Program Review: Physics

Fall 2014

SOLANO
COMMUNITY COLLEGE

Physics Program Review Self-Study, Fall 2014

1.1 Introduction

Introduce the program. Include the program's catalogue description, its mission, the degrees and certificates offered, and a brief history of the program. Include the number and names of full-time faculty, adjunct faculty, and classified staff. Discuss any recent changes to the program or degrees.

The focus of the Physics program is on developing an understanding of, and appreciation for, the basic laws of our physical universe. This is done largely through the development of conceptual understanding, problem solving skills, and laboratory investigations.

The Physics Department at Solano Community College traces itself back to the very start of the college in 1945. This department currently offers six physics classes: a two-term trigonometry-based sequence (PHYS 2-4), a three-term calculus-based sequence (PHYS 6-7-8), and a one-term algebra-based overview of physics (PHYS 10). The trigonometry-based sequence is generally taken by students majoring in biological or pre-med sciences. The calculus-based sequence is taken by students intending to transfer to four-year programs in engineering, physics or computer science. The algebra-based course is taken by students needing to fulfill a general education science requirement.

Solano Community College offers two Physics degrees: an Associate in Science Degree (AS), and an Associate in Science for Transfer (AS-T). Successful completion of this major will assure competence in physics through calculus and calculus-based physics, provide an adequate background for employment in many technological and scientific areas, and provide a firm foundation for students planning to pursue a baccalaureate degree in physics.

The Associate in Science for Transfer, which was initiated in 2014, is especially appropriate for students who plan to complete a bachelor's degree in Physics at a CSU campus. Students completing an AS-T degree are guaranteed admission to the CSU system, but not to a particular campus or major. Students transferring to a CSU campus that does accept the AS-T will be required to complete no more than 60 units after transfer to earn a bachelor's degree. This degree also prepares students for physics degree programs at other four-year institutions, but does not come with the same guarantees.

Historically, the Physics Department consisted of a single full-time faculty member, supplemented by adjuncts as needed. In the past decade, roughly the same teaching load has been spread among several full-time faculty whose efforts are split between different departments. Recently and currently, the full-time faculty members who teach in this program include:

Melanie Lutz (Ph.D., UC Berkeley), full-time Physics/Engineering, at SCC since 1998
Michael Gregg (Ph.D., Yale), full-time Physics/Astronomy, since 2014
Philip Petersen (Ph.D., UC San Diego), full-time Physics/Astronomy, 2004-2014
Zachary Hannan (M.S., UC Davis), full-time Math/Physics, since 2005

Adjunct faculty who teach in this program include:

Darwin Ho (Ph.D., Princeton), adjunct Physics, since 1998
Tom MacMullen (Ph.D., U of Arizona), adjunct Physics, since 1995

Other associated staff includes:

Richard Crapuchettes (B.S., San Jose State), technician for Physical Sciences, since 1987

***1.2 Relationship to College Mission and Strategic Goals**. Describe the program's relationship to the overall mission of the college.*

The Physics program at SCC focuses on (a) providing a firm foundation for students planning to pursue a baccalaureate degree in physics, (b) providing the physics component of the lower-division courses needed by students planning to transfer into four-year engineering programs, (c) providing the physics component of the training needed by students in biological or pre-medical sciences, and (d) providing an opportunity for students to meet their General Education science requirement. Our intake consists mainly of recent high-school graduates from Solano and Yolo Counties, as well as military personnel from Travis Air Force Base. Students are accepted into our courses with a range of educational backgrounds and abilities. Our courses are carefully designed to help prepare these students for transfer to four-year programs, with particular attention paid to articulation of courses to the CSU and UC systems.

Table 1. SCC's Strategic Directions and Goals

Goal 1: Foster Excellence in Learning	Program Evidence
Obj. 1.1 Create an environment that is conducive to student learning.	Courses in the Physics Department generally consist of lecture sessions, one weekly discussion session, and a laboratory. The material is first presented in the lectures, after which the laboratory provides an opportunity for the students to reinforce and demonstrate their understanding. The discussion session provides an opportunity for the instructor to assess the students' grasp of the material and clarify any misconceptions. Instructors provide rapid feedback to students on each homework assignment and test.
Obj. 1.2 Create an environment that supports quality teaching.	The Physics department generally only appoints full-time teachers who have Ph.D. degrees from leading universities (Berkeley, Yale, *etc*.), plus experience in industry or academic research. Consequently, these teachers have a mastery of the subject matter. All teachers, whether full-time or adjunct, must demonstrate excellent teaching skills in their hiring interview. Teachers use student evaluations to identify areas that may need improvement.
Obj. 1.3 Optimize student performance on Institutional Core Competencies.	ICC 1B (writing) is developed through the writing of weekly laboratory reports in each class of the PHYS 2-4 and PHYS 6-7-8 sequences. ICC 2A (analysis), ICC 2B (computation) and ICC 2D (problem solving) are each developed through solving weekly homework problems in each Physics course.

Goal 2: Maximize Student Access & Success	Program Evidence
Obj. 2.1 Identify and provide appropriate support for underprepared students.	Students cannot register for Physics courses unless they have taken the required mathematics prerequisites. However, since the Physics courses do not have high-school physics as a prerequisite, some students who start to take the calculus-based physics sequence PHYS 6-7-8 are soon identified as having difficulty, and are urged to take non-calculus PHYS 002 before attempting calculus-based PHYS 006.
Obj. 2.2 Update and strengthen career/technical curricula.	NA
Obj. 2.3 Identify and provide appropriate support for transfer students.	Our courses PHYS 2-4 and PHYS 6-7-8 articulate to the CSU and UC systems. Extensive effort is expended by faculty to help students obtain summer internships at universities, national laboratories, and engineering companies, which will be of great advantage to students in eventually obtaining full-time jobs or being admitted to graduate school. Recent internships have been obtained, for example, at Lawrence Berkeley Lab, Sandia National Lab, the Stanford Linear Accelerator Center, and the Colorado School of Mines.
Obj. 2.4 Improve student access to college facilities and services to students.	As many, if not most, of our students work outside of college, we offer courses at night (PHYS 002 and PHYS 004), and on Saturdays (PHYS 002 lab sections), in order to improve student access to these courses. PHYS 002 is also offered at Travis Air Force Base.
Obj. 2.5 Develop and implement an effective Enrollment Management Plan.	Our Physics classes are carefully scheduled, in conjunction with the relevant classes taken by our students in other departments (Math, Chemistry, Engineering, *etc.*) to allow students to complete their AS degree and transfer requirements in a timely and efficient manner, so as to minimize attrition. This is also achieved by offering most courses at the main Fairfield campus, allowing students to avoid having to commute between campuses to take all of their required courses.

Goal 3: Strengthen Community Connections	Program Evidence
Obj. 3.1 Respond to community needs.	Our Physics Program serves as a major source of scientists and engineers for the local and state economy. Employers of our recent graduates include Northrup-Grumman, Applied Aerospace Structures Corporation, Conoco Philips, Vandenberg Air Force Base, PG&E, U.S. Army Corps of Engineers, Lockheed Martin, California Dept. of Water Resources, Musco Olive Company, Biruni Motors, U.S. Naval Air Systems Command, and Worley Parsons, to name a few.
Obj. 3.2 Expand ties to the community.	We occasionally invite visitors from industry and academia to give presentations to our classes. For example, in Fall 2013, two scientists from Stanford Linear Accelerator spoke to our PHYS 007 class. Melanie Lutz was an invited speaker at the monthly meeting of the Solano County Taxpayers Association in May 2013. Richard Crapuchettes regularly participates in outreach activities, such as the EPIC Spring Science Day (annually since 2006), the Kaiser Family Wellness Day (September 2012), and Celebrate SCC on April 27, 2012, each of which were were attended by numerous high school students. The job description of the new Physics/Astronomy faculty member includes "participate in student outreach and recruiting"; in particular, this will include outreach to local high schools. Articles about the Physics program and its students appear regularly in *The Tempest* and other local newspapers.
Goal 4: Optimize Resources	**Program Evidence**
Obj. 4.1 Develop and manage resources to support institutional effectiveness.	We utilize our allotment of General Funds to purchase crucial laboratory consumables and to upgrade our lab equipment as needed.
Obj. 4.2 Maximize organization efficiency and effectiveness.	Courses in the two Physics sequences (2-4, and 6-7-8) are carefully scheduled, in conjunction with those related courses in other departments that are taken by our students, to optimize enrollment, with a minimum of duplicated sections of any course in each academic year.

Obj. 4.3 Maintain up-to-date technology to support the curriculum and business functions.	Computers that are needed for laboratories are updated every five years. Software and other laboratory equipment are updated as needed; for example, motion detectors and force sensors were replaced in 2012.

1.3 Enrollment. *Utilizing data from Institutional Research and Planning, analyze enrollment data.*

Given the small number of courses offered in the Physics Department (six), and other anomalies, such as the fact the entire SCC Summer session was cancelled in 2012, it is difficult, and potentially misleading, to try to discern trends from such a small data set. Furthermore, it must be born in mind that the three sequences offered in our department (trigonometry-based, PHYS 2-4; calculus-based, PHYS 6-7-8; algebra-based, PHYS 10) are each taken by entirely different and non-overlapping cohorts of students: pre-med/nursing/biology majors take PHYS 2-4, engineering and physics majors take PHYS 6-7-8, and non-science majors take PHYS 10 to fulfill their general education science requirement. It should also be mentioned that semester-by-semester comparisons are hindered by the fact that there are small fluctuations in the course offerings from year-to-year (*i.e.*, it is not as simple as saying that "PHYS X is taught each spring, and only in the Spring").

With these caveats in mind, the main conclusion that can be drawn from the enrollment data is that the number of courses offered, and the enrollment, as measured by headcount or FTES, all seem to be essentially stable over the past four years. These data are summarized in the table below, on a semester-by-semester basis.

	Fa10	Sp11	Su11	Fa11	Sp12	Fa12	Sp13	Su13	Fa13	Sp14	Su14
Courses	7	6	2	7	5	6	5	1	6	5	2
Headcount	130	115	59	121	110	133	116	31	129	111	33
FTES	25.6	24.4	9.2	26.1	25.9	26.9	27.2	3.1	26.2	25.9	7.0

It is perhaps easier to interpret this information if the data are binned by academic year, starting in the Fall semester, as is done in the following table:

	2010-2011	2011-2012	2012-2013	2013-2014
Courses	15	12	12	13
Headcount	304	231	280	273
FTES	59.2	52.0	57.2	59.1

Bearing in mind that the entire SCC Summer session was cancelled in 2011-2012, this latter table shows that the number of FTES in the Physics Department has been quite constant over the past four years. This should be interpreted in light of two other statistics. According to the American Physical Society, the number of BS degrees awarded in Physics in the US has been more or less stable at about 5000 (plus-or-minus 20%) per year for the

past four decades (http://www.aps.org/programs/education/statistics/index.cfm). Hence, our FTES count is consistent with this nationwide stable trend for undergraduate Physics enrollment. The other statistic to mention is that while our FTES count has been stable over this recent period, the total FTES count for the College as a whole has decreased by 21%. Hence, the health of the Physics program, as measured by FTES, has exceeded that of the College as whole, and been as good as one could reasonably hope for, given the nationwide trends.

1.4 Population Served. *Utilizing data obtained from Institutional Research and Planning, analyze the population served by the program (gender, age, and ethnicity) and discuss any trends in enrollment since the last program review.*

Women are grossly under-represented, relative to their proportion of the student-age population as a whole, in Physics programs throughout the country. This fact is well known, and has been the subject of studies and debates for several decades. Our department is no exception to this pattern. As the issue is a pervasive nation-wide problem, it does not seem likely that it can be successfully addressed on the scale of any individual community college program. The best that we can hope for is that women are not under-represented in our department relative to Physics departments as a whole.

Bearing in mind the difficulties in performing any sort of statistical analysis on small data sets, we have binned the data according to academic year, ignoring Summer sessions, because (a) there was no 2012 Summer session, and (b) the student numbers in Summer session are small and would not have a large effect on the overall results, which will be reported as normalized percentages. In the following table, we have combined the data from each successive Fall-Spring pair, and weighted the data by headcount, rather than simply averaging the Fall and Spring percentages, which would be simpler, but mathematically incorrect (although both methods would yield the same results for this data set, rounded to the nearest percentage point).

	2010-2011	2011-2012	2012-2013	2013-2014
Female	34%	39%	29%	34%
Male	65%	60%	69%	63%
Not reported	1%	1%	2%	3%
Total	100%	100%	100%	100%

These numbers, which show that our enrollment is about 34% female over the past four years, are roughly in line with the fact that about 30% of all bachelor's degrees in the physical sciences are awarded to women, nationwide (data as of 2010; from http://www.aps.org/programs/education/statistics/index.cfm). As gender data was not asked for or reported in the previous program review, we cannot comment on any possible trend going back further in time.

A similar analysis with regards to the ethnicity of our students again shows that our numbers are roughly in line with expectations, based on national statistics. The following table shows the ethnicity of students taking Physics classes, binned by academic year, neglecting the small Summer term cohort, and re-normalized so as to ignore the category of

"other", since there is no sensible way to make comparisons if this category is included in the data. The right-most column shows the average for all of SCC, over the reporting period.

	2010-2011	2011-2012	2012-2013	2013-2014	SCC
White	43%	38%	39%	36%	39%
Hispanic	13%	21%	29%	27%	23%
Black	4%	8%	5%	5%	18%
Asian or PI	33%	29%	22%	29%	19%
Amerindian	6%	4%	5%	3%	1%
Total	100%	100%	100%	100%	100%

These data show that white and Hispanic students seem to be taking Physics classes at a rate nearly equal to their representation in the College as a whole, while Asian students are greatly over-represented in Physics, and Black students are severely under-represented. These results are roughly in accord with nation-wide statistics, which show, for example, that Blacks constitute 14% of the college-age US population, but receive only about 6% of all bachelor's degrees in the physical sciences.

There are numerous clubs and programs on campus, such as Mathematics, Engineering, Science Achievement (MESA), National Society of Black Engineers (NSBE), Society for the Advancement of Chicanos & Native Americans in Science (SACNAS), and Society of Hispanic Professional Engineers (SHPE), that are active in recruiting under-represented minority groups to study physical sciences and engineering, and aiding them in succeeding in their goals.

The age profile of students taking Physics classes is shown in the table below. As with the data presented above for ethnicity and gender, the data have been grouped by academic year, ignoring the small Summer cohort, and then binned by age group. The right-most column shows the data for SCC as a whole, from academic year 2009-2010 (http://californiacommunitycolleges.cccco.edu/collegeDetails.aspx?collegeID=281&txt=Solano%20Community%20College).

Age group	2010-2011	2011-2012	2012-2013	2013-2014	SCC
0-17	4%	4%	2%	2%	60%
18-25	66%	71%	77%	77%	
26-30	17%	17%	12%	13%	12%
31-35	4%	5%	3%	4%	7%
36-40	4%	1%	4%	3%	6%
41-45	2%	0%	2%	0%	8%
46-	3%	2%	0%	1%	7%
Total	100%	100%	100%	100%	100%

The age profile of Physics students is lower than that of the College as a whole. For example, 90% of students taking Physics classes are thirty years old or younger, whereas only 72% of the total SCC student body falls into this age group. Only 1% of Physics students are over forty years of age, whereas 15% of all SCC students are in this age group. This difference is probably attributable to older students tending to return to college for retraining in technical areas such as Welding or Biotech, or fields such as Nursing, rather than as preparation for transfer.

1.5 Status of Progress toward Goals and Recommendations. *Report on the status of goals or recommendations identified in the previous educational master plan and program review.*

Table 2. Educational Master Plan

	Educational Master Plan	Status
1.	Continue to provide all courses needed for transfer to CSU and UC programs	We have continued to provide all courses needed for transfer to CSU and UC programs, with the following exceptions. The Administration cancelled PHYS 002 in the Summer of 2012 and 2013. As this course is a feeder and prerequisite for PHYS 004, an insufficient number of students were registered for PHYS 004 in Fall 2012 and Fall 2013, so these courses were cancelled.
2.	Promote the completion of lower division transfer courses at SCCD	Students in PHYS 002 are urged to take the follow-on course PHYS 004 at SCC, as well as all other required Math, Chemistry and General Education courses. Likewise, PHYS 006 students are urged to take the follow-on courses PHYS 007 and PHYS 008 at SCC, as well as all other required Math, Chemistry and General Education courses.
3.	Continue to provide hands-on learning environment, *i.e.*, lab component of PHYS 002, PHYS 004, PHYS 006, PHYS 007, PHYS 008; PHYS 008 (modern physics) needs new lab equipment	We continue to provide challenging and inquiry-based weekly laboratory experiments in PHYS 2-4-6-7-8. As funds become available, the laboratory equipment in PHYS 008 will be upgraded and expanded.
4.	Improve the prep and storage area (rooms 330 and 331)	Improvements have been made to the prep and storage areas (rooms 330 and 331). Rooms 330 and 331 will become less cramped when Astronomy obtains its own dedicated space, including prep room space.
5.	Update laboratory equipment	The MPLI-based computer-based labs have been replaced with Logger Pro computer-based labs.

Table 3. Program Review Recommendations

Although there was no previous program review for the Physics Program *per se*, Physics was included in the 2010 Program Review for the Physical Sciences. The following table lists those recommendations from the 2010 Program Review that were relevant to physics, and the status of these goals.

	2010 Program Review	Status
1.	No cancellation of any course that is offered only once a year, so that students can count on Solano as a viable institution for their educational goals and can satisfy transfer agreements.	The two courses that are taught only once per year, PHYS 007 and PHYS 008, have not been cancelled, and have each been taught once each year during the period covered by this review.
2.	Maintain two lab sections of Physics 6 to attract as many students as possible into the Math/Science curriculum.	Two lab sections of PHYS 006 have been offered each time this course has been taught (twice per academic year).

1.6 Future Outlook. *Describe both internal and external conditions expected to affect the future of the program in the coming years.*

The Physics Department has recently (Summer 2014) hired a new full-time Physics/Astronomy Instructor, Dr. Michael Gregg, to replace the recently retired Dr. Phil Petersen. As the size of the program is expected to remain stable, to first-order, over the next five-ten years, and in light of the relatively small size of our department, there should be no need for additional full-time hires. To be specific, in recent years there have been three full-time faculty members (Lutz, Petersen, Hannan) who each devote about half of their effort to Physics courses. Hence, an unrealistic program growth of about 67% would be needed to justify the addition of another full-time Physics instructor.

Enrollment in our calculus-based Physics sequence, PHYS 6-7-8, is driven mainly by the Engineering program. According to the results of our student survey, 76% (28/37) of the students taking this sequence this year are engineering majors. Hence, the health of our program is crucially dependent on maintaining the Engineering Program, which is still under threat of Program Discontinuance. With this connection in mind, a new A.S. degree in Engineering has been developed, was reviewed by the Dean, and was submitted to the Curriculum Committee in Fall 2014.

The inquiry-based learning offered to our students in the laboratory components of our courses is heavily dependent on having a skilled, dedicated technician. The current technician, Richard Crapuchettes, will retire within the next ten years, if not the next five years. It is imperative for the continued health of the Physics Program that he be replaced by an equally experienced and skilled technician who will work exclusively for the Physical Sciences Departments, and not shared with other departments.

According the U. S. Bureau of Labor Statistics Employment Projections, 2012-2022, growth in nationwide engineering employment will be only 7.4% over the eight-year period of 2012-2020. This is barely 1% per year, *i.e.*, essentially stable. Since, as mentioned above, the

enrollment in our courses is heavily dependent on engineering majors, the most reasonable expectation is that the size of our program will remain stable over the next five years.

Curriculum Development, Assessment, and Outcomes

Program Level Outcomes

2.1 *Using the chart provided, list the Program Level Outcomes (PLOs) and which of the "core four" institutional learning outcomes (ILOs) they address.*

Table 4. Program Level Outcomes

Program Level Outcomes	ILO (Core 4)	How PLO is assessed
1. Demonstrate analytical and problem-solving skills	IID. Problem Solving	Percentage of students who complete the course with a grade of C or better should exceed 70%
2. Carry out experiments and critically assess their data	IIA. Analysis	Percentage of students who achieve 70% or better on lab portion of course should exceed 70%
3. Learn the roles of hypotheses, measurement and analysis in the development of scientific theory as evidenced by laboratory reports	IIA. Analysis	Percentage of students who achieve 70% or better on lab portion of course should exceed 70%
4. Write a laboratory report or give an oral presentation	IB. Write ID. Speak and Converse	Percentage of students who achieve 70% or better on lab report or oral presentation should exceed 70%

2.2 *Report on how courses support the Program Level Outcomes at which level (introduced (I), developing (D), or mastered (M))*

Table 5. Program Courses and Program Level Outcomes

Course	PL01	PL02	PL03	PL04
PHYS 002	I	I	I	I
PHYS 004	D	D	D	D
PHYS 006	I	I	I	I
PHYS 007	D	D	D	D
PHYS 008	M	M	M	M
PHYS 010	I	NA	NA	I

2.3 Utilizing table 6, describe the results of the program level assessments and any changes/planned actions made based on the outcomes of program level student learning assessments.

Table 6. Program Level Assessments

Note: Until recently, the "Physics Program" had been defined so as to include only the PHYS 6-7-8 sequence. The assessments referred to in the following table therefore include only these three courses.

Program Level Outcomes		Date(s) Assessed	Results	Action Plan
1.	Demonstrate analytical and problem-solving skills	Spring 2013	88% of students received 70% or better on exams	To improve the performance of the remaining 12%, we should impress upon them the importance of regular attendance, and that learning is fundamentally their responsibility
2.	Carry out experiments and critically assess their data	Spring 2013	86% of students received 70% or better on lab reports	To improve the performance of the remaining 14%, we should impress upon them the importance of regular attendance, and that learning is fundamentally their responsibility
3.	Learn the roles of hypotheses, measurement and analysis in the development of scientific theory as evidenced by laboratory reports	Spring 2013	86% of students received 70% or better on lab reports	To improve the performance of the remaining 14%, we should impress upon them the importance of regular attendance, and that learning is fundamentally their responsibility
4.	Write a laboratory report or give an oral presentation	Spring 2013	86% of students received 70% or better on lab reports, papers or oral presentations	To improve the performance of the remaining 14%, we should impress upon them the importance of regular attendance, and that learning is fundamentally their responsibility

2.4 Describe any changes made to the program or courses that were a direct result of program level assessments.

The action plan described above has been discussed by all faculty members, and has been implemented in all Physics courses. As an additional aid to help students succeed in the Physics courses, Instructor Zack Hannan began physics tutoring in the Academic Success Center in the Fall of 2014.

Student Learning Outcomes

2.5 *Describe the current status of SLOs in your program.*
Each Physics course has a full updated set of SLOs. The SLOs for each course are revisited each year, and updated as necessary. Each SLO is assessed every time a course is taught. If deficiencies are uncovered, modifications are made in the course by the instructor, as they deem fit.

We have identified some changes to be made in the SLOs for PHYS 002, to make them more specific and easier to assess. These changes will be implemented in Fall 2014.

The only Physics courses with multiple sections are PHYS 002 (four sections), PHYS 004 (two sections), PHYS 006 (two sections), and PHYS 010 (two sections). In general, the same textbook is used in each section, and each section of a given course utilizes the same SLOs. In PHYS 002 and 004, one instructor distributes his own notes, which cover the same material as does the text used in the other sections. The questions used in the SLO assessment for different sections of the same course cover the same topics, and are designed to be of the same level of difficulty, and so are essentially identical.

2.6 *Review the course level SLOs completed by the program in the last year to ensure accuracy of information provided.*

None of the SLOs were changed in the past year. As mentioned above, we have identified some changes to be made in the SLOs for PHYS 002, to make them more specific and easier to assess. These changes will be implemented in Fall 2014.

2.7 *Describe any changes made to the program or courses that were a direct result of student learning outcomes assessments.*

As an example of a change in a course that was made as a result of analysis of the SLOs, in the PHYS 006 section taught in Fall 2013, only 56% of the students scored above 60% or better on one of the questions. As a result, the instructor decided to incorporate more comprehensive review throughout the course, combining old material with new material into new problems that cover a larger breadth of material.

Curricular Offerings

2.8 Course offerings*. Attach a copy of the course descriptions from the most current catalogue. Include a discussion of courses offered at Centers (Vacaville, Vallejo, Travis) and any plans for expansions/contraction of offerings at the Centers.*

The following six courses are taught in the Physics Department:

PHYS 002 5 Units
General Physics (Non-calculus)
Prerequisite: MATH 051 or MATH 004 with a grade of C or better.
Course Advisory: Eligibility for ENGL 001.
PHYS 002 & 004, a two-semester sequence in introductory physics using math through trigonometry, is recommended for teachers, technicians, pre-dentistry, pre-medical, and biology majors, and others who need a general physics course. PHYS 002 covers the study of motion,

energy, momentum, gravitation, solids, fluids, thermodynamics and the gaseous state, vibration, wave motion, and sound. Experiments relating to the topics covered will be performed and students will analyze the experiments. Field trip may be required.
Four hours lecture/discussion, three hours lab.

PHYS 004 5 Units
General Physics (Non-calculus)
Prerequisite: PHYS 002 with a grade of C or better.
Course Advisory: Eligibility for ENGL 001.
PHYS 002 & 004, a two-semester sequence in introductory physics using math through trigonometry, is recommended for teachers, technicians, pre-dentistry, pre-medical, and biology majors, and others who need a general physics course. PHYS 004 covers electricity, magnetism, light and optics, and modern physics. Students learn to analyze and solve problems appropriate for this level in these topics. Experiments relating to the topics covered will be performed and students will analyze the experiments. Field trip may be required.
Four hours lecture, three hours lab.

PHYS 006 5 Units
Physics for Science and Engineering
Prerequisite: MATH 021 (may be taken concurrently).
Course Advisory: Eligibility for ENGL 001 and High School Physics, or PHYS 002 with a grade of C or better.
The Physics 006-007-008 sequence is a three-semester offering in introductory physics requiring math through calculus. This sequence satisfies the lower division physics requirement for majors in physics, chemistry, geology or other physical sciences, and engineering. PHYS 006 covers mechanics, gravitation, vibration and fluids. Students will learn to analyze and solve problems appropriate for this level in these topics. Experiments relating to the topics covered will be performed.
Four hours lecture, three hours lab.

PHYS 007 5 Units
Physics for Science and Engineering
Prerequisite: A grade of C or better in both PHYS 006 and MATH 021.
Course Advisory: Eligibility for ENGL 001.
The PHYS 006-007-008 sequence is a three-semester offering in introductory physics requiring math through calculus. This sequence satisfies the lower division physics requirement for majors in physics, chemistry, geology or other physical sciences, and engineering. PHYS 007 is a continuation of PHYS 006, covering the topics of electricity, magnetism, wave motion, and sound. Students will learn to analyze and solve problems appropriate for this level in these topics. Experiments relating to the topics covered will be performed.
Four hours lecture, three hours lab.

PHYS 008 5 Units
Physics for Science and Engineering
Prerequisite: A grade of C or better in both PHYS 006 and MATH 021.
Course Advisory: Eligibility for ENGL 001.
The Physics 006-007-008 sequence is a three-semester offering in introductory physics requiring math through calculus. This sequence satisfies the lower division physics requirement for majors in physics, chemistry, geology or other physical sciences, and engineering. PHYS 008 is a continuation of PHYS 006 and PHYS 007, covering heat, optics, relativity, and modern physics. Students will learn to analyze and solve problems appropriate for this level in these topics. Experiments relating to the topics covered will be performed and students will analyze the experiments. Field trip may be required.

Four hours lecture, three hours lab.

PHYS 010 3 Units
Descriptive Physics
Prerequisite: SCC minimum English standard; MATH 330 or MATH 330B.
An introductory physics course for both the non-science and the beginning science student. Includes topics such as nuclear physics, relativity, mechanics, properties of matter, quantum physics, heat, light, electricity, and magnetism. Written assignments, tests, and a comprehensive final exam will be used to evaluate student success. Field trip may be required.
Three hours lecture.

Each of these six courses is taught in face-to-face mode; PHYS 010 is also (usually) taught in online mode. No individual courses have been added or discontinued since the last program review cycle. No courses are taught at the Vacaville or Vallejo Centers. PHYS 002 is sometimes taught at the Travis Center. There are currently no plans to increase our offerings of courses at the centers, although this issue is constantly revisited in light of changes in demand for our individual courses.

In 2014, an AS-T degree in Physics was instituted. Successful completion of this major will assure competence in physics through calculus and calculus-based physics, providing an adequate background for employment in many technological and scientific areas, as well as providing a firm foundation for students planning to pursue a baccalaureate degree in physics. The Associate in Science for Transfer is especially appropriate for students who plan to complete a bachelor's degree in Physics at a CSU campus. Students completing an AS-T degree are guaranteed admission to the CSU system, but not to a particular campus or major. Students transferring to a CSU campus that accepts the AS-T will be required to complete no more than 60 units after transfer to earn a bachelor's degree. To earn this AS-T degree, students must:

• complete the following major requirements with grades of C or better;

• complete a minimum of 60 CSU-transferable semester units with a minimum grade point average of 2.0

• complete either the California State University General Education Breadth pattern (CSU GE), which requires 39 units, or the Intersegmental General Education Transfer Curriculum (IGETC), which requires 34-39 units. Students are not required to complete Solano's Cross-Cultural Studies requirement.

Required Courses

Course No.	Course Title	Units
MATH 020	Analytic Geometry and Calculus I	5
MATH 021	Analytic Geometry and Calculus II	5
MATH 022	Analytic Geometry and Calculus III	4
PHYS 006	Physics for Scientists and Engineers A	5
PHYS 007	Physics for Scientists and Engineers B	5
PHYS 008	Physics for Scientists and Engineers C	5
Total Units		29

***2.9 Fill rates/Class size**. Discuss the trends in course fill rates and possible causes for these trends (include comparison/analysis of courses by modality if applicable).*

Fill rates for all Physics courses over the past four years are shown in the following table, as fractions. When more than one section of a given course was taught in a semester, the results of the sections are combined. The fractions are rounded to two decimal places, for ease of reading.

	Su10	Fa10	Sp11	Su11	Fa11	Sp12	Fa12	Sp13	Su13	Fa13	Sp14
PHYS 002	0.78	0.90	0.97	0.84	0.82	0.97	0.90	0.88		0.72	1.06
PHYS 004		0.66	0.63		0.38	0.56		0.69			0.59
PHYS 006		0.61	0.56		0.69	0.83	0.79	0.75		0.73	0.63
PHYS 007		0.58			0.96		0.83			1.21	
PHYS 008			1.00			1.13		1.25			1.13
PHYS 010	0.94	1.38	0.63	1.16	0.97		0.97		0.97	0.91	
Average	0.86	0.83	0.76	1.00	0.76	0.87	0.87	0.89	0.97	0.89	0.87

Our program-wide fill rate by semester has fluctuated between 0.76 and 1.00, with an average of 0.87. There is no clear program-wide upwards or downwards trend. The only course showing a persistently low fill rate is PHYS 004. It is important to bear in mind that students cannot take PHYS 004 without having passed PHYS 002, and so it is to be expected that enrollments in PHYS 004 will be less than those in PHYS 002, due to students who do not pass PHYS 002, change their major, *etc*. Furthermore, some biology-oriented majors require PHYS 002, but not PHYS 004. There is no other stream of students that can be attracted to PHYS 004 to make up for this natural attrition. A positive point to note is that the fact that our classes tend not to be overfilled allows us to provide the one-to-one instruction and mentoring that is the hallmark of our program.

***2.10 Course sequencing.** Report on whether courses have been sequenced for student progression through the major, how students are informed of this progression, and the efficacy of this sequencing.*

The first course in the trigonometry-based Physics sequence, PHYS 002, is taught each term: Fall, Spring, and Summer. The second course in this sequence, PHYS 004, is taught in the Fall and Spring. As both of these courses are required to be taken by biology and pre-med majors, this sequencing allows these students to start the sequence in any semester, and complete it within less than one academic year.

The first course in the calculus-based Physics sequence, PHYS 006, is taught each Fall and Spring. The other two courses in this sequence, PHYS 007 and PHYS 008, are taught once each year, in the Fall and Spring, respectively. All three of these courses must be taken by Physics and Engineering majors. PHYS 006 is a pre-requisite for both PHYS 007 and PHYS 008, but PHYS 007 is NOT a pre-requisite for PHYS 008. Hence, this sequencing allows students to start the sequence in either the Fall or Spring, and complete the sequence in three successive semesters (not including Summer), *i.e.*, by taking PHYS 6-7-8 or PHYS 6-8-7 in successive semesters.

***2.11 Basic Skills* (if applicable).** *Describe the basic skills component of the program, including how the basic skills offerings prepare students for success in transfer-level courses.*

There is no basic skills component to any of the courses in the Physics program.

2.12 Student Survey. *Describe the student survey feedback related to course offerings.*

Student surveys were distributed in all Physics courses in Spring and Summer 2014. The response rate was over 90%. The survey consisted of fourteen questions. The responses indicated that our students generally approve of the timing, location and mode of our course offerings. A copy of the survey has been appended at the end of this report.

With regards to location of classes, 73% (62/85) preferred Fairfield, 28% (24/85) preferred Vacaville, and 11% (9/85) preferred Vallejo. (Some students indicated more than one preference; hence, the totals add to more than 100%). Although most students are happy with taking the classes at Fairfield, there is clearly some sentiment for holding classes at Vacaville, and, to a lesser extent, at Vallejo. (Note that one section of PHYS 002 is taught each year at Travis). However, given the current overall demands for our classes, adding sections at these satellite campuses does not seem feasible at the current time, as it would only serve to siphon off students from our offerings at Fairfield.

In response to a general request for "suggestions for improvements", 16% (15/95) of respondents indicated a desire for more sections of each course to be made available. Again, given the current fill rates of our courses, it does not seem feasible to add sections.

With regards to the scheduling of classes, 81% (69/85) of respondents said that it was very important that there be no scheduling conflicts between Physics classes and upper-division Math classes, and 86% (41/85) of respondents said that it was very important that there be no scheduling conflicts between Physics classes and upper-division Chemistry classes.

With regards to mode of teaching, 87% (76/87) of our students preferred courses to be taught in face-to-face mode, whereas only 11% (10/87) preferred hybrid mode, and 2% (2/87) preferred online. Note that this year only, due to lack of a teacher trained in the Canvas platform, PHYS 010 was taught face-to-face, rather than in its usual online mode. This probably skewed downwards the number of students indicating a preference for online teaching - but this only applies to PHYS 010.

***2.13 Four-year articulation* (if applicable).** *Utilizing the most current data from the articulation officer, and tools such as ASSIST.org, state which of your courses articulate with the local four-year institutions.*

All six of the courses taught in the Physics Department, PHYS 002, PHYS 004, PHYS 006, PHYS 007, PHYS 008, and PHYS 010, articulate to both the CSU and UC systems.

***2.14 High school articulation* (if applicable).** *Describe the status of any courses with articulation/Tech Prep agreements at local high schools.*

As all of the courses taught in the Physics Department are college-level, we have no articulation agreements with local high schools.

2.15 Distance Education (if applicable). *Describe the distance education courses offered in your program, and any particular successes or challenges with these courses. Include the percentage of courses offered by modality and the rationale for this ratio.*

The only Physics course that is taught online is PHYS 010. As we teach six different courses in our department, this represents 17% (1/6) of our courses weighted by course, and 17% (2/12) of our classes if weighted by individual class offering (*i.e.*, accounting for the fact that some courses are taught more than once per academic year). These percentages are actually much higher than the statewide average: statewide, only 4.4% of Physics classes were taken online in 2011-2012 ("Online Learning and Student Outcomes in California's Community Colleges", Hans Johnson and Marisol Cuellar Mejia, Public Policy Institute of California, May 2014). This latter metric is weighted by student, not by class. If we weight our statistics by student, we find that the percentage of our students taking courses online has been 18% (191/1088 over the past four years) – much higher than the state average.

Our only online offering is PHYS 010, the algebra-based overview of physics that is generally taken as a general education course by non-technical majors. Many of these students have little or no experience with scientific courses, and subsequently don't do well in Module 1 assignments. By encouraging them to listen to the instructor's long Audio Lecture (called the 'Exam Review') in each module, most are able to learn the necessary study habits to succeed in a physics course. In that video, the instructor goes through some examples, including some simple calculations, which then prepare the students to solve problems themselves. Their exam grades generally go up on each 4-week module, and then most students do very well on the in-class final exam.

Aside from PHYS 010, we have no plans to offer any of our other five courses online. This is in accord with the overwhelming sentiments expressed by our students in the 2014 Student Survey. According to this survey, 90% (36/40) of the students in the PHYS 6-7-8 sequence preferred face-to-face mode, only 10% (4/40) preferred hybrid mode, and 0% (0/4) preferred online mode. Of the students taking the PHYS 2-4 sequence, 85% (35/41) preferred face-to-face, 12% (5/41) preferred hybrid, and 2% (1/41) preferred online. It is clear from the above-mentioned statewide statistics that most other community colleges have also decided that it is not appropriate to teach the calculus-based or the trigonometry-based physics sequences in online mode.

However, with regards to PHYS 010, it should be noted that when this course was offered in face-to-face mode in Summer 2014, enrollment was greatly reduced from its usual level (8 in Summer 2014, as opposed to 31 in Summer 2013). These data clearly show the need to return PHYS 010 to online mode.

2.16 Advisory Boards/Licensing (CTE) (if applicable). *Describe how program curriculum has been influenced by advisory board/licensing feedback.*

The Physics Department currently has no external advisory board. Please note that our program is in compliance with most if not all of the recommendations of the "Guidelines for Two-Year College Physics Programs" of the American Association of Physics Teachers. Our main purpose is to prepare students for transfer, and the key requirement for doing so is that our courses articulate to the CSU and UC systems. Our curricula are reviewed regularly to ensure that our articulation and TAG agreements are up to date. This does not require input from an advisory board.

STUDENT EQUITY & SUCCESS

3.1 Course Completion and Retention. *Anecdotally describe how the program works to promote student success.*

Our small class sizes provide the opportunity for individual mentoring of students. We collaborate with Counseling to help students to succeed in reaching their goals to transfer, as quickly and efficiently as possible. Accommodations are made for any DSP student, to provide learning modalities that are recommended by the DSP counselors. Copies of all textbooks are kept on reserve in the library, to allow accessibility to those students who cannot afford to purchase the textbook.

The Physics Department has a long-standing Transfer Agreement (TAG) with UC Davis, and routinely transfer students into the UC Davis Physics Program. We recently established an AS-T degree in Physics, which helps students to transfer to the CSU system.

Collaborative learning methods are used in the PHYS 2-4 sequence by instructor Tom MacMullen. Groups of students are assigned to work on problems during the lecture part of the course. Dr. MacMullen is also developing an algorithm that students can use, along with a firm grasp of physical concepts, to solve physics problems effectively and efficiently.

All Physics courses, with the exception of PHYS 010, include a large number of laboratory sessions to provide the students with hands-on experience, to complement the lectures.

The following table shows the success rate, defined as the fraction of students who obtained a grade of C or better, term-by-term for those terms for which data are available, and broken down into various sub-categories of gender, ethnicity, age and mode of instruction. To avoid too many age groups with very small populations, the age distribution has been divided into two groups, intended to represent "traditional college age", ages 0-25, and "older students", ages 26 and older.

	Fa 10	Sp 11	Su 11	Fa 11	Sp 12	Fa 12	Sp 13	Su 13	Fa 13	Overall
Total	0.76	0.79	0.75	0.69	0.86	0.68	0.68	0.72	0.77	0.73
Male	0.74	0.83	0.68	0.66	0.82	0.66	0.71	1.00	0.66	0.73
Female	0.80	0.74	0.78	0.74	0.93	0.73	0.70	0.65	0.55	0.74
Amerindian	0.67	0.75	0.50	0.33	0.75	0.71	0.80	0.50	1.00	0.71
Asian	0.68	0.70	0.634	0.85	1.00	0.63	0.73	1.00	0.51	0.71
Black	0.86	0.25	0.67	0.56	0.86	0.50	0.67	0.67	0.56	0.64
Hispanic	0.73	0.75	0.89	0.47	0.71	0.63	0.75	0.33	0.67	0.68
White	0.80	0.95	0.82	0.71	0.90	0.74	0.64	0.82	0.65	0.77
0-25 yrs old	0.76	0.78	0.72	0.64	0.87	0.64	0.73	0.76	0.52	0.72
26+ yrs old	0.76	0.82	0.81	0.86	0.86	0.83	0.63	0.79	0.63	0.78
Face-to-face	0.73	0.75	0.74	0.68	0.86	0.67	0.72	NA	0.61	0.72
Online	0.87	NA	0.76	0.81	NA	0.74	NA	0.77	0.69	0.77

As mentioned previously, breaking the data into sub-categories and semesters exacerbates the difficulties in trying to interpret small data sets. Moreover, any semester-by-semester

fluctuations probably reflect the facts that different courses have different success rates, and the same set of courses are not taught in each semester.

So, to shed more light on the success rate data, the rates have been recalculated for the entire four-year period, weighted student-by-student, with these results plotted in the right-most column (see table above). Please note that the success rates reported in this column are *not* obtained by averaging across each row; the success rates in each semester must be weighted by the number of students in that semester who fall into the given sub-group.

The overall success rate has been more or less stable in time, at 73%, with no discernible upwards or downwards trend. Success rates for male and female student are essentially identical. Success rates for all ethnic groups are roughly similar, with the rate for white students a few points above the mean, and that for Black and Hispanic students a few points below the mean. It is difficult to know if these slight differences are statistically meaningful, although the relative success rates correlate with the fact that Black and Hispanic students are traditionally economically and educationally disadvantaged in our society.

Success rates for student of "traditional college age", defined here as being 25 or younger, was 72%, whereas the success rate for "older students", defined here as being 26 or older, was 78%. This is probably a reflection of the increased maturity of level of the older students, who are often more focused on their career goals.

The success rate for students taking online courses is slightly higher than for those taking face-to-face courses. This may be a real effect, or it may simply reflect the fact that PHYS 010 is taught online, whereas the more quantitative Physics courses are taught face-to-face.

Most (56%) of the student who fall into the category of "not succeeding" withdrew from their course; only 44% of the students in the "not succeeding" category finished the course but did not received a grade of C or above. Note also that most (72%) of the students taking *any* Physics course at SCC are actually taking their *first* college-level Physics course. (Students take either PHYS 010, or the PHYS 2-4 sequence, or the PHYS 6-7-8 sequence, but rarely combine courses from these three sequences. So, most students taking PHYS 002, PHYS 006, or PHYS 010 can safely be assumed to be taking their first Physics course). Therefore, our planned efforts to improve the success rate of students in the Physics program will focus on encouraging students to persevere in their first Physics course, and not withdraw, by giving them extra mentoring and encouragement. If successful, this effort will particularly help to improve the success rates of Black and Hispanic students. It should be noted that the deficit in the success rate of Black students amounted to only *four* students over the past four years, *i.e.*, only one per year. For Hispanic students, the shortfall in success rate (*i.e.*, the difference between 68% and 73%) amounted to only nine students, or roughly two per year.

3.2 Degrees/Certificates Awarded (if applicable). *Include the number of degrees and certificates awarded during each semester of the program review cycle. Describe the trends observed and any planned action relevant to the findings.*

Although SCC awards an AS degree in Physics, very few of the students taking Physics classes in the college are Physics majors, and even those who are Physics majors are primarily interested in transferring to a four-year institution – not in obtaining an AS

degree. Furthermore, there has traditionally been little if any demand from students at SCC to obtain an AS degree as a terminal degree. Hence, it is clear that the awarding of AS degrees is not a very useful metric to use for judging the success of the Physics program. With these points in mind, the number of AS degrees awarded in each of the past six years is shown in the table below.

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	Total
Total	5	4	3	10	7	1	30
Male	4	4	3	9	6	0	26
Female	1	0	0	1	1	1	4
Amerind'n	0	1	0	0	1	0	2
Asian	0	0	0	4	5	1	10
Black	0	2	1	0	0	0	3
Hispanic	1	0	0	3	1	0	5
White	1	1	1	3	0	0	6
Other	3	0	1	0	0	0	4

As can be seen, thirty AS degrees in Physics have been awarded over the past six years – an average of five per year. Although there may seem to be a recent downward trend, it is not clear if this is a real trend or a statistical fluctuation. Note that the best-fitting linear regression line through these data shows a downward trend of only 0.11 degrees per year. At this rate, it would take nine years for the expected number of degrees to fall from five per year to four per year!

3.3 Transfer (if applicable).

A main role of the Physics program is to prepare students to transfer to four-year institutions. In particular, the PHYS 6-7-8 sequence is taken by students who intend to transfer to Engineering, Physics, Chemistry, Math, or Computer Science programs. According to our recent student survey, 76% of the students taking this calculus-based physics sequence are majoring in engineering, 11% in computer science, 5% in Math, and 8% in Physics. The following table shows the total number of transfers amongst the cohort of students who took calculus-based physics in each of the previous five academic years.

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	Total
Transfers	10	9	10	16	19	64

All Physics students are well aware of transfer opportunities and requirements, which are discussed with them by Counseling and by faculty in the department.

3.4 Career Technical Programs (if applicable).

The Physics Department does not run a technical training program.

PROGRAM RESOURCES

***4.1 Human Resources**. Describe the adequacy of current staffing levels and a rationale for any proposed changes in staffing (FTES, retirements, etc.).*

For about the past decade, the teaching load in the Physics Department has been spread among three full-time faculty members, whose efforts are split between different departments (Engineering, Astronomy, Math, respectively). Our students benefit from having Physics taught by instructors with knowledge of these other fields, rather than by instructors with a focus and experience limited to Physics.

Full-time Physics/Astronomy instructor Phil Peterson retired after Spring 2014, and was immediately replaced by new hire Michael Gregg, who was previously a research scientist at UC Davis and an adjunct instructor at another local community college. The department also has two long-time adjuncts, Tom MacMullen and Darwin Ho. Recently (summer 2014), one additional adjunct has been added to our pool: Katie Berryhill. Randy Smith, a part-time Astronomy teacher, occasionally teaches Physics courses. Additionally, Mark Feighner, a full-time faculty member who teaches Geology and Physical Science, is qualified to teach Physics, although he has not done so since 2001. This configuration of teachers is sufficient for the number of courses that we offer.

***4.2 Current Staffing.** Describe how the members of the department have made significant contributions to the program, the college, and the community.*

Most of the teaching, and the entire administrative burden, of our relatively small program is shouldered by a small number of faculty (three full-time faculty, each of whom devote about half of their effort to Physics). This does not leave our faculty members much time for optional or extracurricular activities. Nevertheless, we have achieved some major accomplishments in the past few years.

Full-time Physics/Engineering Instructor Melanie Lutz designed the Physics AS-T degree, which was approved in Spring 2014. She chaired the hiring committee for the full-time Physics/Astronomy new hire in 2014, which led to the appointment of Michael Gregg. She prepared the e-brochure for the Physics program in 2014.

Full-time Physics/Astronomy Instructor Phil Petersen published a book entitled "The Quantum Shield" (Empyrean Quest Publishers, 2011).

***4.3 Equipment**. Address the currency of equipment utilized by the program and how it affects student services/success. Make recommendation (if relevant) for technology, equipment, and materials that would improve quality of education for students.*

Although most of our laboratory equipment is old, it is still functional, and suitable for its purpose. This equipment needs to be, and is, maintained and upgraded as needed. The sole exception is PHYS 008, in which course we have a shortage of usable laboratory equipment, *i.e.*, not enough for all students to do the experiments at the same time. This shortage needs to be remedied. We have occasionally submitted instructional equipment requests for additional lab equipment.

***4.4 Facilities**. Describe the facilities utilized by your program. Comment on the adequacy of the facilities to meet program's educational objectives.*

Most of the Physics classes on the Fairfield campus are taught in room 302, with some sections of PHYS 002 and PHYS 004 taught in room 301. These rooms are perfectly suited to our classes, which involve a mixture of lectures, demonstrations and laboratory work. The large desks function well as writing desks during lectures, and as laboratory benches. The proximity of these rooms to the prep room and equipment room is ideal for laboratories and demonstrations. The proximity of this room to the Bird Room allows students to efficiently use their study time between classes. The window in room 302 that looks out into the parking lot is perfectly aligned to allow the telescope to be focused on a far-off object in PHYS 008. Overall, after the refurbishments made in 2011 with Measure G funds, our facilities should suit the needs of the department for many years to come. The Physics Department intends to remain in its current space in Building 300, as new space is not needed, and creating new facilities would not be an efficient use of taxpayer's money, when other programs are in more urgent need of new facilities. Moreover, 72% of students reported in the student survey that they were "satisfied" or "very satisfied" with the lecture and laboratory facilities, and only 6% were "dis-satisfied" or "very dis-satisfied". Furthermore, as shown by the student survey, our students overwhelmingly prefer (73%) to take their Physics classes at Fairfield.

***4.5 Budget/Fiscal Profile**. Provide a five year historical budget outlook including general fund, categorical funding, Perkins, grants, etc. Discuss the adequacy of allocations for programmatic needs. This should be a macro rather than micro level analysis.*

The following table shows the general funds budget for the Physics Department over the past five years. These funds have been adequate to replace equipment and purchase consumables, but are not sufficient to purchase the additional laboratory equipment that is urgently needed for PHYS 008. However, the drastic decrease that our budget has suffered over the past three years must be reversed if we intend to maintain the quality of our laboratory experiments and demonstrations.

Category	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Academic Salaries	201,394	191,065	172,018	129,710	142,955
Classified Salaries	$340	$0	$0	$0	$0
Benefits	$41,128	$43,346	$45,759	$35,256	$34,599
Supplies	$3559	$3559	$500	$628	$1000
Other operating	$582	$582	$0	$0	$0
Capital outlay	$4709	$4709	$0	$0	$0
Total	$251,712	$243,261	$218,277	$165,594	$178,554

PROGRAMMATIC GOALS & PLANNING

5.1 *Summarize what you believe are your program's strengths and major accomplishments in the last 5 years. Next, state the areas that are most in need of improvement.*

The main strength of our program is the excellent instruction and mentoring that we deliver to our students. Ample evidence of this can be found in the comments contained in the student surveys, such as "really awesome teachers", "our teacher is amazing", "they teach in a very open and enriching environment", "[teachers] know their material and present it well". Our relatively small class sizes, generally 20-30 per class, allow us to give our students individualized attention, providing them not only with knowledge transfer, but also with mentoring and career advice.

It must be noted that only a small fraction of students taking Physics classes are Physics majors; most of our students are majoring in engineering, biology, math, *etc*. Our main success is helping to prepare these students for transfer to four-year programs. A very high proportion of our students successfully transfer to four-year programs.

Although our lab equipment is just about sufficient for its purposes in regards to both quality and quantity, our ability to continue to update and replace the equipment as necessary is an ongoing concern. Although most of our courses currently have sufficient equipment, PHYS 008 does not have enough equipment to allow all students to do the lab experiments simultaneously. A fairly large fraction (22%, 17/79) of respondents to our student survey mentioned "lab equipment" as the area of the department most in need of improvement.

5.2 *Based on the self-study analysis, prioritize the program's short (1-2 years) and long term goals (3+ years). In the source column denote "SP" for Strategic Proposals, "DB" for Department Budget, "P" for Perkins or "NR" for No Additional Resources Needed.*

The self-study analysis has clearly indicated that the overall outlook for our program is for no major growth in the near future in terms of number of courses offered, or number of instructors needed. Enrollment in individual courses may exhibit modest gradual growth, particularly as fee increases render the CSU and UC systems more expensive. Both students and staff are satisfied with the existing space in Building 300 of the Fairfield campus. Students are also satisfied with the face-to-face mode of instruction used in most of our courses, although enrollment data indicate that PHYS 010 is much more heavily enrolled when taught in online mode. The student survey indicated that the historical schedule should be maintained, with no conflicts with the relevant Math or Chemistry classes. Overall, our laboratory equipment is appropriate for its purpose, except in PHYS 008, where newer and additional equipment is needed. We have adequate technical support, although the current technician will be retiring in the not-so-near future, and must be replaced with equivalent staff as soon as that occurs. Our short-term and long-term goals for the program are listed in the table below.

Table 8. Short-Term and Long-Term Goals

Short-Term Goals	Planned Action	Target Date	Person Responsible	Source
1. Maintain current scheduling of classes	Scheduling is in progress	Ongoing	Melanie Lutz	NR
2. Return PHYS 010 to online mode	Katie Berryhill will be trained on Canvas platform	Summer 2015	Katie Berryhill	NR
3. Continue to teach PHYS 2-4-6-7-8 in Bldg 300 on Fairfield campus	Ongoing	Ongoing	Administration	NR
Long-Term Goals	**Planned Action**	**Target Date**	**Person Responsible**	**Source**
1. New lab equipment for PHYS 008	Administration must restore budget	Fall 2017	Michael Gregg	DB
2. Replace technician upon his retirement	Will address when time comes	TBD	Administration	DB
3. Create maintenance fund for Physics classrooms in Bldg 300	A portion of Measure Q funds should be allocated for this purpose	Fall 2016	Administration	DB

Solano Community College Physics Student Survey

The Physics Department is undergoing program review this semester. The following questions are designed to help the department evaluate the overall program and its offerings. **If this current class is the only course you have taken in the Physics Department, please respond to the questions based on this course. If you have taken more than one Physics course, consider the questions in light of the Physics courses you have taken in this department.** If you have recently completed and submitted this survey in another Physics class, please do **not** complete a second survey.

Please place crosses in the boxes as appropriate. Do not sign your name to this survey. All information that you provide in this survey will remain strictly confidential.

1. How many Physics courses have you taken at Solano Community College (including this one)?
   - ☐ One
   - ☐ Two
   - ☐ Three
   - ☐ Four or more

2. In which Physics course are you currently enrolled?
   - ☐ PHYS 002
   - ☐ PHYS 004
   - ☐ PHYS 006
   - ☐ PHYS 008
   - ☐ PHYS 010

3. What is your major?
   - ☐ Physics
   - ☐ Engineering
   - ☐ Mathematics
   - ☐ Computer Science
   - ☐ Other: _____

4. What is your reason(s) for taking this class? (mark all that apply)
   - ☐ General education requirement
   - ☐ Required for major
   - ☐ Required for transfer
   - ☐ Professional development
   - ☐ Required for my current job
   - ☐ Prerequisite for another course
   - ☐ General interest
   - ☐ Fits my schedule
   - ☐ Other: _____

5. At which campus would you prefer to take your Physics classes?
   - ☐ Fairfield (Main)
   - ☐ Vacaville
   - ☐ Vallejo

6. What were your reasons for choosing Solano Community College? (mark all that apply)
   - ☐ Location
   - ☐ Good programs/reputation
   - ☐ Availability of childcare
   - ☐ Availability of classes
   - ☐ Other: _____

7. How do you choose your classes? (mark all that apply)
   - ☐ Fits my schedule
   - ☐ Needed for my Major
   - ☐ Instructor's reputation
   - ☐ Friends' advice
   - ☐ Rate My Professor
   - ☐ Location

8. Would it be greatly inconvenient for you if one of your Physics courses conflicted with any upper level math courses?
   - ☐ Yes
   - ☐ No

PLEASE TURN OVER AND CONTINUE

9. Would it be greatly inconvenient for you if one of your Physics courses conflicted with any upper level chemistry courses?

- ☐ Yes
- ☐ No

10. By which mode would you prefer to take this course?

- ☐ Face-to-face
- ☐ On-line
- ☐ Hybrid

11. How satisfied are you with the quality of textbooks and instructional materials utilized in the Physics Department?

- ☐ Very Satisfied
- ☐ Satisfied
- ☐ Neutral
- ☐ Dissatisfied
- ☐ Very Dissatisfied

12. How satisfied are you with the space and facilities in which the courses (lectures/labs/discussions) are taught?

- ☐ Very Satisfied
- ☐ Satisfied
- ☐ Neutral
- ☐ Dissatisfied
- ☐ Very Dissatisfied

13. What are the Physics Department's greatest strengths?

_____

_____

_____

_____

14. Do you have any suggestions for ways that the program could be improved?

_____

_____

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Thank you! We appreciate your time, and your opinions are very valuable to us.

SIGNATURE PAGE

The undersigned faculty in the Physics program have read, and concur with, the findings and recommendations in the attached program review self-study, dated December 31, 2014.

Dr. Melanie Lutz (full-time, Physics/Engineering) — Melanie P. Lutz
Faculty Name — Signature

Dr. Phil Petersen (full-time, Physics/Astronomy)
Faculty Name — Signature

Dr. Michael Gregg (full-time, Physics/Astronomy)
Faculty Name — Signature

Dr. Tom MacMullen (adjunct, Physics)
Faculty Name — Signature