of a Galvanic cell composed of a set of arbitrary reactants and products.

2. The student will follow written procedures used in the general chemistry laboratory accurately and safely. When completing a laboratory report, the student will correctly apply the scientific method by making reasonable estimates of experimental uncertainties and drawing appropriate conclusions based on the gathered data and scientific principles.

3. The student will be able to relate microscopic theories to macroscopic observations specifically using the chemical principles developed in Chem 11/12 to explain observable phenomena.

Example in Chem 11 include:

- Using quantum theory to explain the periodicity of the elements.
- Using the kinetic molecular theory to explain the macroscopic behavior of gases.

Examples in Chem 12 include:

- Predicting the spontaneity of a chemical reaction by consideration of the Gibbs free energy.
- Using the collision theory to explain how the rate of a chemical reaction depends of temperature.

Chem 21: Organic Chemistry I

1. The student will follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such as an organic synthesis comprised of two or more steps, or a determination of the structure of a compound based on spectroscopy (IR, NMR, MS) and/or chemical evidence.

2. When conducting a laboratory experiment, the student will follow written procedures commonly used in the organic

lab (such as reflux, distillation, extraction, recrystallization, and melting-point determination) accurately and safely. When completing a lab report, the student will apply the scientific method correctly by being able to state a hypothesis, take careful measurements, estimate uncertainties and draw appropriate conclusions based on gathered data and scientific principles.

3. The student will explain observable phenomena using appropriate scientific theories, such as writing a reaction mechanism consistent with observed facts or utilizing appropriate structures to represent different types of organic molecules and species.

Chem 22: Organic Chemistry II, Lecture Only

1. The student will follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such as an organic synthesis comprised of

three or more steps, or a determination of the structure of an organic molecule or biomolecule based on chemical evidence.

2. The student will explain observable phenomena using appropriate scientific theories, such as writing a reaction mechanism consistent with observed facts or determination of a compound as aromatic, nonaromatic or antiaromatic by evaluating its structure and/or bonding and utilizing its classification to predict its chemical reactivity.

Chem 24: Organic Chemistry II, Laboratory

1. The student will follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such as the determination of the structure of a compound based on spectroscopy (IR, NMR, MS) and/or chemical evidence, or the prediction of a compound's chemical and/or physical behavior based on the behaviors of similar compounds.

2. When conducting a laboratory experiment, the student will follow written procedures commonly used in the organic lab (such as thin-layer chromatography, recrystallization and reflux) accurately and safely. The student will maintain an accurate and organized lab notebook. When completing a lab report the student will apply the scientific method correctly by being able to state a hypothesis, take careful measurements, estimate uncertainties and draw appropriate conclusions based on gathered data and scientific principles.

3. The student will explain observable phenomena using appropriate scientific theories, such as explaining the likely meaning of a lower-than-expected melting point, correlating the color and visible spectrum of a molecule, or other observations made during lab experiments.

Chem 31: Biochemistry

1. The student will follow a logical process based on well-established scientific principles and demonstrate the ability to use the appropriate problem-solving techniques to solve a scientific problem such has determining the structure and/or function of a protein or explain how the energy of glycolysis and the citric acid cycle is harnessed to fuel biosynthesis.

2. When conducting a laboratory experiment, the student will follow written procedures commonly used in the biochemistry including spectrophotometry, measuring and expressing enzyme activity, and various types of chromatography. When completing a lab report, the student will apply the scientific method correctly by being able to state a hypothesis, take careful measurements, estimate uncertainties and draw appropriate conclusions based on gathered data and scientific principles.

3. The student will explain observable phenomena using appropriate scientific theories, such as explaining the consequences of genetic variations in hemoglobin or writing a reaction mechanism for an enzyme catalyzed reaction.

In all Physics Courses SLO's are used to assess the theoretical capabilities of the student to be able to solve complex problems in idealized situations, and the experimental capabilities in making measurements and being able to explain consistencies and/or anomalies in the taken data using error analysis and/or arguments regarding the theoretical underpinnings of the experimental setup.

Physics 6: General Physics I

1. When presented with a physical situation and asked to solve a particular problem in mechanics (i.e. two masses connected via a string passing over a pulley), the student will follow a logical process based on well-established physics principles (i. e. Newton's laws) and demonstrate ability to use basic mathematical techniques, not including calculus.

2. When conducting a laboratory experiment and writing a lab report, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Physics 7: General Physics II

1. When presented with a physical situation and asked to solve a particular problem in, for example, electricity and

magnetism (i.e. the motion of a moving charged particle inside a magnetic field), the student will follow a logical process based on well-established physics principles (i.e. the Lorentz force) and demonstrate ability to use basic mathematical techniques, not including calculus.

2. When conducting a laboratory experiment and writing a lab report, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Physics 8: General Physics I with Calculus

1. When presented with a physical situation and asked to solve a particular problem in elementary mechanics (i.e. two masses connected via a string passing over a pulley), the student will follow a logical process based on well-established physics principles (i. e. Newton's laws) and demonstrate the ability to use basic mathematical techniques (centered around pre-calculus and calculus) in the problem's analysis.

2. When conducting a laboratory experiment, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Physics 9: General Physics II with Calculus

1. When presented with a physical situation and asked to solve a particular problem in elementary electricity and magnetism (i.e. a wire loop rotating in an external magnetic field), the student will follow a logical process based on well-established physics principles (i. e. Maxwell's Equations) and demonstrate the ability to use basic mathematical techniques (centered around pre-calculus and calculus) in the problem's analysis.

2. When conducting a laboratory experiment, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Physics 12: Introductory Physics

1. When presented with a variety of natural phenomena from everyday life, the student will be able to give qualitative explanations using basic physics principles (i.e. Newton’s laws).

2. When presented with simple physical situations, the student will be able to solve simple quantitative problems using basic physics principles (i.e. Newton’s laws).

Physics 14: Introductory Physics with Laboratory

1. When presented with a variety of natural phenomena from everyday life, the student will be able to give qualitative explanations and solve simple quantitative problems using basic physics principles.

2. (Physics 14 only) When doing a laboratory exercise and writing a report, the student will be able to state a clear and testable hypothesis, take careful measurements, estimate uncertainties, and draw appropriate conclusions based on gathered data and on sound scientific principles.

Physics 21: Mechanics

1. When presented with a physical situation and asked to solve a particular problem in mechanics (i.e. two masses connected via a string passing over a pulley), the student will follow a logical process based on well-established physics principles (i. e. Newton’s laws) and demonstrate ability to use basic mathematical techniques including calculus.

2. When conducting a laboratory experiment and writing a lab report, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Physics 22: Electricity and Magnetism

1. When presented with a physical situation and asked to solve a particular problem in, for example, electricity and magnetism (i.e. the creation of an electric current by a changing magnetic field), the student will follow a logical process based on well-established physics principles (i.e. Maxwell's equations) and demonstrate ability to use basic mathematical techniques, including calculus.

2. When conducting a laboratory experiment and writing a lab report, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Physics 23: Fluids, Waves, Thermodynamics and Optics

1. When presented with a physical situation and asked to solve a particular problem in thermodynamics, wave phenomena, or optics, the student will follow a logical process based on well-established physics principles (i.e. laws of thermodynamics) and demonstrate ability to use basic mathematical techniques, including calculus.

2. When conducting a laboratory experiment and writing a lab report, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Physics 24: Modern Physics with Lab

1. When presented with a physical situation and asked to solve a particular problem in modern physics, the student will follow a logical process based on well-established physics principles (i.e. laws of quantum mechanics) and demonstrate ability to use basic mathematical techniques, including calculus.

2. When conducting a laboratory experiment and writing a lab report, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Engineering 12: Statics

1. A student will be able to analyze a simple structure using the concept of Free Body Diagram.

2. A student will be able to analyze a complex structure using the concept of Free Body Diagram.

Engineering 16: Dynamics

1. A student will be able to predict the behavior and motion of a system under the action of forces.

2. A student will be able to describe the motion of bodies under the influence of forces both conceptually and mathematically.

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2. Describe how the program assesses SLOs and uses the results for program improvement including:

- **how outcomes are assessed and how often**
- **how and when the program or discipline reviews the results and engages program/discipline faculty in the process**

Since our last 6-year review, our department has rewritten the majority of its Student Learning Outcomes to be broader and more consistent across our curriculum. Most of our courses now have three SLO's relating to:

- Problem solving skills – the ability of students to apply scientific principles and appropriate mathematics to solve multistep, complex problems.
- Conceptual understanding – the ability of students to use established scientific theories to explain observed natural phenomena.

- Laboratory skills – the ability of students to follow laboratory procedures accurately and safely, to employ the scientific method, and to interpret and analyze data and error within data correctly.

Adoption of these SLO's has made it possible to have consistent assessment data not only across sections of the same course, but across courses in a sequence as well. These new SLO's also map directly to a number of core competencies under the five Institutional Learning Outcomes so we feel that the accuracy of our contribution to the institutional data set has improved. What we lost in generating these broader SLO's is the more detailed feedback on particular aspects of the course. This issue is being addressed differently by faculty teaching different course sequences:

Chem 9: Everyday Chemistry

Each instructor includes a multiple choice question on their final exams that addresses the above Chemistry 9 Student Learning Outcomes (SLO) 1 and 2. Instructors are then required to input the resulting data into the SMC ISIS-JRE System. Instructor selects "Meets Standard" if the student answered correctly, "Does Not Meet Standard" if the student has answered incorrectly and "Not Assessed" if the student did not take the final exam.

The SLO data is then compiled and evaluated by the Chemistry 9 Program Leader. Each SLO is assessed each fall and spring semester. During the fall semester at the Departmental Flex Day, instructors review data from the previous year. It is at that time that discussions are held which engage program faculty in the process. When deemed necessary, additional conversations and discussions are made during program meetings held throughout the semester.

Chem 10: Introductory Chemistry

Our first two Student Learning Outcomes (SLOs 1 and 2) are assessed using specific multiple-choice questions from a commonly-administered departmental final exam. The Chem 10 departmental exam was initially written by a committee of SMC faculty in 2002, and has been continually refined and improved upon over the intervening years. Originally this exam consisted of 25 multiple-choice questions (1 hour time limit), but in Fall 2009 it was expanded to 30 questions (1½ hour time limit) to better assess the broad range of content covered in the course. In addition, a large database of questions has now been developed for this exam so that we can continually make subtle changes to the exam each semester (and so reduce possible cheating), as well as offer multiple versions of the exam each semester. The departmental exam is given to all our Chem 10 students every semester including the intersessions, and program data is collected every fall and spring semester. Each instructor is required to submit a breakdown of student answers to the selected questions (# of responses of A, # of responses of B etc.) as well as the class average of the exam.

Since Fall 2009 we have used one multiple choice question from the departmental final to assess SLO 1, and one multiple choice question to assess SLO 2. The question used for SLO 1 is a multi-step problem. While the question selected has varied, this question typically involves some combination of nomenclature, equation balancing, moles, dimensional analysis, and stoichiometry. The question used for SLO 2 is a conceptual question. Again, the selected question for this SLO has varied; past examples of questions used have included exploring the conceptual relationship between density-mass-volume, examining the relationship between the composition of an equilibrium mixture and the equilibrium constant, and using Le Chatelier's Principle to predict the shift direction of an equilibrium system subjected to a stress.

The data collected for these questions is periodically reviewed by the Chem 10 committee (comprised of a mixture of full-time and part-time faculty who regularly teach this course) during program meetings, and recommendations – including improvements to teaching methods and changes to our assessment methods – are then proposed as needed. For example, to gain a better overall picture of the competencies assessed we have rotated through several different questions to evaluate these SLOs. Over the past few years we have used questions #2, #21, #11 (current) for SLO 1; for SLO 2 we have used questions #10, #30, #20 (current). The Chem 10 committee is now considering whether to use *several* questions from the final to assess SLOs 1 and 2 in order to gain a more comprehensive measure of student success, which should be superior to the brief "snap-shot" obtained by using just one question.

In contrast, SLO 3 is assessed using a questionnaire and worksheet developed by SMC faculty in Fall 2008 for use during the "Titration of Vinegar" lab. During this lab, instructors must carefully evaluate each student based on 7 specific criteria, including adherence to safety rules, handling of equipment and chemicals, and quality of results. Students must score a minimum of 5/7 to meet the standard of this SLO. Assessments are required of each instructor every fall and spring semester, and completed worksheets are requested for program analysis once a year.

Concerning SLO 3, initial reviews of the worksheet data by the Chem 10 committee indicated that specific safety and equipment-related instructions were not being properly followed by our students, and also that student titration results were frequently poor (not enough pale pink end points). In response, the Chem 10 committee re-wrote sections of the lab procedure to highlight safety and equipment handling in greater detail, and instructors were asked to do hands-on demonstrations with the equipment during their pre-lab lectures. We also increased the number of required titration trials from 2 to 3 to give students more practice with this important technique and improve their results. Subsequent worksheet data showed significant improvements in all of these areas once these changes were implemented. Given the success of this assessment tool, the Chem 10 committee is now considering developing similar questionnaires/worksheets for other core labs in the curriculum.

Chem 11: General Chemistry I

The SLO that relates to problem solving skills has been assessed using multiple choice questions on the final exam.

Intitially, we used only one multiple choice question to assess students success with regards to this SLO. Since Fall 2012, we have been using 4 multiple choice questions, each relating to a different topic in the course, in order to gain a more comprehensive measure of student success. More recently, within the last year, some instructors have given the American Chemical Society (ACS) exam as a final exam and used 10 multiple choice problems from this exam in order to assess the problem solving SLO. This has provided an even broader measure of student success and has the added benefit of enabling comparison to a national standard.

The SLO that relates to conceptual understanding has been assessed by noting whether students can correctly answer questions relating the concepts and theories discussed in the lecture to their measurements in the laboratory.

The SLO that relates to laboratory skills has been assessed by noting the degree of accuracy and precision associated with various laboratory measurements.

Chem 12: General Chemistry II

The SLO that relates to problem solving skills has been assessed using multiple choice questions on the final exam. As with Chem 11 we initially used only one multiple choice question but since Fall 2012 we have been using 2 multiple choice questions to assess this SLO.

The SLO that relates to conceptual understanding has also been assessed using multiple choice questions on the final exam. Initially, we used only one multiple choice question but since Fall 2012 we have been using 2 multiple choice questions to assess this SLO.

The SLO that relates to laboratory skills has been assessed by noting the degree of accuracy and precision associated with various laboratory measurements.

Chem 21/22/24/31: Organic Chemistry and Biochemistry

SLOs are assessed based on student responses to questions on exams, lab tests, finals, and laboratory reports and by observation of lab techniques. This is done at least once a semester.

Results are reviewed by faculty teaching Chem 21, 22, 24, and/or 31 at program meetings. Faculty assess SLO results, both quantitatively and organically, compare results to past semesters, discuss how to improve results, compare methods of instruction and testing, and brainstorm methods to make lab work more fulfilling for students. At the beginning of the program review cycle, we made significant changes in the assessments and assessment methods because the initial data often seemed like a snapshot that didn't really get at the desired outcomes.

All Physics Courses:

SLOs are assessed based on student responses to questions on exams and classroom activities, such as worksheets, and by observation of lab techniques in completing laboratory-based tutorials. This is done at least once a semester.

In the Physics 6/7 sequence, SLOs are assessed once a semester, typically at the end, either just before or in conjunction with the students' final examination. The first SLO, which indicates a student's ability to solve theoretical problems, has typically been measured with multiple-choice tests consisting of approximately thirty questions. The questions are sampled from standardized national exams such as AP Physics B and C exams, the Mechanics Baseline test, the Force

Concept Inventory, and the Conceptual Survey in Electricity and Magnetism. The appropriateness and relevance of the questions in these tests are supported by educational research. The second SLO, which indicates a student's ability to solve experimental questions, has typically been measured through aggregate performance on a subset of their laboratory reports completed throughout the semester.

Recently, in Physics 21, the first course of the physics sequence for engineering students, an effort was initiated to address some of the department's concerns regarding the course. There is often considerable variation of student background within our Physics 21 population. Further, the success rates and GPA for this course have historically varied markedly among different instructors. As several sections of Physics 21 are regularly offered, a move was made to assess more objectively student mastery using portions of an Advanced Placement multiple-choice exam. For several consecutive semesters the averages on the AP exam and average course GPA were studied across all sections. Notable variations among different sections were identified and a discussion of how to establish greater course uniformity takes place on a continuing basis. Future plans are to continue this practice in Physics 21 and to expand it to other course in physics to provide a more uniform standard by which to notice trends in student comprehension and material mastery.

A few methods are used for assessing the capabilities of students regarding the lab component of physics courses. Occasionally questions are asked during an exam that directly pertain to typical laboratory-related issues (such as the resolution of a measurement as it applies to a particular scenario, or the use of uncertainties in a problem to understand the effect that an uncertainty would have on the measurement of a related quantity). Testing for such understanding is useful as often times students take for granted the fact that problems never specify exactly how precise a specific value is, and exactly how such a precision issue can lead to vastly different end results of the calculation in the end. Another method used to assess student achievement on the laboratory SLO is to review a specific lab reports (preferably one assigned towards the end of the semester that tests for measurement capabilities) for students' error propagation knowledge and their ability to articulate on potential effects that were not taken into account in the measurements.

Results are reviewed by faculty annually during program meetings. Even though few instructors teach this sequence as compared to some of the others, the results are still reviewed by the physics faculty as a whole. These reviews allow for reflection on better methods of teaching and assessment, as well as re-evaluation of whether or not these results are sensitive to enrollment trends particular to various courses.

Engineering 12/16:

Course SLO's in Engineering 12 are assessed by student performance on specific exam questions. Results indicate about a 70% mastery rate for SLO 1, and about 50% on SLO 2. No results are available for Engineering 16 as it is now being offered for the first time in many years. The results for Engineering 12 mirror the relatively low success and retention rates. Discussion and analysis of all these results has been lacking. One part-time faculty member teaches these courses in the evenings. Until very recently, he has been employed as an engineer full-time in industry so has not been available to take part in department or program meetings which are held during business hours. Our model for SLO result analysis involves group discussion of results, so this has not been possible in engineering. However, the department chair and the full-time physics faculty recognized the need for improved full-time faculty oversight of both Engineering 12 and 16 and are initiating efforts to address this need. Specific plans are described in the department objectives for the coming year.

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3. If your program or discipline issues a degree or certificate list each degree or certificate and the core competencies students are expected to achieve on completion.

Core competencies focus on the body of knowledge, attitudes, and behaviors a student will have acquired upon completion of a program or certificate and are assessed by either a capstone course or success rates on SLOs for core courses.

The Physical Science Department does not issue any discipline specific degrees or certificates.

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4. What other evaluation measures does your program or discipline use to inform planning? (For example, student surveys, enrollment trends, student success, retention, degrees/certificates awarded, job placement, transfer rates, TIMS report, tutor usage etc.) Note trends and differences in performance by group (ethnicity, gender, age) or enrollment type (day/evening, on-ground/on-line).

Chem 9: Everyday Chemistry

At regular Program meetings we evaluate planning methods. At the 2010 Departmental Flex Day Meeting from discussions regarding the SLO data, it was decided that new labs should be developed specifically for Chemistry 9. These labs would reflect the ecological emphasis of the course. Professor Walker Waugh thereafter obtained a 2011 Margin of Excellence Grant specifically for this purpose and began work on the development of four new labs. In the summer of 2013, through the efforts of Dr. Wenise Wong and Professor Walker Waugh, the following new Chemistry 9 labs were completed and added to the curriculum in fall 2013: Detection and Absorption of Ultraviolet Light Lab, Acids, Bases and pH Lab, and the Synthetic Polymer and Plastics Lab. In addition, further discussions led to the modifications of the Paper Chromatography of Gel Ink Pens Lab, Flame Test and Atomic Spectra Lab and Making Soap - Saponification Lab. Work is continuing towards the development of the Electrical Conductivity and Aqueous Solutions Lab, which will provide students with an overview of the effects of acid rain on the environment.

Chem 10: Introductory Chemistry

Chem 10 uses several evaluation methods to inform planning. It is the largest program in our department as measured by number of sections offered (typically about 30 per semester) so we have focussed efforts for over a decade now on creating consistency in content, rigor, and assessment across all sections of this course.

Student Learning Outcomes: Our methods of evaluating our SLOs are described in detail in our response to Question 2. The SLO data is then reviewed and discussed by faculty, typically during regular program meetings. Over the past five semesters (Fall 2011 – Fall 2013, including Spring semesters), student success rates for our SLOs have been largely unchanged (minor fluctuations only), with the 5-semester averages being 73.4%-SLO 1, 70.2%-SLO 2 and 93.4%-SLO 3. One notable dip occurred with the success rate of SLO 1 for the Spring 2013 semester, which dropped substantially to 63%; however the following semester we saw the success rate return to the five-year average. Given that the same question was used to evaluate SLO 1 over this entire period, the drop was rather surprising. However, it is worth noting that the department switched the Chem 10 textbook in Spring 2013 to one that was deemed more rigorous for the course. It may be that the drop in the success rate for SLO 1 that semester is related to the textbook change, and the Chem 10 committee is planning to re-evaluate the suitability of this textbook and possibly switch to another one in the near future.

Departmental Final Exam: While only two questions from this exam are used to assess SLOs, the data we obtain from analyzing the results of the *entire exam* has been incredibly useful for informing planning. As described earlier, all our Chem 10 students take this final exam, and all instructors are required to submit the results of their section(s) to the Program Coordinator. These results include section averages, as well as a breakdown of student responses to the selected SLO questions. In addition, every few years the Chem 10 committee performs a large-scale analysis of the results of *every question* for *every student* taking the course for a given semester. In this way we can determine the success rate of our Chem 10 students on each question on the final, which allows us to identify overall areas of weakness among the entire cohort. Such a study was most recently conducted using all of our Fall 2013 finals. While some of the results were expected, some were surprising. Discussions during subsequent program meetings will center on isolating issues and brain-storming ways we can improve performance in the weakest areas.

Student Success Rates in Chem 10: When broken down by ethnicity, success rates for all major groups over a five semester period (Fall terms only, 08 – 12) appear to have largely remained flat; averages over this period include success rates of 67.1% for Asian/PI students, 37.3% for Black students, 43.6 % for Hispanic students and 65.3% for White students. These rates are also very similar to those we observed for our last program review. The lower success rates of our Black and Hispanic students continues to be a source of concern; however it is hoped that we will soon see some improvement in these numbers given the unique efforts of the STEM program with these groups. One interesting trend observed across all ethnic groups was a noticeable dip in success rates in Fall 2009 by 5-10%. This may be correlated to the departmental final itself, as this was the first semester we introduced the more rigorous 30 question version of the final. Success rates increased back to average values over the next few years.

Student Success Rates in Chem 11: An average of 41% of students (data obtained from Fall terms 08 – 11) who successfully complete Chem 10 go on to take Chem 11 within a year. Yet when the success rates of these students in Chem 11 are examined, we find that that the grade they earned in Chem 10 strongly correlates to outcomes in Chem 11. Of particular note are the low success rates of students who earned C grades in Chem 10; only 28.1% of these students (average of Fall terms 08 – 11) were successful in Chem 11. Chem 10 faculty plan to work closely with Chem 11 faculty to determine ways in which we can strengthen the critical thinking and problem-solving skills of these students.

Student Surveys: Chem 10 enrolls a diverse population of students with diverse educational and career goals. A recent survey indicated that if SMC were to offer a one-semester General-Organic-Biochemistry (GOB) course for pre-health professionals, 26.7% of our Chem 10 students would have enrolled in that course instead of Chem 10. The "one-size-fits-all" approach to Chem 10 is one of its greatest limitations, as the breadth of material we must cover to satisfy the requirements of such pre-health students (mostly nursing) means that we must sacrifice covering many core topics in greater depth and with greater rigor. The development of such a GOB course has begun, and it is hoped that once it is launched, Chem 10 faculty can modify the Chem 10 curriculum to better serve those students who plan on taking Chem 11 and other higher level chemistry courses.

Chem 11/12: General Chemistry I and II

We periodically administer surveys in our classes in order to facilitate scheduling and to determine the level of student preparation. Many of our students need to take biology, physics and math classes concurrently with Chem 11 and Chem 12 and to the extent that it is possible we try to minimize scheduling conflicts.

We monitor trends in enrollment and student success in order to help us direct our efforts most effectively.

For example, we have discovered that during the fall semesters between Fall 2008 and Fall 2011 only 28% of those students who receive a grade of C in Chem 10 (the prerequisite for Chem 11) are successful (receive a grade of C, B or A) in Chem 11. This number increases to 57% for those students who passed Chem 10 with a B.

Similar to the college at large, we have observed a steady increase in the relative numbers of Hispanic students, most notably between Fall 2009 and Fall 2012. In Fall 2009 16.1% of Chem 11 and Chem 12 students were Hispanic. This number had increased to 24.0% by Fall 2012. Comparatively, collegewide, 31.8% of our students were Hispanic in Fall 2009 and that number has increased to 35.8% in Fall 2012.

It should be noted that the success rate of Hispanic students in Chem 11 and Chem 12 between Fall 2008 and Fall 2012 averaged about 48% compared to an overall success rate in Chem 11 of 61%.

Chem 21/22/24/31: Organic Chemistry and Biochemistry

Enrollment trends are continually being evaluated and resulted in the addition of a an additional section of Chem 24 in the spring semester (starting Spring 2009), for a total of four sections each spring. A hybrid online/on-ground Chemistry 21 course was considered during Fall 2008, but rejected due to the complexity of delivering course content effectively.

Faculty are frequently contacted by former students as they prepare to transfer, attend professional school, or seek employment or internship opportunities. These students, while admittedly a self-selected group, assert that their SMC organic and biochemistry courses have prepared them well for upper-division courses, pre-professional assessment tests, internships, and graduate programs. These students really belong on a list of distinguished SMC-alumni.

Two faculty members administered the American Chemical Society (ACS) test covering Chem 21 material to their Chem 21 classes during the Spring 2011 and Spring and Fall 2013 semesters and the students scored in the 76th to 80th percentile. This test is administered to students at a variety of colleges and universities in the country and our students' results validate the content and rigor of our courses. The ACS test that covers the entire year of organic chemistry is administered to students who have taken Chem 21 and 22 and are transferring to UC Berkeley as chemistry or chemical engineering majors and in a few other cases to students in Chem 22. We don't have entire-class data as we do for Chem 21 and the cohort of students who transfer to UC Berkeley are self-selected; however, the students transferring to UC Berkeley usually perform at least at the 90th percentile.

Physics 6/7: General Physics I and II

Students entering the Physics 6/7 sequence come from a wide array of mathematical backgrounds, some having taken their required math courses as recently as the previous semester, while for others their last math class may have been several years prior. The level of mathematical preparation does not seem to be as important a predictor for student success as the less easily measurable qualities of academic discipline, organization and study skills. Student surveys given at the beginning of the semester are used to gauge the level of general academic preparation of students.

The success rates for this sequence according to student ethnicity have roughly remained steady since Fall 2010. (Prior to Fall 2010, a great deal of variability is present in the data and no interpretation of the fluctuations will be attempted.)

Fall 2010, a great deal of variability is present in the data and no interpretation of the fluctuations will be attempted.) Success rates for the Asian/PI and White ethnic groups tend to be around 70%, for Hispanics around 60%, and for Blacks around 40%. It is important to note that this last percentage applies to a relatively small sample size of 7; random fluctuations will therefore change the percentage markedly.

Physics 8/9: General Physics I and II with Calculus

Student surveys are administered to assess the physics and mathematics background of students, and concept tests are also administered once or twice a semester to assess the level of preparation of the students and progress across a semester. Enrollment trends and retention are also an integral part of the evaluation process.

As an example, the trends have been that students seem to have little preparation in attacking the many facets of this sequence. In particular, tackling word problems, learning the various concepts, and being able to apply those concepts to solve problems rigorously in both the theoretical and experimental setting is a tall order to master for those with little preparation. This can be seen from the SLO success rates and overall enrollment in the classes over the sections offered. In particular, Fall 2011 and Spring 2012 had roughly 60% success rates, with Spring 2012 having a very low enrollment in the end. Physics 9 seems to traditionally have low enrollment even with a single section offered, with a maximum of 22 students assessed in the SLO reports in Spring 2012.

Success rates have also been monitored by ethnicity across the fall semesters from 2008 through 2012. The success rate of the Asian/PI and Hispanic populations is 50%, while the White population has roughly a 60% success rate.

Institutional Research has also provided information regarding the level of preparation in the sciences of students enrolling into Physics 8. For example, about 55% of students having taken Chemistry 10 or above ended up getting an A, B, or a C in Physics 8. However, about 30% of this crowd received a D or F.

As such, a movement should be made by the physics program to prepare students well enough to enter into this sequence and to remain within the sequence until the very end. In the works is a plan to create a new preparatory course to help students be better prepared when taking the calculus-based sequences. Surveys have been administered asking students if they would have felt better prepared had they taken such a course, and many surveys agreed with this notion. Although feedback from the surveys suggested that the necessary math was taken by the students, coupling this with student success in this sequence seems to suggest inadequate preparation. A preparatory course could potentially help bridge this gap, particularly if the course can be transferred to other colleges and universities, making it worth the students' time to take it.

Another method of evaluation stems from an open discussion among faculty members during program meetings regarding their own experiences from teaching the sequence. Indeed, the general consensus for the Physics 8/9 sequence has been to propose an increase the number of weekly hours of contact time (at least by an additional hour) in order to appropriately cover all of the material within the sequence, in line with the rigor that is desired in the student learning outcomes.

Physics 12/14: Introductory Physics

Success in Physics 14 is strongly correlated with the amount of mathematics preparation the students have received. Upwards of 90% of the students who have completed transfer level mathematics succeed in P14, while between 60% and 70% succeed if the math level is intermediate or below. Ethnicity is far less robust of an indicator - except in as much as it correlates to mathematics background. Similarly, the greater the number of units that students have completed before attempting Physics 14, the more successful they are in general. This could also relate to the level of mathematics completed, since many students put off completing physics until they are close to transferring, they therefore also would be more likely to have completed more mathematics. Their motivation to complete the course successfully, if it is one of the last classes needed to transfer, may also raise their performance.

Physics 21/22/23/24:

Some instructors administer a mathematics survey at the beginning of the semester to gauge student preparedness in mathematics, and some administer pre and post tests to assess some areas of physics knowledge, using a nationally known tool, the "Force Concept Inventory".

Students have responded voluntarily to a survey as to their future educational goals and previous math and physics preparation in high school and college.

Engineering 12/16:

The department reviews success and retention rates for students taking our Engineering courses.

Objectives

As part of the planning process, programs are expected to establish annual objectives that support the program's goals. Please document the status of the program/function's previous year's objectives. Add comments if you feel further explanation is needed.

Objectives

<u>Objective:</u> Convene an ad hoc departmental safety committee to: a. Assess existing laboratory hazards. b. Review appropriateness of current PPE requirements for each laboratory course and modify as needed. c. Review and make appropriate updates to the student chemistry lab safety contract. d. Identify additional training needs and make recommendations to Risk Management. e. Review and make recommendations for updates to the CHP to Risk Management. f. Identify SOP’s needed and write them. g. Prepare laboratory safety manuals to be disseminated via a binder in each laboratory room and online. <u>Status:</u> In Progress <u>Comments:</u> Items a, b, c, d, and e are all complete. The most significant change is an increase in the required PPE (Personal Protective Equipment such as laboratory coats, gloves, goggles, etc) for students, including clearer delineation of which steps in which experiments require particular PPE. Item f is in progress and has been entered as an objective moving forward. Item g is nearly complete---the lab manual is posted online and hardcopies are ready for distribution to all lab rooms as soon as the SOP's can be added to them.	
<u>Objective:</u> Implement STEM Grant Year 2 Activities including: a. Pilot Supplemental Instruction in Chem 10, Chem 11, Phys 21. b. Purchase and install new NMR and IR. c. Develop Intro to Research course in conjunction with Life & Earth Science. d. Develop Intro to Physical Science Research Methods course. e. Develop and offer math/fundamental skills intervention workshops for SRI cohort students in conjunction with Life & Earth Science. <u>Status:</u> In Progress <u>Comments:</u> Items a, b, c, and e are complete, and d is in progress. a. SI is ongoing in these classes and expanded to Chem 12 for spring 2014. b. Both instruments are operational and integrated into our organic chemistry curriculum. SRI students experienced an introduction to both instruments and their value as research tools during the winter skills workshops. Interested students are taking good advantage of opportunities to delve further into NMR spectroscopy via Independent Study.	

c. The class ran in Winter 2014 and a second section is scheduled for spring semester. Participation in this course will qualify SRI students to apply for research positions at UCLA for summer 2014. d. Development of a second research course focusing on methods is being reevaluated because, following input from UCLA, the first research course includes a significant methods component already. We are currently working with our colleagues in other science departments via the STEM project to determine whether or not it would be useful to students for us to develop this second course. e. Such workshops were offered in Winter 2013, Summer 2013, and planned for Summer 2014.	
Objective: Pilot Test Annual Program Review Status: Eliminated Comments: This objective was eliminated because the CurricUNET system was not yet ready for use with Program Review. Instead, we are pilot testing the system this year with our 6-year review.	
Objective: Pilot Test use of TurnItIn.com in some lab classes. Status: Completed Comments: Two chemistry faculty piloted TurnItIn.com for use with student laboratory reports and portions thereof. They presented on their experiences at a departmental flex day. Overall, the system was found to be very effective at reducing instances of plagiarism as well as in streamlining the grading process itself. Other department faculty have since adopted TurnItIn.com for their classes as well.	
Objective: Complete & adopt online laboratory manual for Chemistry 12. Status: Completed Comments: As of fall 2013, students are no longer required to purchase a laboratory manual for Chemistry 12. All experiments are now authored in house and available for students to download from our department website. This is analogous to what we did earlier in Chem 10, 11, and 9. The primary motive is to reduce costs for students, but we feel the new labs are also more effective pedagogically, use fewer hazardous substances, and produce less hazardous waste.	

Looking Back

In this section, please document what you did last year as a result of what you described in Section C.

1. Describe any accomplishments, achievements, activities, initiatives undertaken, and any other positives the program wishes to note and document.

Several significant projects were completed, or very nearly completed, in the past year as detailed in our review of the past year's objectives in section *D1. Objectives* of this document. They include a major review and update of our laboratory safety policies and procedures; creation of an online laboratory manual for Chemistry 12 (continuing the effort previously completed with Chemistry 10 and 11, the goal of which is to reduce costs to students by eliminating the need for a laboratory textbook while improving the alignment of our laboratory exercises with our lecture material); purchase and installation of new NMR and IR spectrometers and implementation of other STEM grant activities including installation of new NMR and IR spectrometers and implementation of other STEM grant activities including winter/summer skills workshops, supplemental instruction in gateway courses, and the development of the new interdisciplinary course *Science 10: Introduction to Scientific Research*. Please refer to these objectives for more detailed information on these accomplishments.

Another notable achievement since our last six-year review is the computer enforcement of all same-discipline prerequisites and co-requisites, effective fall 2011. Before that it was possible for students to enroll without meeting the prerequisites. Previously, instructors could only check students' records *after* the start of the semester by reviewing grade rosters maintained by the department for students who had taken the prerequisites at SMC, or by individually collecting and evaluating transcripts for non-SMC students. Implementation of prerequisite enforcement included:

- working with MIS to develop an effective method for enforcing our Chem 22-Chem 24 co-requisite. Algorithms for prerequisite enforcement were already in placed since Math, English, and ESL had been enforcing prereqs long before our department joined them, but a system to enforce co-requisites had not yet been developed;
- creation of a process for reviewing transcripts and course descriptions for non-SMC students to determine equivalencies and grant prerequisite waivers, a task handled jointly by the department's administrative assistant and chair;
- implementation of midterm placement rosters for all courses serving as prerequisites;
- creation of ineligibility rosters and a process for dropping ineligible students who enrolled in courses based upon midterm roster results but who did not go on to complete their prerequisite class successfully;
- creation of a list of courses at nearby colleges that meet the prerequisites for Chem 21, 22, and 24 to aid the chair to clear students for enrollment into those courses;
- creation of challenge exams for all prerequisite courses to be administered by the department in cases where students claim to have the prerequisite knowledge but who cannot document that with a transcript.

In the fall of 2012, affecting student enrollment for winter/spring 2013 and beyond, the department implemented a new cut score for our Chemistry 10 Challenge Exam. Previously, the cut score had been 22 out of 40 points. Hannah Lawlor of Institutional Research, working with Esau Tovar in the Assessment Center, conducted a comprehensive challenge exam validation study involving collection of student grade information, faculty surveys, and student surveys, and concluded that our cut score was too low. This finding correlated strongly with prior findings of department faculty. A request for renewal of validation for this exam, including a request to raise the cut score (see attached documents *SMC Request for Renewal of Validation of CCDT* and *CCDT Disproportionate Impact Discussion*), was filed with the Chancellor's Office and permission was granted to raise the cut score to 26. We did not experience a measurable increase in success rates in Chem 11 after the new cut score went into effect, but that is probably because the number of students who score between 22 and 26 on the Chem 10 Challenge Exam is too low to impact the overall success rates for this high enrollment course. However, we can speculate that the impact on that small population was significant and hopefully saved them from experiencing failure in Chem 11.

Several faculty have piloted the use of the American Chemical Society's standardized exams in General Chemistry for use as final exams in our Chem 11 and 12 classes with tremendous results: The average of student scores across fifteen sections of Chem 11 placed these students in the 88th percentile nationwide, and averages for eleven sections of Chem 12 placed our students in the 82nd percentile! (Note that there are two questions on the Chem 12 exam that pertain to topics not covered in our course.) The program will be expanding the use of these exams to all sections of the classes and using them for SLO assessment as well as to gather comparisons of our students to those across the nation.

The organic program developed a spectral bank for faculty teaching Chemistry 21 and 24 so that they can efficiently provide NMR spectra to their students for the compounds prepared, isolated, and analyzied in these courses. These spectra are gradually being replaced by digital copies of spectra taken on the new NMR spectrometer purchased with the STEM grant.

Finally, the department has successfully hired five new full-time faculty since our last program review: three in chemistry, and two in physics. All of these hires were replacements for full-time faculty lost to retirement or resignation. In chemistry, the hiring has kept pace with attrition so our faculty has maintained its size, but in physics, we still need two more hires to keep pace, one of which is in process and the other was proposed to the new faculty ranking committee. Brief biological sketches of the five most recent hires follow.

Sehat Nauli is from Jakarta, Indonesia. He earned his B.S. in Biochemistry at UCLA, and his Ph.D. in Biochemistry from the University of Washington where his dissertation was entitled *Folding Kinetics and Redesign of Peptostreptococcal* *proteins L and G*. After completing postdoctoral research at UC San Francisco on the design and synthesis of potential inhibitors of a protein kinase and at UCLA on designing a protein crystallization module based on the TEL-SAM domain, Dr. Nauli joined the full time faculty at SMC in 2008.

Steve Paik is from Duarte, CA. He earned his B.S. in Physics from the California Institute of Technology in 2003 and his Ph.D. in Physics from the University of Washington in 2010. His dissertation is titled *Thermodynamics of gauge theories with N=2 supersymmetry*. He joined the SMC faculty in 2010.

Mahealani Bautista is from Orangevale, CA. She earned her B.S. and M.S. degrees in Chemistry from California State University, Sacramento, and her Ph.D. from the University of California, San Diego. Her doctoral dissertation is entitled Identification and Design of Small Molecules that Associate with Aggregated Alzheimer's-Related beta-Amyloid Peptides. She joined the full-time faculty at SMC in 2011.

Jennifer Hsieh is from La Verne, CA. She earned her B.S. in Biochemistry from California State University, Fullerton, and her M.S. and Ph.D. in Biochemistry & Molecular Biology from UCLA. Her dissertation is entitled *A GFP-based strategy for overexpression, purification and characterization of membrane proteins and the crystallographic structure of murine aminoacylase 3 with substrates*. She joined SMC's faculty in 2011.

Emin Menachekanian was born in Tehran, Iran. He earned his B.S., M.S. in Physics from UCLA and has just submitted his doctoral dissertation in experimental physics, an anticipates awarding of his Ph.D. this spring semester. The title his dissertation is *3rd Sound in Superfluid Helium Films Adsorbed on Carbon Nanotubes*. He joined SMC's faculty in 2012.

2. Summarize how the program or service area addressed the recommendations for program strengthening from the executive summary of the previous six-year program review.

In 2008, the Program Review Committee recommended the Physical Science Department consider the following to further strengthen their programs:

1. Consider mirroring the Chem 9/10 structure and engagement for Physics 6/7.
2. Consider standardizing identified Physics testing and grading practices to ensure consistency among faculty and to combat the impact of rating websites such as Pick a Prof.
3. Continue to pursue opportunities to collaborate with external groups and other areas of the college to improve the recruitment and retention of underrepresented students.
4. Dialogue with the Math department to develop strategies (including new courses) to help students better prepare for all Physical Science classes, especially the Physics sequences.
5. Maintain the high level of self-analysis, evaluation and responsiveness to findings.

Recommendations 1 and 4 above relate to an ongoing challenge in our physics program, and indeed to physics programs in general. Success rates in the entry class to each sequence (Physics 6, 8, and 21) are low, while those of the courses that follow are higher. These "gateway" classes are clearly effective in preparing students for the remainder of the course sequence, but too many students do not make it past these entry classes. The physics faculty have devoted considerable time and effort to researching and discussing the reasons for the low success rates and strategizing regarding possible solutions. The faculty met with representatitives from the math faculty, and those discussions led to the conclusion that, while most of the math skills needed for success in physics courses were indeed covered in the prerequisite math courses, the focus in math was more theoretical than the applied approach needed for physics, and some topics needed for physics were scattered among higher level math courses not included in our physics prerequisites. It is important to note that this situation is not unique to SMC, but is a challenge faced by physics educators in general. To address this problem, the physicists plan to develop a preparatory course for students planning to enter calculus-based physics (either Physics 8 or 21) since the success rates are most worrisome there. This preparatory class will cover only those specific math skills needed for success in physics, and will teach them within a physics context with a focus on skills for approaching and solving challenging problems.

We believe this approach will provide the physics program with a similar structure to that used in chemistry. In chemistry, Chem 10 was developed many years ago to prepare students for entry to Chem 11, which is General Chemistry I. Later, we developed Chem 9 to better focus the curriculum on the specific needs of different student populations. Now, it is our plan that Chem 9 address the needs of nonscience majors, allowing Chem 10 to focus on preparing science students for Chem 11. Physics is moving towards and analogous situation, but from the reverse direction. Physics 12 and 14 were developed to meet the needs of nonscience majors, and now a new physics course will focus on preparing science majors for their entry into the physics course sequences.

for their entry into the physics course sequences.

Recommendation 2 regarding inconsistent grading practices in physics continues to be addressed via several initiatives. Peter Morse applied for and received a sabbatical leave to conduct an analysis of assessment and grading practices at a number of physics institutions. In physics 21, several full-time faculty (Peter Morse, Jacob Morris, and Nuria Rodriguez who has since retired) piloted the use of a standardized portion of their final exams providing objective comparisons of student achievement to support their discussion of appropriate grading standards. The next step is to implement the standardized questions in sections taught by part-time faculty and in other physics courses.

We realize that progress on these issues in physics is slow, but it is critical to note both that these are difficult problem to solve, and that our physics program has been working on doing so while suffering from a very low ratio of full-time to part-time faculty. Our recent full-time hires are wonderful contributors to the program and are helping to accelerate progress on these issues, though the physics faculty continue to devote a significant portion of their nonteaching time to the mentoring of our large part-time physics faculty population.

Recommendation 3 regarding recruitment and retention of underrepresented groups continues as a primary challenge for the department, though progress is being made. Perhaps due to increased enrollment of Hispanic students campuswide, and perhaps due to the efforts of our HSI STEM grant recruitment projects, enrollment of Hispanic students in both chemistry and physics has increased significantly in recent years. See section B of this document for details, but as a department, we have moved from about 17% Hispanic enrollment to about 28%. Over the same time period, Hispanic enrollment campuswide has increased from 26% to 36%. Thus, Hispanic enrollment in Physical Science has increased by about 65% while it increased for the campus by about 38%. The influx of new Hispanic students to SMC is clearly enrolling in the sciences at a greater rate.

Enrollment of African-American students in science classes has not increased. Sadly, the number of African-American students enrolled in our courses is often so low that we cannot obtain meaningful information on success rates. Women also continue to be underrepresented in our physics program, though not in chemistry. Our challenges are clearly to recruit more African-American students to the sciences, more women to physics and engineering, and to help them as well as our Hispanic populations to thrive in our courses.

Ongoing efforts to improve recruitment and retention of these populations include continuing active participation in STEM grant activities such as supplemental instruction, outreach to local high schools, cohort strengthening activities. We are also continuing efforts to hire a more diverse physical science faculty and have plans, with assistance from Melani Bocanegra, STEM Director, to reach out to underrepresented populations at professional conferences, meeting prospective new faculty and informing them about our programs' commitment to these efforts. Another new initiative involves the strengthening of our partnerships with Adelante and Black Collegians. Muriel Walker Waugh has been a strong liason between our department and these programs for years, but we are striving to get greater involvement from other department members as well. Finally, we think that our efforts to further focus our introductory chemistry curriculum on specific student populations (nonscience students in Chem 9, nursing students in the new General/Organic/Biochem course, and only those planning to enter Chem 11 in Chem 10) will help us better meet the needs of each population, thereby improving success rates for all students, especially those taking Chem 11 and beyond. Similarly, the new physis prep class is intended to improve success rates for all students, including minorities and women, entering the Physics 8 and 21 sequences.

Finally, regarding recommendation 5, we are trying!! And the District's commitment to hiring more full-time faculty is helping tremendously.

3. Describe any changes or activities your program or service area has made that are not addressed in the objectives, identify the factors (e.g., licensure requirements, state or federal requirements, CCCO mandates, regulations, etc.) that triggered the changes, and indicate the expected or anticipated outcomes.

All of our major activities are covered in the objectives or in item 1 above. Note, however, that changes to safety protocols described in last year's objectives were precipitated by an increased focus on chemistry laboratory safety nationwide. Four years ago, a recent chemistry graduate was hired as a lab technician in a research lab at UCLA. After suffering burns during a terrible accident that occurred while working with a pyrophoric material (a substance that catches fire upon exposure to air), the young woman died. Her death launched a major investigation into safety procedures and their enforcement primarily at academic research labs, but also at academic laboratories in general. There is now a heightened focus on lab safety issues nationwide. Our chemistry program responded enlisting the assistance of UCLA's Office of focus on lab safety issues nationwide. Our chemistry program responded enlisting the assistance of UCLA's Office of Environment, Health and Safety to guide us in a thorough review of our own lab safety practices. For more detailed information on the results of that review, please see section D1 Objectives.

4. If your program received one time funding of any kind indicate the source, how the funds were spent and the impact on the program (benefits or challenges).

STEM Grant funds have provided the following support to our program:

- The marginally to non-functioning NMR and IR spectrometers were replaced during the 2012-2013 academic year. Students were thrilled to have access to this instrumentation that allowed them to verify the identity of substances they prepared or isolated in the lab while developing their skills with this powerful, industry-standard instrumentation.
- Several sections of several course (Chem 10, 11, 12, and Physics 21 and 23) have benefited from Supplemental Instruction. We are anxiously awaiting receipt of data on the effect of this resource on student success, but need more time to collect a meaningful quantity of data.
- Laboratory equipment to support the new course, Science 10: Introduction to Scientific Research. This course includes a significant hands-on component in which students gain experience with real research projects.
- Additional laboratory equipment was purchased to support a number of courses in the program, including hand-held Vernier devices that allow students to collect data digitally in a number of experiments, then send those data to their own computers for analysis.

Margin of Excellence projects over the past six years have enabled the purchase of:

- iclicker student response devices that have enabled extensive interactive classroom engagement for all students, an experience of particular value for international students who traditionally are reluctant to answer - or ask - questions in class.

- a periodic table of ***real*** element samples that draws the attention of many students daily in our lobby area.

- polymer exchange membranes (PEMs), isomorphic graphite sheets, and power tools including a band saw and a drill press for fabricating the graphite electrodes, that allow students to design, construct, and characterize hydrogen fuel cells. This gives them hands-on experience in experimental design, engineering, scientific research and the scientific method in general.

- two rotary evaporators that students use to evaporate organic solvents from solutions obtained from extraction of carotenoids from fruits and vegetables in a quick , a safe and environmental friendly way.

- two visible light spectrometers which provide Chem 31 students with increased hands-on experience in the lab.

- a selection of chemical laboratory equipment and supplies that enabled the development and implementation of several new experiments for our Chemistry 9 course.

- organic chemistry glassware to support experiments in Chemistry 24.

- A Macbook Air laptop used to make videos for a flipped version of Chem 11.

SMC Fellowships and Sabbaticals supported:

- Peggy Kline's project to develop, pilot, and implement new and modified experiments for Chem 21 that eliminated the use of the carcinogenic substance methylene chloride.
- Peter Morse's project to conduct a review of physics assessment and grading practices at a number of institutions which is supporting our department's efforts at improving consistency in grading practices amongst faculty.
- Asma Said's project to research relationships between student performance in physics courses and math skills upon entry to those courses.
- Roman Ferede's research on beta carotenes in staple foods of malnourished populations conducted at the International Institute of Tropical Agrigulture (IITA) in Nigeria.

Chair of Excellence funds were received by Roman Ferede (2009-2012) and Deborah Schwyter (2012-2015) to support students directly by purchasing supplies and equipment used in regular and special projects courses. Deborah Schwyter used her Chair of Excellence funds purchase a UV spectrophotometer and related supplies which have improved students' laboratory experiences in Chem 31. Roman Ferede purchased equipment to support her ongoing student-driven research project on carotenoids in staple foods in collaboration with researchers at the IITA in Nigeria, giving dozens of students research experience and exposure to an important application of their chemistry skills.

5. Describe departmental efforts to improve the teaching and learning environment.

The Physical Science department makes effective use of SMC's peer evaluation process to provide all faculty with ongoing feedback and opportunities for discussion of methods for the improvement of teaching and learning. Evaluations are thorough and efforts are ongoing to maintain a culture of peer support in the implementation of teaching methodologies.

Several physical science faculty are either experimenting with our making substantial use of "flipped classroom" techniques in which some delivery of content occurs before class using online videos or other asynchronous techniques, and class time is used for interactive and collaborative problem solving exercises that provide students with practice applying the new information. Sehat Nauli has taken a lead role with this technique, but many other department faculty are now making extensive and effective use of it as well.

Iclickers are now in common use in many of our classrooms. This effort was initiated by Peter Morse in physics classes years ago, but use has expanded tremendously since then and is common in both chemistry and physics. The technique has proven very successful in keeping students engaged with the material throughout class sessions.

The value of live demonstrations to peak student interest and ensure their memory of specific content is well established, and is recognized by our faculty as well. We have long sought to develop a robust library of standard demos but this vast project is often trumped by more pressing projects. Nonetheless, we recognize that each instructor has amassed a small, or in some cases not so small, collection of favorite demos that he/she finds invaluable in the classroom. To help share these jewels with each other, one of our departmental flex days last year was devoted to this topic. "Demo Day" consisted of two separate gatherings, one for chemistry and one for physics, when instructors shared their best demos with their colleagues. It was fun, and succeeded in increasing our use of the best demos.

Two organic chemistry program faculty members were part of the TurnItIn pilot program during the Spring 2013 semester. This change was inspired through discussion of the lab SLO assessment results, and the difficulty students encounter when writing lab reports; in some cases, these reports show students have many problems with plagiarism and originality. Use of TurnItIn has inspired more originality among the students which will, in turn, lead to an increased emphasis on lab reports and effective data analysis by the students, thus improving the course-level outcomes. The faculty presented their experiences at a departmental flex day in a joint session with Life Science faculty. Several other faculty in both departments are now also using TurnItIn with their classes.

Independent study courses are offered by several different faculty within the physical science program to provide students with an introduction to scientific research, including hands-on use of the FT-NMR instrument, participation in the IITA collaborative project, and building and improvement of a hydrogen fuel cell. Students taking the independent studies courses in conjunction with an organic lab course are able to integrate the information learned in the classroom directly with real projects, and all independent study students learn to solve the concrete issues encountered when trying to get research results from scientific instrumentation. They are also able to extend many of their skills to the equivalent of an upper division or graduate level, helping them prepare for a smooth entry into research laboratories outside of SMC.

Three department faculty participated in last summers Faculty Summer Institute. They reported on their experiences to the rest of the department at a fall flex day, unanimously expressing tremendous satisfaction with the experience. We are encouraging several more faculty to participate in the Institute this summer as well.

The HSI STEM initiative is providing effective professional development opportunities to STEM faculty as well. Last week, Dr. David Drew, author of STEM The Tide: xxx gave a very interesting seminar to members of all the science departments and the math department. In addition, a copy of his text was purchased for each department and is circulating among department faculty. Last month, STEM sponsored a seminar by Dr. Amelito Enriquez entitled *Strategies for Expanding & Strengthening the Community College STEM Pipeline* and, again, all STEM faculty were invited. Not only is the STEM project sponsoring valuable events like these, but it is also increasing interaction among science and math faculty of different disciplines and stimulating cross-disciplinary discussions of STEM education issues in general.

6. If there is a tutoring component or other learning support service associated with the program, describe the relationship between the service(s) and the instructional program. If applicable, discuss any data you have compiled regarding student participation and the impact on student success.

The Science Learning Resource Center, located in Science 245, is staffed by Saundra Willis (Tutoring Coordinator), Cindy Kelly (daytime LRC Clerk), and Nichelle Monroe (evening LRC Clerk). The LRC operates under the direction of Mona Martin, Dean for Learning Resources, who handles evaluation of the tutoring and support services housed there, including gathering and analysis of data on the impact their services have on student success. However, it is important to note that the Physical Science faculty have an effective working relationship with the LRC staff and vice-versa. Because we share a common facility, we see each other often in the hallways and staff workroom and interactions are frequent and collegial. Faculty are easily able to update the LRC staff of any curricular, textbook, or other relevant changes. Staff are also able to talk with faculty regarding questions or concerns that arise in their work with science students. When asked, Physical Science faculty reported a high level of satisfaction with the LRC services and staff.

At the time of this writing, oversight of the LRC and its services is transitioning from Mona Martin to Ron Furuyama. We look forward to developing a strong working relationship with Ron as we have with Mona.

Moving Forward

Discuss and summarize conclusions drawn from data, assessments (SLO, UO) or other evaluation measures identified in Section C and indicate responses or programmatic changes planned for the coming year(s) including:

- **how the assessment results are informing program goals and objectives, program planning, and decision-making**
- **specific changes planned or made to the program based on the assessment results**

The majority of our plans for the coming year are presented in section D2. Objectives. Below are descriptions of additional plans that are specific to one course only.

Chem 9: Everyday Chemistry

In response to students' expressed interest in this subject and its potential usefulness in illustrating course concepts, we wish to develop and implement a Forensics Chemistry experiment.

We are also initiating collaborations with Adelante, Black Collegians, and Athletics to improve enrollment and retention of African-American and Hispanic students.

Longer term goals for Chem 9 include further expansion of the number of sections offered to continue migrating non-science majors out of Chem 10 and into Chem 9. We are also considering offering the course online. We have offered hybrid chemistry courses in the past, but the lab component always had to be conducted on campus. However, we believe the Chem 9 labs could be performed safely and effectively by students in their own homes, thereby opening up the possibliity of a DE version of Chem 9.

Finally, we have a noted a small number of students in Chem 9 who decide to continue on in chemistry but who have insufficient math backgrounds in to move on to Chem 10. We are considering creation of a 1-unit course in math skills for chemistry that would assist these students in achieving access to Chem 10.

Chem 10: Introductory Chemistry

We have begun a review of textbooks and plan to select a replacement that fulfills the faculty desire for greater rigor for which the current text was selected, but which also addresses specific issues that have arisen concerning the current text.

Because the laboratory experiment currently used to assess SLO#3 (laboratory skills) has been improved so directly based on the assessment results, a different experiment will be used for this purpose going forward. A new assessment tool based on a different experiment will be developed.

To improve the reliability of our SLO assessment results, we will increase the number of questions selected from the standardized final exam for use in assessment of SLO's 1 and 2.

The Chem 10 instructors will discuss significant findings from the full-scale analysis recently conducted of the Fall 2013 final exams. A longer term goal is to find ways to let individual instructors know of the relative strengths and weaknesses of their students' performance on various items within the exam while respecting academic freedom and privacy.

Finally, in order to focus Chem 10 activities more exclusively on preparing students for entry into Chem 11 (data reveal that, currently, students completing Chem 10 with a C grade have only a 28% chance of passing Chem 11), our chemists will develop a new course covering elements of General, Organic, and Biochemistry that will better meet the needs of our Nursing students. Once the pre-nursing population is extracted from Chem 10, we will work to improve Chem 10's effectiveness in preparing students for success in Chem 11.

Chem 11/12: General Chemistry

We are planning to administer the ACS general chemistry exam in all of our Chem 11/12 sections. This will serve two purposes.

(a) The total score on the exam can be used as a more comprehensive diagnostic of SLO#1 and/or SLO#3.

(b) We can compare the results of our exams with the national average, providing us with a measure of our overall effectiveness. In addition, by analyzing student success on particular problems, or certain types of problems, we can identify potential weaknesses in our program.

We have noted that for students who have received a grade of C in Chem 10, and then enrolled in Chem 11, the success rate is only 28% (see part C). We believe this low success rate is a result of the increased rigor of Chem 11 compared to Chem 10.

We hope to increase this success rate by modifying the content of Chem 10. Our plan is to include less content, but to increase the level of rigor of the content that remains, introducing more emphasis on problem solving, mathematical reasoning, and critical thinking. Chem 10 will become less like a survey course and more like a preparatory course for Chem 11. Students who do not intend to take Chem 11 but who need a laboratory science class will be encouraged to enroll in Chem 9 instead of Chem 10. In addition, we hope to create a new class that will cover general, organic and biochemistry that is more suitable for nursing students.

We have noted that the percentage of Hispanic and African-American students enrolled in Chem 11/12 is significantly lower than their representation in the college as a whole. While we have observed some lessening of this gap over the last 3 years (see part B) we hope to that our ongoing STEM program will continue this trend.

Chem 21/22/24/31: Organic Chemistry and Biochemistry

The data accrued from the last five semesters of SLO results are fairly consistent from semester to semester. Students appear to struggle the most with assignments and questions that ask them to explain observable phenomena using appropriate scientific theories. This includes, but is not limited to, writing mechanisms for organic reactions and biochemical processes, analyzing and presenting graphical data, and writing conclusions and analyses that focus on the critical objectives of experiments.

We continue to compare and analyze teaching methods and suitable problems for mechanisms, both during our program meetings and informally. We are also reviewing several chemistry texts with a variety of approaches to mechanistic chemistry during the Spring 2014 semester. Although the main goal is the possible adoption of a new book for Chem 21 and 22, an inevitable side product is learning new ways to present and interpret the material to students.

The ACS exams that we have been using in Chem 21 and Chem 22 contain problems on topics, most notably polymer chemistry, that we do not cover. We plan to discuss the topics covered as part of our textbook review during the spring 2013 semester.

Performing a group of experiments with a common theme often helps students to see connections between topics that are presented at different times in lecture and to compare techniques We have several of these experiments in place in all the lab courses in the program, including a three-week qualitative analysis lab in Chem 24, but plan to pilot more labs with a common theme during the 2014-2015 academic year. If a new textbook is adopted for Chem 21 and 22, this may have an impact on the experiments performed in Chem 21 and Chem 24.

As noted in other parts of this Program Review document, several faculty are using Turnitin to catalyze the production of more original lab reports from students. That will enable us to emphasize lab reports and the writing of suitable conclusions and analysis to a greater extent in all of our lab courses.

Chemistry 31 plans to incorporate more graphical analysis and interpretation in lab reports. Data interpretation is an important component of the new MCAT 2015 that will be taken by our students who apply to medical school in the future.

We have experienced a drop in enrollment of students in Chem 31: Biochemistry. This may be in part due to the fact that other colleges that previously did not offer a biochemistry course, now do. Also, some students preparing for the new MCAT 2015 are being advised to take a "bio-organic" not offered at SMC.

Over the past few years, a number of student inquiring about Chem 31, are really looking for a GOB (General Chemistry, Organic Chemistry and Biochemistry) course that meets the pre-requisites of nursing programs and other allied health career programs. We have begun efforts to develop such a class at SMC.

A long-term goal of the organic and biochemists is to have all of the Chem 21 and Chem 31 labs available online for students. Most of the Chem 31 labs and several of the Chem 21 labs already are. As part of this effort, several of the labs in these courses may be rewritten and some new labs may be added. The new and revised labs will incorporate some changes resulting from items discussed in Part D, including a series of related labs and increased graphical data analysis. Faculty members will start piloting labs during the 2014-2015 academic year.

Physics

Relatively low success rates and SLO mastery rates in the entry courses to our calculus-based physics sequences, Physics 8 and 21, indicate the need to take action. We plan to increase the weekly contact hours in physics 8 and 9 to allow faculty sufficient time to cover the mandatory topics therein. In addition, we plan to develop a preparatory course covering a mixture of math skills (drawn from several different math course at various levels) and physics content to help students become proficient in the application of mathematical techniques to physics problem solving. This course would serve as a prerequisite to Physics 8 and 21, but a challenge exam will be developed to allow those with sufficient preparation to bypass this new course.

One additional goal of the physics program is to continue its discussion of grading practices and development of strategies to narrow the variations in grading standards across sections of each course. Development and use of more common assessment tools in various physics classes may assist in this effort, and will also help to make SLO assessment methods more consistent and assessment results more reliable.

Engineering

The lack of any full-time faculty teaching engineering, and the fact that our full time physics faculty lack significant expertise or minimum qualifications in this field, makes it very difficult for us to guide the engineering program in a direction that will improve its success and retention rates. This very small program (one section of Engineering 12 per semester, and none of Engineering 16 until this spring when we are experimenting with re-offering it) has made the hiring of a full-time instructor in engineering unwarranted. However, as interest in engineering majors increases (as evidenced by our surveys of STEM cohort participants), we are hoping to expand the size and visibility of this program on campus. Therefore, a request has been submitted for a new full-time faculty hire with the expertise to supervise this part of the physical science program *and* the skills to be an effective physics faculty member as well. This is seen as a vital step to invigorate and improve the quality of the engineering program.

One of the current full-time physics faculty will attend the spring 2014 meeting of the Engineering Liason Council. This group is a consortium of community colleges and four year universities in California that looks at current trends in engineering education and specifically addresses ways to better streamline the transfer of community college students to the UC's and CSU's. This will be the first visit of a full-time faculty to this group and it is hoped that the information gathered there, and partnerships begun, will be a first step in us improving the strength and effectiveness of the engineering part of our program. We will implement a new process of SLO assessment for ENGR 12/16 and delineate how the faculty will review and discuss the results and their impact on the future planning for the engineering courses.

Objectives (Moving Forward)

Objective #1
Objective:

Write and implement Standard Operating Procedures (SOP's) for the use of all hazardous materials in chemistry and physics laboratories.

Area/ Discipline/ Function Responsible: All

Assessment Data and Other Observations:

External Factors:
Other Factors
Recommendation from UCLA Office of Environment, Health and Safety (EHS)

Timeline and activities to accomplish the objective: 1. Standardize the format for existing SOP's already used by chemistry stockroom staff (Spring 2014).
2. Develop a second, more concise format for use in student laboratories for both chemistry and physics. (Spring 2014)
3. Using the new formats, write SOP's for all identified hazards in both chemistry and physics labs.
4. Publish the SOP's in the Physical Science Department Lab Safety Manual.
5. Print the short-form SOP's onto laminated cards and provide them in student laboratories as appropriate for the particular experiments scheduled in each class session.

Describe how objective will be assessed/measured: 1. Laboratory Safety Manuals containing detailed SOP's will be present in each lab and on the department website.
2. Relevant short-form SOP's will be distributed to classrooms routinely as appropriate to the scheduled activities.

Comments: Hazardous substances and materials are those identified by department safety committee members in 2013 using the Laboratory Hazard Assessment Tool adopted from UCLA's EHS Office.

We would love to have a Chemical Hygiene Officer to assist in this process by helping identify areas where an SOP is needed and by reviewing these SOP's as we develop them. See Part G - Current Planning for more on this need.

Objective #2
Objective:

Review texbooks and online learning systems for use in Chem 10, Chem 11/12, and Chem 21/22.

Area/ Discipline/ Function Responsible: CHEM: CHEMISTRY

Assessment Data and Other Observations:
SLO Assessment Data

External Factors:
Other Factors
Chem 10: We switched to a more rigorous text for the past year but many faculty are expressing dissatisfaction with it so would like to search further. In Chem 11/12, the current text is a new adoption for the department that was intended to be just a one-year pilot. It is now time to evaluate the results and decide whether to return to the previous book, keep the new text, or try a third option. In Chem 21/22, there is a desire to have a textbook organized so that more reactions are in the first semester (Chem 21), thus easing transfer to some institutions. There is also a desire to have a consistent, reliable and robust online homework/learning system. These two are grouped because most of the homework/online learning systems are coupled with textbooks.

Timeline and activities to accomplish the objective: Spring 2014: Chem 10 and 21/22 will review several texts each.

Chem 11/12 will convene a discussion of the current text and determine a plan to either keep it, keep the former text, or conduct a new textbook search in 2014-2015.

Spring 2014: Class testing of online homework systems for Chem 22/24, including those based on MarvinSketch (Mastering Chemistry and WileyPLUS) and those based on MoleDraw (Sapling, Norton SmartWork).

Describe how objective will be assessed/measured: Implement new texts, if we chose to, for the Fall 2014 semester in Chem 10 and Chem 21, for the Spring 2015 semester in Chem 11 and Chem 22, and for the Fall 2015 semester for Chem 12.

Comments: The current text for Chem 21/22 (Bruice, Organic Chemistry, 7th edition) has been used for some time and

has been renewed without seriously reviewing other texts when the last two editions came out. Program faculty are interested in reviewing and and learning from other options. Even if no change is made, the review process will provide us with new ways to approach various topics. In addition, as part of the discussion of our SLO assessments, the organic group has the strong sense that students who are able to use an interactive, graphics-intensive, online homework system typically do better and learn faster over the two semester sequence. In such homework systems, the immediate feedback showing whether they are drawing their structures correctly is invaluable.
The following article has been a springboard for conversation: Parker, L. L.; Loudon, G.M. Case Study Using Online Homework in Undergraduate Organic Chemistry: Results and Student Attitudes. J. Chem. Ed. 2013, 90, 37.

Objective #3
Objective:

Change prerequisite for Chem 31 so that Chem 21, but not necessarily Chem 22, is required.

Area/ Discipline/ Function Responsible: CHEM: CHEMISTRY

Assessment Data and Other Observations:
SLO Assessment Data
Institutional Research Data
Other data or observed trends

External Factors:

Timeline and activities to accomplish the objective: Complete prerequisite grid for Chem 21 to Chem 31, rewrite supporting documents, and submit to Curriculum before or during the Fall 2014 semester.

Describe how objective will be assessed/measured: Enrollment trends before and after the prerequisite change will be compared. The new prerequisite should result in an increase in enrollment in Chem 31.

Comments: Students who have not taken Chem 22 before taking Chem 31 do not have an unsurmountable disadvantage when taking Chem 31. Students who have taken Chem 21, which includes a lab, along with the general chemistry courses that are a prerequisite for Chem 21 will have sufficient lab experience to succeed and be safe in the Chem 31. laboratory.

Objective #4
Objective:

Investigate the effectiveness of Supplemental Instruction in improving student success in physical science classes.

Area/ Discipline/ Function Responsible: All

Assessment Data and Other Observations:
SLO Assessment Data
TIMS Report Data

External Factors:
Other Factors

STEM grant planned activity

Timeline and activities to accomplish the objective: We can probably have enough data this year to determine the impact in Chem 10 and 11. However, where SI has been implemented only in one or two sections, as with Chem 21, Physics 21 and Physics 23, we will need to collect data over another year or two to obtain meaningful results.

Describe how objective will be assessed/measured: In collaboration with the Directors of STEM and SI, we will compare student success and retention rates of students who participated in SI with those who did not.

Comments: This is a STEM grant activity, but the physical science faculty are keenly interested in the outcome.

Objective #5
Objective:

Strengthen collaboration with Adelante and Black Collegians to identify more effective strategies for increasing both enrollment and success rates of Hispanic and African American students.

Area/ Discipline/ Function Responsible: All

Assessment Data and Other Observations:
SLO Assessment Data
TIMS Report Data
Institutional Research Data

External Factors:

Timeline and activities to accomplish the objective: 2014-2015

Describe how objective will be assessed/measured: We will survey our faculty to see if the dialog with counselors has provided them with new and/or improved strategies for working with students who are struggling academically, especially those in underrepresented populations. We will review the success rates of these populations in our courses, bearing in mind that enrollment of African American students in some courses may be too low to yield meaningful results.

Comments: N/A

Objective #6
Objective:

Add one lecture hour each to Physics 8 and Physics 9.

Area/ Discipline/ Function Responsible: PHYSCS: PHYSICS

Assessment Data and Other Observations:
SLO Assessment Data
TIMS Report Data
Institutional Research Data
Other data or observed trends

External Factors:

Timeline and activities to accomplish the objective: 2014-2015 Academic Year

Describe how objective will be assessed/measured: Physics 8 and 9 are approved with one additional lecture hour each by the Curriculum Committee and this extra hour is added to class schedules.

Comments: N/A

Objective #7

Objective:

Objective:

Develop objectives for a preparatory course for students entering calculus-based physics sequences (Physics 8 and 21).

Area/ Discipline/ Function Responsible: PHYSCS: PHYSICS

Assessment Data and Other Observations:
SLO Assessment Data
TIMS Report Data
Institutional Research Data
Other data or observed trends

External Factors:
Program Review Committee Recommendation

Timeline and activities to accomplish the objective: 2014-2015

Describe how objective will be assessed/measured: A draft course outline is approved by the department.

Comments: N/A

Objective #8
Objective:

Investigate opportunities to expand support for engineering majors.

Area/ Discipline/ Function Responsible: PHYSCS: PHYSICS

Assessment Data and Other Observations:
Other data or observed trends

External Factors:
Other Factors
National efforts to increase STEM majors, especially in engineering, as well as our own STEM grant goals.

Timeline and activities to accomplish the objective: Spring 2014: Request an additional full time insructor in physics AND engineering (one position that can teach in both disciplines)
Spring 2014: Attend the Southern California Engineering Liaison Council (ELC) meeting at Alan Hancock College to meet and build relationships with faculty in 4-year engineering programs.
2014-2015: Continue efforts to connect with 4-year engineering programs

Describe how objective will be assessed/measured: Specific plans for new engineering courses or support activities are identified.

Comments: In collaboration with the Director of STEM.

Objective #9
Objective:

Investigate options for purchase of Parscore or similar system to assist with analysis of standardized exam items.

Area/ Discipline/ Function Responsible: All

Assessment Data and Other Observations:
SLO Assessment Data

External Factors:

Timeline and activities to accomplish the objective: 2014-2015: Meet with Waleed Nasr regarding pros/cons of SMC's current ParScore systems
2014-2015: Invite reps from competing vendors to demonstrate their systems for department faculty
Spring 2015: Submit Margin of Excellent grant proposal to obtain funds to purchase a system.

Describe how objective will be assessed/measured: Parscore or similar system has been selected and funds identified to allow purchase.

Comments: Perhaps this is a need common to other departments as well?

Objective #10
Objective:

Add *Chem 9: Everyday Chemistry* to the list of approved courses to fulfill the Global Citizenship graduation requirement.

Area/ Discipline/ Function Responsible: CHEM: CHEMISTRY

Assessment Data and Other Observations:
Institutional Research Data
Other data or observed trends

External Factors:

Timeline and activities to accomplish the objective: Spring 2014: Go before the Curriculum Committee to make our case. We have already submitted the necessary documentation to the committee.

Describe how objective will be assessed/measured: Chem 9 is incorporated into the list of courses that fulfill the GC requirement.

Comments: Our intended goal of enrolling primarily nonscience majors into this class has been achieved, enabling us to make these alterations to the curriculum without jeopardizing student preparation for entry into higher level science courses that is a concern in our Chem 10 classes.

Curriculum Review

To comply with accreditation standards, programs are required to update their curriculum outlines of record (CORs) every six years. Be sure to submit your updated outlines to the Academic Senate Joint Curriculum Committee in time for them to be reviewed prior to or at the Curriculum Committee's last scheduled meeting of the year (check the committee's submittal deadlines at (click here for dates and deadlines). The Program Review annual report will note whether course outlines are up to date.

1. Discuss how the department reviews, revises, and creates new curriculum. Include the following information:

- **The process by which department members participate in the review and revision of curriculum.**
- **How program goals and SLOS are integrated into course design and curriculum planning.**
- **The relationship of program courses to other college programs (cross-listing, overlapping content**
- **The rationale for any changes to pre-requisites, co-requisites and advisories.**
- **How the department ensures course syllabi are aligned with the course outline of record.**

Responsibility for curriculum development and maintenance lies entirely with our full-time faculty who rely upon their own expertise along with consideration of articulation requirements, professional school entrance requirements, and college initiatives and priorities. We have divided our courses into subgroups which we refer to as "programs". Each program is governed by the faculty who commonly teach those courses and had a designated program leader. The programs are currently:

- Chem 9
- Chem 10
- Chem 11/12
- Chem 21/22/24/31

- Chem 21/22/24/31
- Physics 6/7
- Physics 8/9
- Physics 12/14
- Physics 21/22/23/24
- Engineering 12/16

Each program group meets several time per semester to discuss all issues related to their courses, including SLO assessment and results; student success and retention; enrollment trends; emerging issues and changes within the disciplines; laboratory procedures, supplies, and safety considerations, etc. When warranted, or every six years during program review (whichever comes first), course outlines of record are updated.

Course SLO's have evolved over time as described in section C of this document. Current SLO's focus on three primary areas:

- student conceptual understanding of scientific principles as assessed by their ability to use appropriate theories to explain observable phenomena;
- student critical thinking/problem solving skills as assessed by their ability to solve given problems of varying complexity; and
- student laboratory knowledge including assessment of skill with common laboratory procedures and techniques and ability to apply the scientific method in their experimental work.

Each objective in our course outlines relates to one or more of these SLO's. Course outlines are used by all faculty in generating their individual course syllabi. SLO's and course outlines are provided on the department's homepage in part to ensure all faculty have convenient access to these documents while preparing their syllabi. New faculty receive an orientation from the department chair as well as from a discipline colleague who, along with a myriad of other information and mentoring, provide the new hires with copies of the course outlines and sample syllabi to ensure alignment of syllabi with outlines. Course outlines are also provided to peer evaluators who review faculty syllabi as part of the evaluation process.

Since our last program review, we have made several curricular changes:

- As described in section D1 of this document, we have begun computer-enforcement of all of our same-discipline prerequisites and implemented all the necessary procedures to provide waivers when appropriate, submit midterm placement rosters, drop ineligible students, etc.

- We created a new course, Science 10: Introduction to Scientific Research, in collaboration with colleagues in the Life and Earth Science Departments. This course is cross listed among the science disciplines and is now being offered for the second time to participants in the SRI (STEM) grant project. The course allows beginning science students to experience the excitement and relevance of participating in a research project and prepare them for possible participation in summer research programs at UCLA and elsewhere.

- We have modified our Chem 9 course to further emphasize the relationships between the chemical principles taught therein and issues of wide-spread interest and concern including environmental challenges, forensics, and household uses of chemistry. We have submitted the updated curriculum along with a request to consider Chem 9 for fulfillment of the Global Citizenship graduation requirement to our Curriculum Committee and those changes are now pending approval.

- We have submitted all of our remaining course outlines to Curriculum for approval of very minor revisions, primarily of a "housekeeping" nature, including updates of textbook lists, inclusion of sample assignments (which were not part of the course outline at the time of our last program review), and separation of objectives for the lecture and laboratory portions of our courses. All of the updates are now pending Curriculum approval.

- We modified the prerequisite for the second semester organic chemistry lab-only course, Chem 24, changing the prerequisite from Chem 21 (first semester lecture+lab) to a pre/co-requisite of Chem 22 (second semester lecture only). The subjects covered in Chem 24 are parallel to Chem 22, and this same prerequisite pattern is used at many other California colleges. The change ensures that students are applying the material learned in the lecture to the laboratory.

Community Engagement

In the prompts that follow, please delineate the partnerships you have with the rest of the SMC community as well as those you have with external organizations.

1. If applicable, describe how your department staff members engage in institutional efforts such as committees and presentations, and departmental activities.

We are very proud of our talented, devoted, and hardworking department members consisting of eighteen full-time faculty, approximately thirty-three adjunct faculty, a department secretary shared with Life Science, and three full-time laboratory technicians. It is this team of professionals who make our department and our academic programs extremely successful. It is the culture of the department to do whatever it takes to maintain a high level of academic rigor in our classes while simultaneously providing an environment that encourages each student to do his or her best and get excited about science. Our students continue to transfer to prestigious universities where they do very well academically. They also compete for, and sometimes win, scholarships, research internships, medical and other health professional school admissions, and the like.

Examples of nonteaching activities in which members of our department are currently and/or recently engaged include:

- student club advising
- maintenance of sophisticated scientific instrumentation
- advising/supervising student independent study
- sabbatical and fellowship special projects

In addition to ongoing efforts to maintain and improve our instructional program in the physical sciences, a number of our department members also contribute to broader campus community and are represented on:

- the Academic Senate
- the Academic Senate Leaders
- the Academic Senate Executive Committee

- joint committees of the Academic Senate
- the Faculty Association Representative Assembly
- the Faculty Association Leadership
- District Committees

We are also well-represented as EEO representatives on District hiring committees and as out-of-discipline members of probationary faculty evaluation panels.

The attached file entitled *Physical Science Department Nonteaching Activities* details the high level of campus and professional involvement of our department members. Included are all the full-time faculty and staff in the Physical Science Department, and some of our adjunct faculty members.

2. If applicable, discuss the engagement of program members with the local community, industry, professional groups, etc.)

Many Physical Science faculty are members of the American Association of Physics Teachers (AAPT), the Southern California AAPT (of which recent retiree Nuria Rodriguez is an officer), and/or the American Chemical Society (ACS). Under the leadership of faculty member Jenn Hsieh, our student ChemClub is now an official student chapter of the ACS as well.

In collaboration with Life and Earth Sciences, and with great support from the SMC Associates and, until her recent retirement, Judy Neveau, we are in our 14th year of hosting the Distinguished Scientist Seminar series. These seminars attract a large audience from within SMC, but also from the surrounding community.

Our Chem Club students are actively involved in community outreach through visits to local elementary and middle schools where they perform exciting chemistry demos for the students. They, along with the Pre-Health Professionals Association (another SMC student club), also bring members of the community to SMC to speak with students about

Association (another SMC student club), also bring members of the community to SMC to speak with students about careers in the sciences. The STEM grant also supports a number of community outreach efforts, primarily to area high schools, in which our faculty have been involved.

Over the years, we have participated in several collaborations with UCLA. Currently, such collaborations include the HSI STEM grant and our recent relationship with their office of Environment, Health, and Safety as advisors to our own laboratory safety efforts.

Roman Ferede, chemistry faculty, has been a collaborator with researchers at the International Institute of Tropical Agriculture in Nigeria for several years now and regularly involves SMC students in their ongoing research projects.

Local science fairs are always in need of volunteers and our faculty have been generous in serving as judges for these events.

The attached file entitled *Physical Science Department Nonteaching Activities* includes listings of specific contributions to the broader community made by our department members.

3. Discuss the relationship among and between full and part-time faculty, involvement of part-time faculty in departmental activities, and part-time faculty access to resources and support.

Part time faculty are invited to and encouraged to attend all department meeting and flex day activities, and many do. In addition, our department also conducts a lot of its work in smaller "program groups" each with a designated full-time faculty to lead it and comprised of all faculty who teach in that "program" our group of courses. Many adjunct faculty prefer to attend program meetings where the topics are specifically related to the courses they teach, rather than our larger department meetings where broader issues are generally presented and discussed. Agendas for all meetings are distributed to all faculty and staff prior to each meeting via email.

Newly hired part-time faculty are assigned a mentor from the full-time faculty who assists them with syllabus preparation, exam preparation, gaining familiarity with our laboratory facilities and policies as well as course experiments, and serves to answer questions and provide a sounding board for issues and concerns that may arise regarding the teaching of their assigned courses. The department chair also conducts and orientation for each new hire to familiarize him/her with department and college facilities, policies, and procedures.

All faculty are evaluated by a peer according to the procedures outlined in the faculty contract. This provides a formal opportunity for constructive feedback between faculty. Our department is committed to providing thorough, meaningful evaluations to provide every instructor with the tools and knowledge to be a highly effective educator.

Part time faculty from both Physical Science and Life Science currently share the use of one double office (two desks, each with a computer), as well as common workspace housing three more computers in a general faculty/staff workroom. However, both departments are currently hiring full-time faculty so we anticipate having no office space at all available to part-time faculty for 2014-2015. We have identified a large alcove in the elevator lobby of the 2nd floor of the Science Complex that has the potential to be converted into shared office space for our adjunct instructors and are working with the college Facilities Department staff to determine whether this can be accomplished. Office space is critical for part-time faculty to complete their prep work, individual meetings with students, and mandated office hours. The lack of sufficient space for these activities is a serious concern.

Current Planning and Recommendations

The following items are intended to help programs identify, track, and document unit planning and actions and to assist the institution in broad planning efforts.

1. Identify any issues or needs impacting program effectiveness or efficiency for which institutional support or resources will be requested in the coming year. [This information will be reviewed and considered in institutional planning processes but does not supplant the need to request support or resources through established channels and processes].

We have identified two two areas for which we seek institutional support in the coming year. The first involves the identification of a Chemical Hygiene Officer to assist our laboratory technicians and our faculty regarding issues of chemical safety. We have already conveyed this request informally to Risk Management and to the Executive Vice chemical safety. We have already conveyed this request informally to Risk Management and to the Executive Vice President. The second is a request for improved formatting of the highly valuable program assessment data that were provided to us by the Office of Institutional Research and by the MIS department via the faculty portal. We plan to bring these suggestions to the Institutional Effectiveness Committee for their consideration. Both requests are further explained below.

All institutions using chemical substances are required by OSHA to have a written Chemical Hygiene Plan as well as a designated Chemical Hygiene Officer to provide regular updates to the plan and to ensure that the plan's components are indeed practiced by those employees handling hazardous substances. SMC's Chemical Hygiene Plan is updated regularly by our Office of Risk Management with input from the faculty of the Physical Science Department and from the District's loss control consultants. Most recently, the Office of Environment, Health and Safety at UCLA also reviewed our plan. We appreciate the collaborative effort and feel that our plan is appropriate for our program. One weakness, however, is that we do not have a Chemical Hygiene Officer with training in chemistry and chemical safety on campus. Our department is therefore working with the District to identify potential solutions to this problem.

This is our department's first program review since the hiring of Hannah Lawlor and two researchers to staff our Institutional Research (IR) office. It is also our first program review since the establishment of SLO rosters and SLO reports within the faculty portal. The data packet compiled by IR for our department's 6 year review and the access to

compiled SLO assessment data via ISIS were both *extremely* helpful in allowing our department to engage in a data driven analysis of our program's strengths and weaknesses. However, we have a few suggestions regarding the format of these data that we believe would facilitate the dialog further:

- For six-year reviews, we would like IR to include summaries of SLO assessment results in the same format currently used to compare success and retention rates over the past six years. Currently, we need to download literally hundreds of different data files from the semesterly ISIS SLO reports to gather SLO assessment results over all of the intervening years, and then the data do not allow for easy viewing of longitudinal trends in the results. In fact, the number of files just to gather SLO assessment results for Physical Science for only three years was over 100, and that is the reason these documents were not included among the attached files on this report.
- Also for six year reviews, we would find it helpful to have at least some of the data broken down by course, or even course sequence. For example, our courses that serve nonscience majors have dramatically different demographies than those that serve only science majors, yet the current format aggregates data for all courses within a discipline. We realize that specific needs of this sort will vary significantly from department to department, but request that IR consider the issue to see if it could be addressed in a way that would not simply overwhelm departments with data.
- For annual reviews, we suggest that MIS provide success and retention data, currently available only to department chairs, to individual faculty on a semesterly basis via the portal. These reports would be very similar to the existing SLO reports faculty can view currently. Each instructor could view his/her own "TIMS" data along with averages for the course(s) they taught. In addition to facilitating analysis of current success and retention rates for purposes of the annual reviews, these data would also assist individual faculty in knowing how their own grading practices compare to others teaching the same course. This suggestion will be discussed with other departments at one of the spring 2014 Department Chairs and Coordinators meetings.

2. If applicable, list additional capital resources (facilities, technology, equipment) that are needed to support the program as it currently exists. [This information will be reviewed and considered in institutional planning processes but does not supplant the need to request resources through established channels and processes].

Since the opening of the current Science building 15 years ago, there has been such tremendous expansion of our course offering that we are not currently able to meet student demand for some courses due to insufficient laboratory and classroom space. Our introductory and general chemistry labs are booked from early morning, often starting at 7:00 a.m. through the evening hours Monday through Thursday and until late afternoon/early evening on Fridays and we could still fill additional sections of Chem 10, and probably of 9 and 11, if additional lab space were available. We hope to gain at least one chemistry lab when the second Science/Math building is designed and built in the coming years, but we have no solution for expanding our course offering to meet demand in the near future.

As our student enrollment has grown, so too has the size of our faculty. Where once we had double offices each occupied by one full time instructor with the second desk shared by part time instructors, we are now about to lose the last shared desk for part time faculty. All of our faculty offices are fully occupied by full time faculty except for one of our two-person offices that is now shared by all 60-70 part time faculty employed by Physical Science and Life Science combined. However, each department is currently hiring a new full time faculty member for fall 2014 and there are no full time retirements planned, so that last office will be used by the two new full time hires. Our part time faculty will then have no office space remaining, including no space in which to hold their mandated office hours. However, there is a large alcove in the elevator lobby of the 2nd floor of our building that originally housed vending machines and a coin-operated photocopier. All but one Coke machine have since been removed due to problems with vandalism so the space sits empty. We propose moving that last vending machine to the plentiful lobby space and converting the alcove to a shared office for the part time faculty of both the Physical and Life Science departments. To our untrained eyes, it appears to be a very simple project involving installation of a door and counter space. We have proposed this modification via work orders and are awaiting a response.

And, of course, as the program grew, so did our need for lab preparation space and lab technicians. Our current chemistry stockroom is bursting at the seams with chemicals, glassware, and other supplies. We have one lab tech office, but two lab techs, and the office opens into the stockroom itself, an arrangement that we are told is no longer allowed. We hope to remedy this issue with the new math/science building and, in the meantime, our techs share one office and are masters at working in small spaces and keeping supplies on movable carts, in the basement storage, etc.

Finally, we have recently implemented Supplemental Instruction support for many of our courses as part of our HSI STEM grant activities. Finding space for these groups to meet is challenging and is now a limiting factor in determining how many class sections can have SI support. While we have not yet received data from the SI office regarding its impact on student success in our program, the data from the math department which initiated SI 5 years before we did, are very compelling. We hope to demonstrate similar improvents to student success rates soon and to expand SI in the sciences as space and funding will allow.

In addition to the shortage of space needed to support our current program, we also have a number of problems related to building maintenance that are negatively impacting our program.

There are ongoing maintenance issues with the facilities in the organic chemistry lab (Sci 305). As of Spring 2014, six of the thirteen fume hoods regularly used by students to perform experiments had at least one sink that leaked. The pattern is that a sink develops a leak, a sign is placed on the hood and maintenance is informed, and eventually the problem is fixed; however, the fixes are often short-lived. The hoods themselves are aging, with the hood sashes needing replacement in some cases, while in others, the emergency warning buttons are broken. In addition, two of the seven large sinks used for washing glassware are currently unusable -- one has had a plugged drain for the last two semesters, and the hot water faucet is non-functional on the other.

Two additional building problems have been occurring for several years now. There is a natural gas smell in the laboratories on the north side of the lab wing of the Science complex, including Sci 101, Sci 201, Sci 301, and Sci 303. Efforts are ongoing to determine the cause and implement a solution. Also, several rooms have such loud air handling systems that students have trouble hearing their instructors, particularly 101, 106, and 122 (the physics classrooms). Similar problems are reported in other areas of the laboratory wing occasionally as well.

Just this year, the laboratory wing of the Science complex has developed significant leaks during rainstorms, especially in rooms 320 (Chemistry stockroom), 322 (Chemistry Lab)and 333 (a Life Science lab).

We have one equipment request which we plan to submit to the Information Services Committee as well. Our Chem 10 program (about 30 sections per semester) and now our Chem 11/12 program (another 20 or more per semester) are using common multiple choice final exams across all sections. The physis program appears to also be headed in a similar direction. Analysis of the student responses to each exam question provides powerful information for discussions of course improvements, but managing such large amounts of data is extremely cumbersome and time-consuming. We request a scoring and analysis system (like Parscore) that will allow our faculty to run Scantron answer keys from students directly into a computer system so program faculty can easily obtain tabulated data aggregating student responses to individual exam questions.

3. If applicable, list additional human resources (staffing, professional development, staff training) needed to support the program as it currently exists. [This information will be reviewed and considered in institutional planning processes but does not supplant the need to request resources through established channels and processes].

In the past decade, the physics program lost four of its six full-time faculty, three to retirement and one to resignation. We have replaced two of the four faculty lost, and were approved to hire a third new full time physicist to begin in fall 2014. That process is underway but a hire has not yet occurred. We are requesing the fourth replacment instructor this year to begin in fall 2015. With this hire, we seek another strong instructor for our physics team, but we also seek full time leadership for our engineering program in that same individual. Data collected through our STEM grant activities show a sharp increase in the number of engineering students taking science courses at SMC. Indeed, engineering is the most popular major indicated by the 200+ students in our first two cohorts of participants in the grant project. The nationwide focus on STEM seems to be succeeding in increasing student interest in engineering careers and we need someone to take ownership of that program by teaching the existing engineering curriculum, building new partnerships and strengthening transfer pipelines with four-year engineering programs in the area, and exploring options to give our engineering students exciting hands-on experiences related to engineering while at SMC.

In addition, we are requesting one more chemistry instructor to teach both organic chemistry and introductory chemistry. The vast majority of our Chem 10 classes are taught by part time faculty. Our scheduling of general chemistry and organic chemistry courses involves allowing several lab sections to attend a common lecture. This is an extremely efficient use of our faculty and facilities and is absolutley necessary for our program to function, but it means that one Chem 11 or 12 course involves 17 weekly teacher hours (WTH) and one organic course involves 13 WTH. This makes it impossible to employ part time faculty in these courses without resorting to team teaching arrangements that we belive are pedagogcaly less desireable. For example, we can have a full time instructor teaching the lectures and hire part time faculty to teach the labs, but we then lose the beauty of having our labs and lectures combined into a single course. Lab becomes disconnected from lecture and instructors lose the flexibility to integrate the two experiences. Thus, we strive to place FT faculty in these courses leaving our Chem 10 program, our largest program by far, with a majority part time instruction. Our idea is therefore to hire one more full time chemist who could teach in the Chem 10 program but who could also rotate into the organic program, thereby freeing some of the existing organic faculty to also rotate into the chem 9 and 10 programs, something they are currently not free to do despite our great desire for their contributions to these introductory courses.

Please see also our response to question 1 above in this section of our report where we document our need for a Chemical Hygiene Officer with training in chemical safety.

Future Planning and Recommendations

The following items are intended to help programs identify, track, and document unit planning and actions and to assist the institution in broad planning efforts.

1. Projecting toward the future, what trends could potentially impact the program? What changes does the program anticipate in 5 years; 10 years? Where does the program want to be? How is the program planning for these changes?

Several external factors may impact physical science curriculum in the next few years.

The MCAT is being revised for 2015 and its decreased focus on some traditional organic chemistry topics may have an impact on enrollment in Chemistry 21, 22, and 24. The organic chemistry faculty will continue to stay abreast of developments in the MCAT, discuss enrollment trends with faculty at other colleges and universities, and monitor enrollments in our courses. It is possible that the organic chemistry requirement for premedical students would be lowered by American medical schools, however it is currently not clear whether the most common BS degrees obtained by premedical students will follow suit.

Nursing programs are increasingly becoming 4-year or 2+2 programs, and the prep courses required by these programs are increasingly the GOB (General-Organic-Biochem) courses that cover pieces of our General, Organic and Biochemistry courses all compressed into one semester. We have begun developing one of these classes to offer at SMC. Based on a rough survey of fall semester Chem 10 students, we anticipate demand for this new course to be significant As we begin to offer this new course, we will need to reduce the Chem 10 offering accordingly, both because of space limitations (we cannot offer additional sections of lab courses in chemistry until the Science Building Phase II comes online) and because the new course will draw from the pool of students currently enrolling in Chem 10. Chem 10 is currently our largest enrollment course with about 30 sections per semester and evidence of unmet demand. Significant changes to Chem 10 enrollment would therefore have a large impact on our scheduling of classes.

As we continue the process of regrowing our full time physics faculty, we look forward to being able to make some improvements to both the physics and the engineering programs. New hires can help us to create new courses in both fields, to increase student opportunties for hands-on experiences in these fields, and to strengthen partnerships with transfer institutions offering engineering majors. We are planning for these changes by hiring additional full time faculty in physics, and requesting hire for an individual meeting minimum qualifications for both fields.

2. If applicable, list additional capital resources (facilities, technology, equipment) that will be needed to support proposed changes. [This information will be reviewed and considered in institutional planning processes but does not supplant the need to request resources through established channels and processes].

Phase II of the Science Building will house the Departments of Earth Science and Mathematics, and will be adjacent to, and probably connected to, the existing Science complex which houses the Life and Physical Science departments. The new building will also allow for expansion of the Physical Science department. Design and construction of this building has been delayed as we wait for completion of the Student Services building to be completed first. However, we have identified several critical needs that the new building can address for the Physical Science department.

We need additional space for general and introductory chemistry labs. Both programs are currently unable to meet student demand due to insufficient lab space. We also need expanded chemisry stockroom/prep facilities and office space for our lab tech. We, along with Life Science, need additional space for faculty offices (for both full-time and part-time faculty) and for office hours and Supplemental Instruction sessions.

The American Chemical Society (ACS) 2009 Guidelines for Two-Year College Programs in Chemistry recommends no more than 25 students per lab section and 20 students maximum for organic chemistry for safe and effective instruction. All of our chemistry lab sections are currently limited to 28 students. Perhaps this, and some of the lab design recommendations in the same document, could be implemented for Phase II of the Science Building.

We are very excited about the new building in part because it will address the needs described above, but largely because it will place our department in close proximity to our Earth Science and Math colleagues, thereby generating new opportunities for collaboration and interdisciplinary initiatives.

3. If applicable, list additional human resources (staffing, professional development, staff training) that will be needed to support proposed changes. [This information will be reviewed and considered in institutional planning processes but does not supplant the need to request resources through established channels and processes].

In addition to the hiring of more full time faculty to replace those already lost in physics, keep pace with growth of the department and its component programs, and keep pace with future retirements in both disciplines, the department is also in need of a Chemical Hygiene Officer to advise us on specific issues related to chemical laboratory safety procedures and legal compliance with Cal OSHA standards.

4. If applicable, note particular challenges the program faces including those relating to categorical funding, budget, and staffing.

Please see our comments regarding a Chemical Hygiene Officer in Section G1.

5. Summarize any conclusions and long term recommendations for the program resulting from the self evaluation process.

In the coming years, the Physical Science Department needs to:

- work with STEM, Adelante and Black Collegians to implement strategies to improve the retention and success rates

  of our Hispanic and African-American students, as well as the recruitment of students in both groups, especially African American.
- expand and improve our program for engineering majors.
- work with Facilities to design an expansion of the Science Complex that will meet the current and future needs of our program.
- work with Risk Management to identify an effective way to continue to provide Chemical Hygiene expertise to our department.

- continue to update and refine our curriculum to meet the changing needs of students as they seek to fulfill transfer and professional program admittance requirements.
- evaluate the effectiveness of our Supplemental Instruction program in the sciences and make plans for its future after the conclusion of the STEM grant.

6. Please use this field to share any information the program feels is not covered under any other questions.

N/A

Evaluation of Process

Please comment on the effectiveness of the Program Review process in focusing program planning.

The new format, especially online, has made our review more concise and focused than our previous reviews. The online tool has been great in allowing multiple contributors to the document. While there are certainly instances in our report where a notable change in "voice" will be detected, we view this as a strength because it is the direct result of broad particpation from many faculty within the department.

Section D was confusing because the two components (Moving Forward and Objectives) seemed redundant. We chose to put smaller projects impacting only one course, as well as speculation on possible future directions within "Moving Forward", reserving the objectives for broader departmental efforts that are definitely on our agenda in the coming year, as well as for planned changes to curriculum. However, other departments will likey come up with their own interpretations of how to divide content among these two sections and further guidance from the PR committee would be welcomed.

We also noted that there was no place that was clearly the correct location to discuss SLO assessment RESULTS. We put them in C and in our objectives.

Please see also our comments in the second half of our answer to section G1, question 1 regarding inconsistency in the format of data available to departments in support of our program review activities.

Executive Summary

These fields to be filled out by the Program Review committee. Reports will be sent to the program and will be available on-line to populate relevant fields in the annual report and the next 6 year report.

Narrative

Program Evaluation

Commendations

Recommendations for Program Strengthening

Recommendations for Institutional Support

Attached File Upload

Attached Files	
CCDT Disproportionate Impact Discussion	
Faculty Nonteaching Activities	
IR Data for Physical Science, 2014	
IR Data for Physical Science, 2014, Additional	
SMC Request for Renewal of Validation of CCDT	