

PROGRAM REVIEW: PHYSICS

FALL 2022



Program Review - Physics (2022)

SECTION 1: Program Overview

1.1 - Introduction - List the names of full-time and adjunct faculty in the program, along with any staff members and their titles/roles. Note major changes in personnel since the last program review.

Note: This program review covers the seven-year period between 2015-2022.

The following instructors currently teach courses within the SCC Physics Program:

Full-time faculty

Melanie Lutz (Ph.D., UC Berkeley), Physics/Engineering, full-time since 2000

Zachary Hannan (M.S., UC Davis), Math/Physics, full-time since 2005

Maura Rabbette (Ph.D., University College Dublin), Astronomy/Physics, adjunct 2016-2022, full-time since 2022

Adjunct faculty

Darwin Ho (Ph.D., Princeton), Physics, adjunct since 1998

Philip Petersen (Ph.D., UC San Diego), Astronomy/Physics, full-time 2004-2014; adjunct since 2016

Tracey Johnson (M.S., UC Davis), Physics/Astronomy, adjunct since 2015

Trevor Gonzalinajec (Ph.D., UC Berkeley), Physics/Astronomy, adjunct since Spring 2018

Bogdan Popescu (Ph.D., University of Cincinnati), Physics/Astronomy, adjunct since 2019

The following instructors taught courses within the Physics Program within the reporting period, but are no longer associated with the program:

Michael Gregg (Ph.D., Yale), Astronomy/Physics, full-time 2014-2015

Alessandro Baldi (Ph.D., University of Milan), Astronomy/Physics, full-time temporary 2015-2016

Tom MacMullen (Ph.D., U of Arizona), Physics/Engineering, adjunct 1995-2016

Other associated staff included:

Richard Crapuchettes (B.S., San Jose State), lab technician for Physical Sciences, 1987-2020; there has been no lab technician associated with this program since Spring 2020.

1.1a - Briefly summarize any large, substantive changes made to the degrees/certificates since the last program review, and what prompted those changes. Note also any organizational changes (for example, if the program is now in a

different School/Division than before). If changes have already led to noticeable improvement, please describe.

The focus of the Physics program at SCC 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 002-004), a three-term calculus-based sequence (PHYS 006-007-008), and a one-term algebra-based overview of physics (PHYS 010). 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, Chemistry, Geology, 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.

A new Associate in Science in Physics for UC Transfer, which aligns with the University of California Transfer Pathways (UCTP), has recently been developed and approved by the Curriculum Committee, and is planned to become active in Fall 2023.

1.1b - CTE Programs: Describe the membership of the program's advisory board. Describe how the program requirements are influenced by the advisory board, accrediting institutions, and other external organizations. Note how the membership might be expanded to get more helpful, diverse voices in the field.

NA

1.1c - CTE Programs: Provide advisory board minutes from the past two years [upload to the blue folder in the upper right corner of Section 1]. If minutes are unavailable, please describe what meetings have taken place, noting dates if possible, along with attendees' names and professional positions.

NA

1.2 – Future Outlook: describe conditions (inside the college, or beyond) that may affect the future of the program in the coming years. For example, note what factors may put a strain on the program or give it a boost in the next five years.

The Physics Department has recently (Fall 2022) hired a new full-time Astronomy/Physics Instructor, Dr. Maura Rabbette, to replace a position that had been unfilled since Michael Gregg resigned his tenure-track position in 2015, after one year in post. As the size of the program is expected to remain stable 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.

Enrollment in our calculus-based Physics sequence, PHYS 006-007-008, is driven mainly by the Engineering program. According to the data from 2022, 60% of the students taking this sequence are engineering majors. Hence, the health of our program is crucially dependent on maintaining the Engineering Program. With this connection in mind, a new A.S. degree in Engineering was developed, and has been active since Fall 2019. According the U.S. Bureau of Labor Statistics Employment Projections, growth in nationwide engineering employment will be 8.3% over the ten-year period of 2016-2026

(<https://www.bls.gov/careeroutlook/2018/article/engineers.htm>). This is roughly 1% per year, *i.e.*, a slow growth, but 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 Physics program will remain stable over the next five years.

The inquiry-based learning offered to our students in the laboratory components of our courses is heavily dependent on having a skilled, dedicated lab technician. The previous lab technician, Richard Crapuchettes, who worked with the Physics, Engineering, Geology, Geography, Astronomy, and Physical Science Departments, retired in Spring 2020. It is imperative for the continued health of the Physics Program that an equally experienced and skilled lab technician be hired to work exclusively for the above-mentioned Physical Sciences Departments on the Fairfield campus, and not shared with other departments.

1.2a - CTE programs: Review the provided labor market data, including employment and wage projections for employees in fields related to the program [upload any additional data to the blue folder in the upper right-hand corner of Section 1].

Comment on any areas that appear especially relevant to the program and its graduates.

NA

1.3 Population - Address how the population of students majoring in the program and/or taking classes in the program differ from the college as a whole; note what demographics (age, race, gender, etc.), are more or less represented, if any.

The following table shows the racial/ethnic breakdown of SCC students taking Physics courses, contrasted with the corresponding breakdown for SCC as a whole:

	Asian	Black	Hispanic	Other/Unknown	2 or more	White
SCC	15%	15%	13%	4%	27%	26%
Physics	26%	5%	13%	3%	27%	26%

For most categories (Hispanic, White, Two or more, Other), the percentages of that group in the Physics cohort closely mirrors the percentages for SCC as a whole. The two discrepancies are that Black students are under-represented in Physics, and Asian students are over-represented. Although Black students are under-represented in the SCC Physics program, this is roughly similar to nationwide statistics. In fact, the 5% Black component of our program is almost twice as high as the nationwide average of 3% Black undergraduate Physics students (<https://www.aps.org/programs/education/statistics/degreesbyrace.cfm>).

The following table shows the gender breakdown of SCC students taking Physics courses, contrasted with the corresponding breakdown for SCC as a whole:

	Male	Female	Other or Not-reporting
SCC	42%	56%	2%
Physics	48%	50%	2%

The gender breakdown for the SCC Physics student population is roughly the same as that for SCC as a whole. However, note that the percentage of female Physics students at SCC is twice as high as the US average of 25% (<https://www.aps.org/programs/education/statistics/womenphysics.cfm>).

The age distribution of Physics students at SCC is nearly the same as the distribution for SCC as a whole. Both distributions peak at about age 19, and more than half of the students are in the age range of 18-21.

1.3a – In the student survey, students were asked to identify why they were taking Program courses. Please summarize and briefly discuss the results.

Most students taking all or part of the PHYS 006-007-008 sequence are majoring in Physics, Engineering, Chemistry, or Computer Science, and are taking these courses because they are required for their major. Most students taking the PHYS 002-004 sequence are majoring in Biology, and take these courses to fulfill their major requirements. The vast majority of students taking PHYS 010 do so to fulfill a GE requirement.

PROGRAM OVERVIEW - GOALS

Program Goals	Actions to be taken	Person(s) responsible	Priority (Important or Urgent)	Time frame (Short term or long term)
No changes foreseen at this time.	NA	NA	NA	NA

SECTION 2: COURSES IN DEPARTMENT (TABLE)

2.1 Course Offerings - Specify which courses in the department and/or degree/certificate have been deleted or added since the last program review, and what prompted those changes. If these changes have already led to improvement, please describe.

As a consequence of AB705, Elementary Algebra, MATH 330 or MATH 330A, was removed as a prerequisite to PHYS 010. PHYS 010 was taught only by one instructor during this eight-year cycle, and the instructor saw no change whatsoever in the student success rate.

For completeness, we will also list here the full course offerings of the Physics Department. As explained in previous sections of this review, the Physics Department currently offers six classes: a two-term trigonometry-based sequence (PHYS 002-004), a three-term calculus-based sequence (PHYS 006-007-008), and a one-term algebra-based overview of physics (PHYS 010).

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.

A new Associate in Science degree in Physics for UC Transfer, was created to align with the University of California Transfer Pathways (UCTP) program, has recently been developed and approved by the Curriculum Committee, and is planned to become active in Fall 2023.

To earn the Associate in Science in Physics for UC Transfer degree, students must:

- (1) Complete a minimum of 60 semester units of courses that are eligible for transfer to the University of California system;
- (2) Complete the Intersegmental General Education Transfer Curriculum (IGETC) requirements;
- (3) Complete ten required units of Chemistry (CHEM 001, 002), fifteen required units of Physics (PHYS 006, 007, 008), and twenty-one required units of mathematics (MATH 020, 021, 022, 023, 040);
- (4) Obtain a minimum overall grade point average of 2.0.

Sample Course Sequence for Physics UCTP

Course No.	Course Name	Units	Sequence
MATH 020	Analytic Geometry and Calculus I	4*	Year 1, Fall
MATH 021	Analytic Geometry and Calculus II	4*	Year 1, Spring
MATH 022	Analytic Geometry and Calculus III	4	Year 2, Fall
MATH 023	Differential Equations	4	Year 2, Spring
MATH 040	Introduction to Linear Algebra	3	Year 2, Spring
PHYS 006	Physics for Science & Engineering I	5	Year 1, Spring
PHYS 007	Physics for Science & Engineering II	5	Year 2, Fall

PHYS 008	Physics for Science & Engineering III	5	Year 2, Spring
CHEM 001	General Chemistry I	5	Year 1, Fall
CHEM 002	General Chemistry II	5	Year 2, Fall
ENGL 001	College Composition (IGETC Area 1A)	4	Year 1, Fall
ENGL 002	Introduction to Literature (IGETC Area 1B)	4	Year 1, Spring
SPAN 001	First Semester Spanish (IGETC Area 6)	5	Year 2, Spring
HIST 002	World History to 1500 (IGETC Area 4)	3	Year 1, Fall
ARTH 001	Introduction to Art History (IGETC Area 3)	3	Year 2, Fall
BIO 014	Principles of Microbiology (IGETC Area 5B)	4	Year 1, Spring

*Units for MATH 020 and 021 reflect changes made in Fall 2022

2.1a - Describe what new course or courses are planned and provide reasons for these new offerings, including how these courses might address issues of equity and student success. CTE programs: Note how advisory board input has led to planned course changes. Please add any new course plans to the Course Goals table at the end of Section 2.

There are currently no plans to add any new courses to our Physics degrees or department.

2.2 Scheduling, Sequencing, and Fill - Describe the student survey feedback related to course scheduling. What barriers to enrollment do students report? In terms of timing, location, and instructional format of course offerings, what changes are suggested by the survey responses?

(Be sure to add any goals which address these survey responses to the Course Goals table at the end of Section 2.)

The Student Survey was sent out in Spring 2022. Most students reported no barriers to enrolling in their desired courses. A small number mentioned that their desired course was not offered at a convenient time. However, it must be noted that of the roughly 200 students taking Physics courses in Spring 2022, only 10 students (approx. 5%) answered the survey. This pool is much too small to provide a statistically meaningful basis for analyzing the results. In the previous program review, each department was allowed to craft its own survey questions. Using generic one-size-fits-all questions makes it impossible to compare with previous years. In addition, in the previous program review, the surveys were distributed in person and completed during class time, and the response rate was close to 100%.

2.2a - For courses with low enrollment numbers, note possible causes (such as the type of class, scheduling, etc.).

All of the courses offered by the Physics Department generally meet the 60% minimum required fill rate, as specified in the contract. During the pre-COVID years of 2015-2019,

the average fill rate our Physics classes was 80%; during the COVID-era of online courses, the fill rate has increased to 91%.

There is only one course that shows a data-driven need to add an additional section: this would be to add an extra section of PHYS 002 in the Spring semester.

We have decided that there should be no additional Physics course offerings in the summer. There is no obvious demand for more offerings, and it is pedagogically unsound to offer foundational physics courses in a condensed format.

2.2b - Note if there is a preferred sequence of classes that students should take in the department/degree/certificate, or if there is no preferred sequence, and how students are informed of your preferred sequence (if any). Describe any work done to support PACE/Guided Pathways and inform counselors.

The sample course sequences for each of the degrees offered in the Physics Department are listed in the SCC catalog.

The sample sequence for the PHYS-AS degree is shown below; the listed GE courses are indicative only, and are shown as examples.

Sample Course Sequence (PHYS-AS degree)

Course No.	Course Name	Units	Sequence
MATH 020	Analytic Geometry and Calculus I	4*	Year 1, Fall
MATH 021	Analytic Geometry and Calculus II	4*	Year 1, Spring
MATH 023	Differential Equations	4	Year 2, Fall
PHYS 006	Physics for Science & Engineering I	5	Year 1, Spring
PHYS 007	Physics for Science & Engineering II	5	Year 2, Fall
PHYS 008	Physics for Science & Engineering III	5	Year 2, Spring
BIO 002	Principles of Cell & Molecular Biology	5	Year 1, Fall
CHEM 001	General Chemistry	5	Year 2, Spring
ENGL 001	College Composition	4	Year 1, Fall
ENGL 002	Critical Thinking and Writing About Literature	4	Year 1, Spring
COMM 001	Introduction to Public Speaking	3	Year 2, Fall
SPAN 001	First Semester Spanish	5	Year 2, Spring
HIST 002	World History to 1500	3	Year 1, Fall
PLSC 001	Introduction to American Government & Politics	3	Year 2, Fall

*Units for MATH 020 and 021 reflect changes made in Fall 2022

The sample sequence for the PHYS AS-T degree is shown below; the listed GE courses are indicative only, and are shown as examples.

Sample Course Sequence (PHYS AS-T degree)

Course No.	Course Name	Units	Sequence
MATH 020	Analytic Geometry and Calculus I	4*	Year 1, Fall
MATH 021	Analytic Geometry and Calculus II	4*	Year 1, Spring
MATH 022	Analytic Geometry and Calculus III	4	Year 2, Fall
PHYS 006	Physics for Science & Engineering I	5	Year 1, Spring
PHYS 007	Physics for Science & Engineering II	5	Year 2, Fall
PHYS 008	Physics for Science & Engineering III	5	Year 2, Spring
BIO 002	Principles of Cell & Molecular Biology	5	Year 1, Fall
CHEM 001	General Chemistry	5	Year 2, Spring
ENGL 001	College Composition	4	Year 1, Fall
ENGL 002	Critical Thinking and Writing About Literature	4	Year 1, Spring
COMM 001	Introduction to Public Speaking	3	Year 2, Fall
SPAN 001	First Semester Spanish	5	Year 2, Spring
HIST 002	World History to 1500	3	Year 1, Fall
PLSC 001	Introduction to American Government & Politics	3	Year 2, Fall

*Units for MATH 020 and 021 reflect changes made in Fall 2022

The sample sequence for the Associate in Science in Physics for UC Transfer (UCTP) is shown below. The listed GE courses are indicative only, and are shown as examples. This suggested sequence of courses is consistent with the Guided Pathway, as outlined in the Program Map that can be found on the Physics Department website, and which has been supplied to the Guided Pathways coordinator. Since the list of courses offered by the Physics Department has been stable for several decades, the Counseling Department is well aware of our course offerings.

Course No.	Course Name	Units	Sequence
MATH 020	Analytic Geometry and Calculus I	4*	Year 1, Fall
MATH 021	Analytic Geometry and Calculus II	4*	Year 1, Spring
MATH 022	Analytic Geometry and Calculus III	4	Year 2, Fall
MATH 023	Differential Equations	4	Year 2, Spring
MATH 040	Introduction to Linear Algebra	3	Year 2, Spring
PHYS 006	Physics for Science & Engineering I	5	Year 1, Spring
PHYS 007	Physics for Science & Engineering II	5	Year 2, Fall
PHYS 008	Physics for Science & Engineering III	5	Year 2, Spring
CHEM 001	General Chemistry I	5	Year 1, Fall
CHEM 002	General Chemistry II	5	Year 2, Fall
ENGL 001	College Composition (IGETC Area 1A)	4	Year 1, Fall
ENGL 002	Introduction to Literature (IGETC Area 1B)	4	Year 1, Spring
SPAN 001	First Semester Spanish (IGETC Area 6)	5	Year 2, Spring
HIST 002	World History to 1500 (IGETC Area 4)	3	Year 1, Fall
ARTH 001	Introduction to Art History (IGETC Area 3)	3	Year 2, Fall

BIO 014	Principles of Microbiology (IGETC Area 5B)	4	Year 1, Spring
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*Units for MATH 020 and 021 reflect changes made in Fall 2022

2.3 Prerequisites, Course Advisories, and Placement. Review and summarize student survey feedback regarding prerequisites. Note how advisories and pre- and co-requisites might be changed to get students better prepared for classes in the program. Be sure to add any goals which address these survey responses to the Course Goals table at the end of Section 2.

The Student Survey was sent out in Spring 2022. No issues were raised by students regarding prerequisites or advisories.

Course Goals:

Course Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)
Faculty are discussing adding "hybrid" as a possible permanent mode of delivery for all of our lab-based courses.	If it is decided to implement these changes, they will be incorporated into the Physics Curriculum Review in year 2023-24.	Melanie Lutz	Important	Long Term

SECTION 3: ASSESSMENT OF PLOS & SLOS (TABLES)

Assessment of PLOs

PLOs for PHYS AS-T	Expected Performance	Performance
PLO 1: Demonstrate analytical and/or conceptual problem solving skills in the study of Physics. (Active from Spring 2020)	70.0%	92.2%
PLO 2: Carry out experiments and critically assess data. Students will learn the role of hypothesis, measurement, and analysis in the development of scientific theory, as evidenced by lab reports. (Active from Spring 2020)	70.0%	94.1%

PLO 3: Write a professional laboratory report. (Active from Spring 2020)	70.0%	92.2%
PLOs for PHYS AS-T		
PLO 1: Demonstrate analytical and/or conceptual problem solving skills in the study of Physics. (Active from Spring 2020)	70.0%	92.2%
PLO 2: Carry out experiments and critically assess data. Students will learn the role of hypothesis, measurement, and analysis in the development of scientific theory, as evidenced by lab reports. (Active from Spring 2020)	70.0%	94.1%

3.1 Program Learning Outcomes (PLOs) - Summarize the student survey feedback related to PLOs. To what extent do majors understand the PLOs, find the classes effective in preparing them to succeed in the PLOs, and feel they are able to achieve the PLOs?

According to the Student Survey that was sent out in Spring 2022, 82% of the respondents said that they understood the PLOs. However, only 54% of the respondents found the classes to be effective in preparing them to succeed in the PLOs. These latter responses pertained mainly to the PLOs that related to laboratory experiments, and underscore the need to hire a full-time lab technician to facilitate the return to in-person labs.

Assessment of SLOs

SLOs for PHYS 002	Expected Performance	Performance
SLO 1: Use Newtons laws to solve a problem involving motion under constant acceleration.	70.0%	81.4%
SLO 2: Use the law of conservation of energy to solve simple mechanics problems.	70.0%	93.0%
SLO 3: Solve problems related to standing waves on strings or in air columns.	70.0%	69.0%
SLOs for PHYS 004		
SLO 1: Use Ohm's law to analyze simple series and parallel resistor circuits.	70.0%	95.7%
SLO 2: Use the lens equation and ray diagrams to solve simple optics problems.	70.0%	73.9%
SLO 3: Use Heisenbergs uncertainty equation to compute the uncertainty in measurements of position or momentum.	70.0%	91.3%

SLOs for PHYS 006		
SLO 1: Use Newton's laws of motion to solve two-dimensional problems in particle statics and dynamics.	70.0%	98.2%
SLO 2: Use energy methods to solve dynamics problems involving translational or rotational motion of particles and rigid bodies.	70.0%	92.9%
SLO 3: Use the principles of conservation of linear and angular momentum to solve to problems involving impacts and collisions.	70.0%	73.2%
SLOs for PHYS 007		
SLO 1: Solve problems involving one-dimensional wave motion in a continuous medium.	70.0%	96.1%
SLO 2: Calculate the electric field and potential due to a given distribution of charges.	70.0%	94.1%
SLO 3: Use Kirchhoff's laws to analyze simple electrical circuits.	70.0%	92.2%
SLO 4: Use Maxwell's equations to calculate magnetic fluxes and induced EMFs in simple situations involving wires and coils.	70.0%	88.2%
SLOs for PHYS 008		
SLO 1: Use the first law of thermodynamics to solve problems involving phase changes.	70.0%	85.7%
SLO 2: Use the equation for constructive wave interference to solve problems involving diffraction gratings.	70.0%	85.7%
SLO 3: Solve the time-independent Schrodinger equation to calculate the possible energy levels for a "particle in a box."	70.0%	85.7%
SLOs for PHYS 010		
SLO 1: Use Newton's laws and energy methods to answer simple questions in mechanics.	70.0%	96.6%
SLO 2: Use the concepts of electricity and magnetism to answer questions about	70.0%	93.1%

circuits, magnets, and electrical charges.		
SLO 3: Use the laws governing light and optics to answer simple questions involving reflection, refraction, and color.	70.0%	96.6%
SLO 4: Use the laws governing sound and waves to answer simple questions involving wave interference and the Doppler effect.	70.0%	89.7%

3.2 Student Learning Outcomes (SLOs) - Review the current status of SLOs in your program. Note if all course SLOs are written and up-to-date (at least two per course). Identify which courses have not been assessed in over two years, and note which of these courses have not been offered in over two years.

All course SLOs are complete and up to date, and can be found in the Course Outline of Record (COR) within eLumen. All six courses in the Physics Department have been offered at least once each year, and all have been assessed within the past two years.

3.2a - Describe collaborative efforts among faculty to assess SLOs. For example, note if SLO assessments in online and face-to-face courses have been compared, and what these comparisons indicate. Note if rubrics have been used in different sections of the same course, or across courses, to aid SLO assessment.

By comparing SLO assessment results between the same course as taught face-to-face, and as taught online, it seems that SLO success rates are roughly similar. In courses, such as PHYS 002, 004, and 006, that are taught by multiple faculty members, common rubrics for SLO assessments have been distributed.

SECTION 4: STUDENT SUCCESS (by RACE/ETHNICITY and GENDER – TABLES)

4.1 Student Success and Support - Describe the student survey feedback related to success. What barriers did students identify, and what did they find helpful? How did students address the question of equity and emotional safety?

The Student Survey that was sent out in Spring 2022 did not uncover any barriers to student success. Only a very small number of respondents mentioned aspects that helped them to succeed. These comments included “(a) Lots of studying. (b) YouTube. (c) Learning from multiple sources such as the textbook and the professor and making the connection between the two have helped me succeed more than anything. (d) Study groups with other students, effective study methods, a lot of practice problems”.

Five of the nine students responded affirmatively to the question “The courses (online or face-to-face) in this program/department provide an emotionally safe, supportive learning environment, where I can explore ideas and express myself”. As alluded to earlier, it is difficult to interpret such results when only 9 out of roughly 200 students responded to a question.

4.2 Success by Population - Review the student success rates in the program/department, if available. If possible/applicable, review student success in general education classes (across specific populations) with student success in degree-specific courses. Note if certain groups are significantly more or less successful than their peers, and if there have been any clear trends upward or downward since the last program review. Provide possible reasons for higher or lower success rates.

The success rate for all courses taught in the Physics Department, over the entire reporting period, was 79%. This success rate was higher than the success rate for SCC as a whole, which was 75%.

The Physics Department’s success rate of 79% shows a substantial improvement from the 73% success rate that was reported in the previous program review.

The overall success rate in those Physics courses that are required for a major was 79%, whereas the success rate for the sole GE course, PHYS 010, was 85%. (Note that the success rate for Physics as a whole lies between the success rate for courses required for a major, and the success rate for the GE course, as it must. But when rounded to two digits, this ordering is not obvious).

The following table shows the racial/ethnic breakdown of the success rates of SCC students taking Physics courses, contrasted with the corresponding breakdown for SCC as a whole:

	Asian	Black	Hispanic	Other/Unknown	2 or more	White
Physics	79%	68%	74%	88%	80%	83%
SCC	79%	65%	73%	73%	73%	78%

The success rate for each racial/ethnic group in Physics was in all cases at least as high, and in most cases higher, than the success rate for that group in SCC as a whole.

The next table shows the gender breakdown of the success rates of SCC students taking Physics courses, contrasted with the corresponding breakdown for SCC as a whole:

	Male	Female
Physics	77%	82%
SCC	74%	75%

The success rate in Physics for female students (82%) was slightly higher than the success rate for male students (77%). The success rates for both male and female students in Physics were each higher than the corresponding success rates in SCC as a whole.

4.3 Degrees/Certificates Awarded (if applicable). Review the number of degrees and certificates awarded over the past five years, if available, and address any clear upward or downward trends. If students are leaving the program before earning the degree/certificate, note whether certain courses are a stumbling block, or if students don't need all the courses in the program to achieve their goals. If possible, note if certain populations of students are having greater difficulty completing the program.

The Physics Department has been offering an AS degree and an AS-T degree during the entirety of this reporting period. The number of degrees awarded each year is shown in the following table:

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Average
AS	4	7	6	6	6	7	6.0
AS-T	2	7	5	6	8	5	5.5

During the period covered by the previous Program Review (2008-14), we offered only an AS degree in Physics, and an average of 5.0 degrees were awarded per year. The number of AS degrees awarded each year has therefore remained roughly stable. Additionally, a similar number of AS-T degrees are now awarded annually. Hence, the total number of Physics degrees awarded each year has, on average, roughly doubled.

During the 2008-14 period covered by the previous Program Review, the percentage of Physics degrees awarded to women was 13%. During the current period, the percentage of Physics degrees awarded to women has increased to 28%. This percentage has therefore doubled in less than a decade, and is now higher than the percentage of Physics degrees awarded to women in the US as a whole, which during the period 2016-22 was 23%.

4.4 Preparation for the Future - Describe how students are informed about future options, such as the kinds of schools they might transfer to, the kinds of employment available in their field, and what further degrees might be useful to get into a particular profession. CTE programs: Note also if any agreement or MOU exists with employers to place graduates.

The Transfer Center at SCC provides prospective transfer students with direction and assistance in navigating the transfer process. The services that they offer include connecting students with university representatives, holding transfer-related workshops and transfer fairs, helping students access information on transfer websites, and assisting students with researching colleges, and arranging campus tours. SCC counselors and individual Physics instructors also

give advice to students regarding career pathways, transfer opportunities, and degree options, that will help them to achieve their goals.

4.4a CTE programs: Note if there are any statewide, local or national tests that students should take, after leaving your program, in order to get employed or be more competitive in the job market. Note also if students need additional study or coursework (not provided by the college) before they are ready to take those tests. Explain how students are informed about these requirements.

NA

SECTION 5: OUTREACH

5.1 Outreach for Equity - Describe outreach efforts since the last program review to attract and retain under-represented populations (such as diversified curriculum or guest lecturers).

- Three SCC Physics students, Leena Hussein, Kathleen Matsumoto-Elliott, and Kelsey Balella, attended the American Physical Society Conference for Undergraduate Women in Physics at UC Davis on January 18-20, 2019. <http://www.solano.edu/president/insidesolano/2019/Inside012819.pdf>.
- Faculty member Katie Berryhill, and former SCC Physics student Nicole Peacock participated in the SCC Women in STEM Panel, on March 21, 2019. <https://www.dailyrepublic.com/all-dr-news/solano-news/fairfield/solano-college-to-host-stem-panel-discussion/>.

5.2 Outreach on Campus - Describe how the program has connected with the campus community. Include any cross-discipline collaborations, student clubs, or other activities that connect students in the program to the college as a whole. Note whether there is currently need for more coordination with Counseling.

- Scott Berta set up a table to promote Physics and Engineering at the SCC Majors Fair on March 20, 2018 on the Fairfield campus.
- Scott Berta set up a table to promote Physics and Engineering at the SCC Majors Fair on March 20, 2019 on the Fairfield campus.
- Scott Berta gave a presentation about the Physics and Engineering programs at the SCC High School Counselors Conference on March 3, 2022.

5.3 Outreach to the Community - Describe how the program has connected with the larger community. Provide examples of activities, field trips, and community/classroom partnerships since the last program review. Note who has been brought into the classroom, and where students have been brought, beyond the classroom.

- Melanie Lutz invited two US Navy Representatives to a session of PHYS 006 on February 21, 2018, to inform students about job opportunities in Nuclear Engineering in the US Navy.
- Maura Rabbette organized and chaired Special Women’s History Month Presentation at the SCC Fairfield campus by Sarah Stewart, a MacArthur Genius Award winner and UC Davis Professor of Astrophysics, on March 7, 2019.
<http://www.solano.edu/president/insidesolano/2019/Inside030419.pdf>.

OUTREACH GOALS

Outreach Goals	Actions to be taken	Person(s) responsible	Priority (Important or Urgent)	Time frame (Long term or Short term)	Funding (NA, One-time, Ongoing)	Cost
Faculty will continue to participate in SCC outreach activities to promote the Physics program	Participate in SCC outreach activities	Faculty and lab technician	Important	Long term	NA	%0

SECTION 6: RESOURCES

6.1 Human Resources - Describe the current staffing levels in the program, and whether they are currently adequate to meet students’ needs. If the program has been functioning for a while without needed faculty/staff, note how long has this position been needed, and how this gap has affected the program’s health.

After a seven-year period in which we had not replaced Phil Petersen, the full-time Astronomy/Physics faculty member who retired in 2014, we hired Dr. Maura Rabbette as a full-time faculty in Astronomy and Physics in Fall 2022. In combination with our two other full-time faculty who teach partly in the Physics Department, and our cohort of adjuncts, we now have sufficient staff to teach our Physics courses.

However, since the retirement of lab technician Richard Crapuchettes in 2020, our Physics program in Fairfield, where 77% of our Physics lab sections are taught, has been without a lab technician. All but one of our Physics courses contain one three-hour lab session each week. In order to fully return to face-to-face lab sessions, we need to hire a fully-trained, full-time lab technician for Physics and the other Physical Science departments.

6.1a - Note what gaps will need filling within the next year, and within the next five years, and why new or replacement faculty/staff will be needed.

There are no immediate teaching gaps in the short or medium term. However, it is imperative that a full-time lab technician be hired to help with the laboratory sessions in PHYS 002, 004, 006, 007, and 008 at the Fairfield campus.

6.2 Technology - If the program has been functioning for a while without needed technology (IT, software, hardware), note how long the technology/equipment has been needed, and how this gap has affected the program's health.

Although most of our laboratory equipment is old, it is still functional, and suitable for its purpose. This equipment, along with the desktop and laptop computers used in the labs, 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. Maintaining our aging equipment will require a lab technician, the need for which has been mentioned elsewhere in the Program Review.

6.2a - Note what new or special technology will be needed in the next year, and the next five years, and why it will be needed.

No new technology will be needed at Fairfield, aside from normal maintenance and upkeep of our existing lab equipment and laboratory software. The Physics lab at the Vacaville Center could use a small mill, and a 3D printer for rapid prototyping and production of parts for development and repair.

6.2b - Describe survey feedback describing students' experiences with technology in the classroom.

In the Student Survey that was sent out in Spring 2022, six of the nine respondents (67%) commented that the statement: "The classroom facilities, equipment, and physical space support student learning in this class" was not applicable to them, as they were taking the course online. During the past three calendar years, 2020-23, most Physics courses have been delivered online, and no issues have been reported by students with the Zoom or Canvas technology that has been used.

6.3 Facilities & Equipment - Note what classrooms, buildings, and other facilities the program currently uses/occupies. Describe how the existing facilities/equipment serve the program's needs, and in what ways the existing facilities are inadequate to meet students'

needs. If the program has been functioning for a while with inadequate facilities/equipment, note how this has affected the program's health.

Currently, all Physics courses are taught either online, or at the Fairfield campus in Room 301 or Room 302, or in Room 112 of the Vacaville Center. These rooms, and their associated prep rooms and machine shop, are perfectly suited to the needs of this program, for the near future.

The new Science Building at Fairfield, Building 2700, which houses Biology, Chemistry, Geology, and Geography, does not contain any space for our growing Astronomy program. The need for additional space for Astronomy, including a domed planetarium, coupled with the fact that Building 300 (used by Physics, Physical Science, Engineering, and Astronomy at Fairfield) and Building 1500 (used by Math at Fairfield) will eventually approach the end of their life cycle, highlight the need for a new STEM Center at Fairfield that will house Mathematics, Physics, Engineering, Astronomy, Physical Science, along with our new Data Science Program. This new STEM Center, which will contain a state-of-the-art computer lab, was mentioned in Section 4.4 of the 2016 Astronomy Program Review: "For the longer term, the Astronomy Department faculty, along with the Physics and Engineering Departments, have been advocating the construction of a new dedicated Physical Sciences building, which would include a domed planetarium."

6.3a - Note what new facilities/equipment will be needed in the coming years.

As mentioned above, our long-term plans are to move the Physics program at Fairfield into a new STEM Center, which will house the Physics, Astronomy, Engineering, Physical Science, and Mathematics Departments.

6.3b - Describe survey feedback describing students' experiences with the Program's facilities/equipment.

In the Student Survey that was sent out in Spring 2022, six of the nine respondents (67%) commented that the statement: "The classroom facilities, equipment, and physical space support student learning in this class" was not applicable to them, as they were taking the course online.

6.4 Library and Student Support Resources - Note how the program uses tutors and other specific support for student learning. Include any plan to change or expand student support in the goals list below.

This program does not currently use tutors or other specific support. Many students from our Physics program have served as tutors in the MAC lab, and at the Academic Success and Tutoring Center (ASTC).

6.4a - Review the college’s discipline-specific library resources with a librarian. Summarize the current status of the library resources and plans to supplement the collection. Upload the librarian’s collection evaluation form to the blue folder in the upper right-hand corner of Section 6.

Copies of all textbooks used in the Physics program are kept on file in the SCC Library.

6.5 Other Resources - Note the program’s routine or special costs not addressed above, such as regularly contracted services. Note whether any of the funds for these goods/services come from a special source; if so, note if the funding will run out or will continue for the foreseeable future, and potential impact on the program.

NA.

6.6 Resources Leading to Improvement - Using specific examples, describe how changes to staffing, faculty, technology, equipment, facilities, library collection, student support, and/or funding have led to an improved experience for students and greater student equity. CTE programs: Address specifically any improvements funded by Perkin’s money or other sources.

We have recently hired a full-time faculty member, astrophysicist Maura Rabbette, to teach in our Astronomy and Physics Departments. Dr. Rabbette will bring years of experience working at NASA to our program, which will help in motivating our students.

Resources: Hiring Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)
1. Hire an experienced lab technician dedicated to the physical science departments.	Post job advert	HR/Dean	Urgent	Short Term

Resources: Technology Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)
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			Urgent)	long term)
1. Upgrade Logger-Pro Software in Fairfield	Order new software	IT/Lab Tech	Important	Long Term
2. Upgrade desk-top and laptop computers in rooms 301 and 302	Place request to IT	IT/Lab Tech	Important	Long Term

Resources: Facilities and Equipment Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)
1. Purchase mill for Vacaville	Place order	Zak Hannan	Important	Short Term
2. Purchase 3-D printer for Vacaville	Place order	Zak Hannan	Important	Short Term
3. Remove bank of Geography files drawers in room 301 and replace with large chalk board	Work order was placed to Facilities in Aug. 2022	Melanie Lutz/Maura Rabbette	Urgent	Short Term
4. Add on/off light switch in room 302	Place work order to Facilities	Melanie Lutz	Important	Short Term
5. Finish furnishing room 344	Place work order to Facilities	Maura Rabbette	Urgent	Short Term

6. Order Telescopes (to be shared with Astronomy)	Place purchase order	Maura Rabbette/Lab Technician	Important	Short Term
7. New teachers chair in room 301	Place work order to Facilities	Maura Rabbette	Urgent	Short Term

Resources: Student Support Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)
Supply desk copies of all textbooks for 2-hr reserve to library	Contact publishers for desk copies	All faculty	Important	Long term

Resources: Other Resource Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)
None at this time				

Please Note: All information regarding funding type and cost is TBD and is awaiting the hiring of a Physical Sciences lab technician.

END OF SECTION 6: HR GOALS, TECHNOLOGY GOALS, FACILITIES GOALS, STUDENT SUPPORT RESOURCES GOALS, OTHER RESOURCES GOALS

SECTION 7: CONCLUSION

7.1 Need for Improvement and Support - Summarize the program's top two or three areas most in need of improvement and support.

1. It is imperative that a full-time lab technician be hired to support PHYS 002, 004, 006, 007, and 008.
2. It is imperative that we retain our classrooms 301 and 302 on the Fairfield campus, and their associated prep rooms.
3. Our longer-term plan is to move Physics teaching at the Fairfield campus into a new STEM Center that will include a domed planetarium.

7.2 Improvement, Success, and Strength - Summarize the program's top two or three areas of improvement, success, and strength.

Among the improvements made in the SCC Physics program over the period 2015-22 are the following:

- A new Associate in Science degree in Physics for UC Transfer (UCTP) has been developed, and will become active in Fall 2023.
- A new full-time Astronomy and Physics instructor, Maura Rabbette, was hired in 2022. Dr. Rabbette has a Ph.D. in Astrophysics from University College Dublin, and has worked as a research astrophysicist at NASA, and as a Program Manager for the U.S. Air Force and Space Force at Travis Air Force Base. Maura brings great experience and enthusiasm to our program.
- A new Physics Lab (Room 112), and an associated machine shop, were built in 2017-18 at the Vacaville Center. This lab houses sections of PHYS 002, 004, and 006.

Among the many notable success stories of our Physics Program have been the following:

Faculty:

- Melanie Lutz received the SCC Presidential Recognition Award in 2015.
- Maura Rabbette received the SCC adjunct Distinguished Faculty Award in 2019.
- Melanie Lutz published two papers in refereed scientific journals:
 1. "Effect of the interphase zone on the conductivity or diffusivity of a particulate composite using Maxwell's homogenization method", M. P. Lutz and R. W. Zimmerman, *Int. J. Eng. Sci.*, vol. 98, pp. 51-59, 2016.
<https://www.sciencedirect.com/science/article/pii/S0020722515001056>
 2. "The effect of pore shape on the Poisson ratio of porous materials", M. P. Lutz and R. W. Zimmerman, *Math. Mech. Solids*, vol. 26(8), pp. 1191-1203, 2021.
<https://journals.sagepub.com/doi/full/10.1177/10812865211023535>

Students:

- Michael Lostica did a Summer REU Internship at Brandeis University in 2017.
- Hunter Martin did an REU summer internship in Physics at UC Davis in 2017.
- Jordan Van Leuven presented a poster entitled "Statistical Analysis of the Distribution of Speeds in a 2D Monatomic Gas" at the 2018 California Mathematics Council Community Colleges Conference (CMC3) in Monterey.

- James Alsip did a Summer Assure Internship at UC Berkeley in 2022.
- Mackenzie Cassell did a Summer REU Internship in Physics at UC Davis in 2022.

Graduates:

- SCC Physics graduate Dan Wiese received a Ph.D. in Mechanical Engineering from MIT, and founded his own biomedical device start-up company in Boston.
- SCC Physics graduate Nick Sherman won the American Physical Society Leroy Apker Award in 2018, for Outstanding Achievements in Physics by an Undergraduate Student, for his work at UC Davis in “theoretical condensed matter and mathematical physics dealing with the subjects of quantum entanglement in mixed states.” Nick is currently pursuing a Ph.D. in Physics at UC Berkeley.

<http://www.solano.edu/president/insidesolano/2018/Inside091718.pdf>

7.3 Signature Page - The following faculty in the program (or in a related program) have read this self-study report and have had the opportunity to provide feedback:

Melanie Lutz, full-time

Zachary Hannan, full-time

Maura Rabbette, full-time

Philip Petersen, adjunct

Trevor Gonzalinajec, adjunct

Darwin Ho, adjunct

Tracey Johnson, adjunct

Bogdan Popescu, adjunct