Fullerton College Program Review and Planning
Self-Study for Instructional Programs
Fall 2021

Physics and Astronomy
Natural Sciences

Statement of collaboration

The program faculty members listed below collaborated in an open and forthright dialogue to prepare this Self Study. Statements included herein accurately reflect the conclusions and opinions by consensus of the program faculty involved in the comprehensive self-study.

Participants in the self-study

Seung Ji
Liliana Barabas
Chris Persichilli
Alaric Doria

Authorization

After the document is complete, it must be signed by the Principal Author, the Department Coordinator, and the Dean prior to submission to the Program Review and Planning Committee.

Printed name	Signature	Date
Seung K. JI	Seung Ji	11/14/2021
Printed name of principal author	Signature	Date
Seung K. Ji	Seung Ji	11/14/2021
Printed name of department coordinator	Signature	Date
Bridget Salzameda	Bridget Salzameda	12/14/2021
Printed name of Dean	Signature	Date

1.0 Executive Summary

The physics department has successfully provided essential physics and astronomy courses and offered Astronomy Associate in Arts Degree (AA) and Physics Associate in Science Degree for Transfer (AST) despite various challenges and the covid-19 pandemic. Currently, the physics department consists of five full-time faculty and one lab technician. We plan to enhance the current curriculum and SLO assessment and expand the number of sections offered.

Mission and Goals

The physics department supports the college's mission and goals. The department's mission and goals are revised in accordance with the changes in the college's plan.

Students

In section 3.0, Students, enrollment demographics and student achievement, and equity gaps are discussed. The OEI data show a clear achievement gap for our Latinx, Black, and Filipino students. We see a 6.8% gap in the course success rate. There is also a clear achievement gap along with income, with low-income students having a 7.9% (384 students) deficit in course achievement. However, we need further investigation to find the correct causes of the achievement gap.

The number of sections offered decreased significantly in the past five years, mainly due to leaving adjunct and full-time faculty and the covid-19 pandemic. We plan to hire new adjunct faculty to increase the number of sections.

The physics department developed effectively underwent the transition to online classes during the covid-19 pandemic. New do-at-home experiments were designed, and new pedagogy was practiced and shared in the department.

Outcomes

PSLOs and CSLOs are assessed in this section. We did not find any statistically meaningful changes from the previous review cycle. We plan to improve the current SCLO assessment method.

Other Areas of Program Effectiveness

The physics department has Astronomy Associate in Arts Degree (AA) and Physics Associate in Science Degree for Transfer (AST) programs. Also, the department has been running Peer

Assisted Tutoring (PAL) program to help students who need additional assistance for their success in the courses.

Planning

After the review process, the physics department has four major Strategic Action Plans (SAPs)

1. Hire new instructors to provide more physics courses.
2. Develop a systematic CSLOs and PSLOs assessment plan.
3. Develop new experiment activities and repair or replenish equipment for lab activities.
4. Create a Campus STEM Resource Center.

2.0 Mission and Goals

Mission: Fullerton College physics department fosters a supportive and inclusive environment for students to be successful learners. We provide students opportunities to build critical thinking, creative thinking, problem-solving, and quantitative reasoning skills.

Vision: Physics is one of the fundamental sciences. Students learn the thought processes of great pioneers in physics, and we help students "see further on the shoulders of Giants."

Core Values: Physics department has been and will have practiced and developed curriculum and pedagogies to promote the core values of Fullerton college: Community, Diversity, Equity, Excellence, Growth, Inclusivity, Innovation, Integrity, Partnership, Respect, and Responsibility.

College Goals:

The department promotes excellence in learning by providing a rigorous program of transfer-level courses.

The department promotes partnerships with local K-12 and higher education institutions. The COVID-19 pandemic recently hurt these partnerships, but we hope to reinstate them in spring 2022. In particular, we hope to have more Special Admit Students who are K-12 students to enroll in college-level courses by filling out a Special Admit Packet.

The physics department applies innovative teaching methods and technologies to enhance student success outcomes. We use state-of-the-art sensors in laboratory experiments and data analysis software to streamline our students' laboratory experience and increase their focus on the actual physical principles that are being tested instead of focusing on number crunching and arithmetic. While teaching online, faculty in our department make use of various online software to enhance student interactivity. Such software includes but is not limited to Zoom Breakout Rooms, Slack, Discord, MasteringPhysics, LearningCatalytics, and many different "online whiteboards" such as LucidSpark.

The department has a number of ongoing efforts to increase student success. The most important of these is a program of supplemental peer instruction. The department has run the Peer Assisted Learning (PAL) program. The PAL program was temporarily suspended during the covid-19 pandemic, but it will restart in the 2022 spring semester. During these difficult times, physics faculty have made themselves highly available for students, including meeting with students over the weekend for optional Zoom review sessions and office hours.

The majority of students entering our courses are underprepared in mathematics, science, and critical thinking, and we are continuously working to improve our ability to address their needs without sacrificing academic standards.

Students work as a group in the majority of Physics and Astronomy classes, and the department has encouraged peer instructions in physics courses. Physics and astronomy classes are essential places to learn the importance of inclusiveness and equity in the STEM fields.

3.0 Students

3.1 Enrollment demographics

1. There has been a -44.7 % decrease in the enrollments of students over the past five years. (see Appendix A section 3.1.1.) The decline in enrollment was mainly due to losing adjunct faculty and the retirement of two full-time facilities. The physics department hired five adjunct faculty in AY 17/18, but the number was reduced to zero in AY 20/21(see Appendix A section 3.4.1). However, the fill rate of the classes has been over 90% for all classes over the past five years. The fill rate was over 100% in AY 19/20. This indicates that the demand for physics and astronomy classes is high. We plan to hire more adjunct faculty in the future, but it has been challenging to hire adjunct faculty in the past years. Parity between lecture and laboratory pay has been a large hurdle to attracting Adjunct faculty, who are generally underpaid and must commute between several colleges daily to make ends meet.

2. The data provided by the OIE shows age groups and gender gaps, and the students' demographics. 78% of students are 20 or older, and 21 % of students are under 20. More Asian and White students enroll in physics/astronomy classes than other programs. (see Appendix A section 3.1.2) The gender gap in STEM is shown in the enrollment by gender data. 55.9% of the students in physics/astronomy classes are men, and 38.9% of students are women. However, female students show a higher success rate. (see Appendix A 3.2.2)

   Students enrolled in physics/astronomy classes showed higher degree or transfer rates (86%) than all other programs average (77%). Physics major students showed even higher degree or transfer rates, but there were only 22 physics major students in AY 20/21. More data is necessary to have a more concrete conclusion.

3. The physics department offers three types of classes. There are general education courses. ESC 116 F and ESC 116LF are astronomy lecture and lab courses. Physics 130 F is a survey of physics courses. There are algebra and calculus-based physics courses for life sciences. They are Physics 205 and 206 (algebra-based) and Physics 210 and 211 (calculus-based). Finally, we offer Physics 221, 222, and 223, which are calculus-based physics courses for students majoring in the physical sciences and engineering.

4. ESC 116 F and ESC 116 LF are general education courses. ESC 116 F Astronomy is the most enrolled course. (See Appendix A 3.1.5) We offer 22 % of ESC 116F classes online. There is a high demand for general education courses for non-science majors. However, the physics department was not able to offer enough astronomy classes.

   Physics 205/210 and 206/211 are physics courses for life sciences. We only offered one physics 205 and 210 per semester and offered physics 206 and 211 only in the spring semesters. There have been occasions when life science major students took physics for physical sciences and engineering because there were not enough physics courses for life sciences. We plan to offer more physics courses for life science majors.

   Each semester, the physics department offers 6~8 physics 221F sections, 3~4 physics 222F sections, and 1~2 physics 223F sections and matches students' preparation and goals. However, the number of sections decreases during the covid-19 pandemic. We plan to scale back up to the regular number of sections in the future.

5. The number of sections decreased from 52 sections in AY 16/17 to 34 sections in AY 20/21 (see Appendix A 3.4.1) mainly because faculty left the physics department. In AY 18/19, we lost four adjunct faculty. This led to a 30.7 % decrease in enrollments in AY 18/19. Two full-time faculty retired earlier than their initial plan in AY 19/20 during the covid-19 pandemic. This led to a 19.7% decrease in enrollment in AY 20/21. We hired two new full-time facilities in AY 20/21. We plan to increase the number of sections next AY.

3.2 Student Achievement and Equity

1. According to the data provided by OIE in Appendix A, program-wide completion rates for physics have not shown any major overall trends in the past 5 years. Course completion averaged for physics over the last 5 years was 76.2%, which is 6.2% lower than the average for all other programs. Course success rates show some moderate increases (5%) since AY 19/20 and slightly beat the "all other programs" average in AY 20/21 (69.4% vs. 69.1%). Since this upward trend only contains three data points, it will be interesting to see if this trend continues.

Earned degrees have varied between 8 and 16 per year and are quite variable due to the low numbers of physics degrees awarded. Likewise, the total number of transfers from physics has fluctuated around 20 per year. The large majority of our students take our courses as a core element of a STEM degree outside of physics.

2. Section 3.2.2 of Appendix A breaks down course completion and course success according to several equity categories (race/ethnicity/ancestry, gender, low income, etc.) and further into groups (Asian, Latinx, White, etc.). Groups which show lower achievement than the average of all other groups in that category and which OIE has determined to be statistically significant are flagged in orange. It is worth noting that what exactly counts as statistically significant is perhaps debatable when small numbers are involved, e.g., the calculated equity gap of -4 for course completion among our 14 Native Hawaiian/Pacific Islander students in the last 5 years. The narrative is also complicated by the differences in course completion and course success. For example, Latinx students showed no equity gap in course completion but a -4.8% (-140 student) gap in course success, while non-military students showed a 4.4% (-265 student) gap in course completion but a 5.5% (not significant in OEI's analysis) advantage in student success. The latter is easily explained by the fact that there are only 197 military students in the sample, so the apparent gap in non-military student completion is likely an artifact of the unaccounted-for uncertainty in the completion rate of military students. This is to say, OIE's determination of which results do or do not provide statistically significant evidence of equity gaps should be taken with a grain of salt. Rather than dwelling on which of the specific groups identified by OEI have "real" equity gaps we will focus on those gaps which are most clear, speculate on likely causes, and identify practices that can be broadly impactful for increasing equity.

   For simplicity, we will focus on gaps in course success. Within the race/ethnicity/ancestry category, a clear achievement gap can be seen for our Latinx students (our largest group by enrollment). Our Black and Filipino students also appear to show significant achievement gaps, though the number of students in these categories is significantly lower. Aggregating the data into two categories, White/Asian (the highest performing groups in this metric), and all others, we see a 6.8% gap (250 students) (see table below).

   There is also a clear achievement gap along with income, with low-income students having a 7.9% (384 students) deficit in course achievement. A gender achievement gap also exists, with male students averaging 3.5% lower (-125 student gap).

Race/Ethnicity/ Ancestry	Number Enrolled	Course Success Rate	Gap % (number)
Asian and White	2496	69.7%	-------------------------------
All Others	3676	62.9%	-6.8% (-250)

Table 1: Course Success Data aggregated from Appendix A, Section 3.2.2

While the data provided by OEI is helpful in showing that achievement gaps exist, identifying causes is more complicated. A deeper study of the covariance between groups in different categories (e.g., the correlation between low-income status and various race/ethnicity groups) and more data to contextualize the physics department results (division and school-wide statistics for comparison) would both be helpful. With that in mind, we can speculate as to possible causes of some of the achievement gaps.

Many of the students who enter our core physics track are underprepared in mathematics, science, and critical thinking. Low-income students and students in disadvantaged racial/ethnic groups are more likely to be underserved by their public school system. Students who enter the physics track without pre-developed study, time management, and computer literacy skills will struggle to gain these skills in the context of a fast-paced, high-content physics class. These students will have a steep hill to climb in order to achieve the standards of success for a course like Phys 221 (which has one of the lower success rates and higher withdrawal rates in our department, see Appendix 3.3.1). Low-income students may also be more likely to have work/family responsibilities which limit their time to study. Therefore, it seems plausible that physics classes with large outside-of-class time requirements would disproportionately affect low-income students. Additionally, reliance on expensive textbooks and online homework systems in some sections may disproportionately impact these same students.

The lower average achievement of male students is interesting and is likely best understood in the context that female students are under-represented in enrollment (see section 3.1.2 of Appendix A). This achievement gap likely tells us less about how men are performing in physics and more about which women are *not* enrolling in our courses. Average course success rates for female students can *increase* if selective pressures disproportionately prevent women from low-income or disadvantaged racial/ethnic groups from enrolling in physics courses or pursuing degrees in STEM fields. This example highlights the need for careful consideration of the data before prescribing targeted interventions.

3. The physics department does not meet regularly to discuss equitable grading, attendance, late work, and extra credit policies. These topics are typically explored in individual instructors' professional development or brought up as part of the adjunct/tenure review process. It is certainly possible that some changes to classroom policy could have a positive impact on equity, and this could be helped by more intra-department of communication about which policies are being employed.

4. Equity Action Plan:

a. Increase intra-department discussion about equitable course design and grading practices to identify areas where change can be implemented.
b. Identify and commit to those best practices which can be adopted across sections to increase the consistency of the student experience while still allowing for academic freedom.
c. Investigate the adoption of online education resources to lower student costs, with the goal of identifying one satisfactory OER textbook per course.
d. Revise CSLO assessments so that they are more consistent across sections and can provide some of the additional data that would be useful in diagnosing equity gaps and assessing the effectiveness of interventions.
e. Restart the PAL tutoring program, which was paused during the COVID epidemic, and continue to support and expand on other programs of supplemental instruction.
f. Increase department involvement in outreach, especially outreach targeted at women and other groups which are underrepresented in enrollment.
g. Review/revise the hiring process/interview questions to help bring in faculty which can help our department become more equitable and inclusive.

Proposed Support for the Equity plan:

a. Assistance in identifying/creating professional learning opportunities relevant to equitable teaching practices in physical science, specifically.
b. Assistance in placing students into internships/research opportunities.

3.3 Student Achievement and Pathways

1. Physics 221 is a gateway course for physical science and engineering major students, and physics 205 and 210 are gateway physics courses for life science majors. Physical science and engineering major students start from physics 221F General physics I and take physics 222 and 223.

   Life science major students generally take two-semester physics courses. Physics 205F and 210F are the first half of the two-semester courses.

   Appendix A 3.3.1 shows that the success rates of gateway courses (physics 205, 210, and 221) are lower than consecutive courses(Physics 206,211, 222, and 223). Also, Physics 205, 210, and 221 show much higher withdrawal rates than other classes. Physics 221F, Physics 205F, and Physics 210F are bottleneck courses. After passing the gateway courses, students' success rates are generally higher.

2. The Physics and astronomy current requirements are in line with the Transfer Model curriculum. There has not been any change in the curriculum.

3. The Physics department had a guided pathway meeting with counselors and mapped the Astronomy Associate in Arts Degree (AA) and Physics Associate in Science Degree for Transfer (AST) programs in spring 2020. We mapped two-year and three-year pathways for students in various circumstances.

4. For the past 5 years, 62 students earned physics AST degrees, and one student earned an astronomy AA degree. (See Appendix A 3.2.1) The majority of students who earned physics transfer to UCs or CSU after completing the programs.

3.4 Faculty

1. The workload of each faculty has not changed significantly over the past five years. However, there were many changes in the number of faculty in the department. 5 adjunct faculty left the department, and two full-time faculty retired. We hired four new full-time instructors, but the number of sections offered was reduced from 52 sections in AY 16/17 to 40 sections in AY20/21. (See Appendix A section 3.4.1) In AY 20/21, the

number of sections is reduced to 34 sections because of the covid-19 pandemic. Should we return to pre-COVID-19 enrollment numbers without being able to hire new adjunct or full-time faculty, the workload of the current full-time faculty will be greatly increased. Physics department faculty will be faced with the choice of taking overload or canceling high-demand physics courses.

2. The physics department will have fully in-person classes in spring 2022. It is not clear how the class demand will change next semester. Thus, we do not have a plan to hire a full-time faculty next year. We will hire more adjunct faculty to meet the class demand next year unless there is a dramatic change in the class demand. However, it has been difficult to recruit and maintain qualified adjunct instructors willing to work for sub-standard pay. The district's lack of lecture/lab parity, which is the standard in surrounding districts, is a major deterrent for the adjuncts that we need to teach our core physics classes (which are a 50/50 lecture/lab split).

3.5 Covid-19

Peer instruction and laboratory experience are essential for physics and astronomy courses. It has been a great challenge to provide the same quality of education remotely during the covid-19 pandemic. The physics department made the swift transition to online teaching and developed do-at-home experiments to provide effective education.

Physics faculty members developed 28 new experiments that can be done at home with simple lab kit items. All physics and astronomy classes underwent the transition to remote classes in spring 2020. In the fall 2020 and spring 2021 semesters, all courses were taught as Zoom or online classes. Since virtual labs or simulations can not replace physical experiments, we design lab kits and lab manuals so that students do the labs at home. However, the class size was restricted to 25 students because of limited quantities of lab kits.

We also adopt hornet tutoring to more physics classes to provide additional assistance to students.

In fall 2021, most physics courses are in-person lab/zoom lecture hybrid. Most labs are done in person. The transition back to in-person classes started. We plan to restart the peer-assisted tutoring program (PAL) in spring 2022.

3.6 What has not been asked?

4.0 Outcomes

4.1 Program Student Learning Outcomes (PSLOs)

The current PSLOs are

- Demonstrate an understanding of how the scientific method is used to explore topics in physics.
- Demonstrate the ability to apply physics concepts to solve problems.

We revised the PSLOs. The new PSLOs are

- Apply the concepts of physics and predict qualitative outcomes by deductive reasoning with the appropriate laws and principles of physics.
- Apply the law of physics and formulate quantitative outcomes by applying algebra, trigonometry, geometry, and calculus with the appropriate laws and principles of physics.
- Analyze various physics scenarios experimentally and explain the results in terms of the appropriate laws and principles

We plan to develop new PSLO assessment tools.

4.2 PSLO Assessment

In the past, the physics department assessed PSLOs by combining CSLO assessment results. We combined all CSLO assessment results from 2016 to 2021 and compared the result with the previous program review assessment. 39%~55% of students meet expectations in the 2017-2018 review, and 46%~ 60% of students meet expectations in the 2021-2022 review. The result does not show statistically meaningful changes. The assessment result shows a similar outcome as the previous assessment.

There wasn't a systematic assessment method in the past. We plan to develop an effective assessment method for the future analysis of the PSLO outcomes.

PSLO Assessment (All physics classes)	2017-2018	2021-2022
	Meets expectations (%)	**Meets expectations (%)**
1. Students will be able to determine qualitative outcomes by applying deductive reasoning with the appropriate laws and principles of physics	49%	50%
2. Students will be able to determine quantitative outcomes by applying algebra, trigonometry, geometry, and calculus with the appropriate laws and principles of physics.	39%	46%
3. Students will be able to investigate various physics scenarios experimentally and explain the results in terms of the appropriate laws and principles of physics.	55%	60%

Table 2: PSLP Assessment Summary from Appendix B, Section 4.2

4.3 CSLO Assessment

We plan to redesign the CSLO assessment tools. Over the past five years, four new full-time faculty were hired, and 5 adjunct faculty left the physics department. Two experienced full-time faculty retired in 2020. During these dramatic changes, CSLO assessments were done by individual instructors, and there were no common assessment methods. As a result, we only assessed each course once or twice over the past five years, and the sample sizes were only about 20 students in each assessment.

The assessment results are shown in Appendix B. The result does not show any statistically significant changes from the previous program review period, but there is an interesting finding. Based on the assessment, students' success rate is lower in physics 221 than physics 222 and 223. Physics 221 is the gateway course of physics 221, 222, and 223 series. The result indicates that students in the first physics class need more assistance to be successful. However, the conclusion is not conclusive since the sample size is too small.

We will have more specific plans for SLO assessment and begin assessing physics 221 students in the Spring 2022 semester. One effective assessment method is using a well-researched pre-post test assessment tool called the Force Concepts Inventory (FCI). The FCI is designed to be a zero-stakes (does not count towards the students' grades) assessment tool given at the beginning and end of the semester during Phys 221. The normalized learning gain obtained from this pre-post test assessment device will allow faculty to compare students from diverse backgrounds and preparations. Additionally, this will allow faculty to differentiate between different teaching methodologies and determine which methodologies are more effective for Fullerton college students.

4.4 SLO Equity Analysis

The SLO equity analysis shows the result consistent with the OEI data analysis. White/Asian students show a higher success rate than other ethnic groups in physics classes. Interestingly, the difference in the success rate was small in astronomy courses. We need further investigation to find the causes. As we mentioned in section 4.3, we plan to resign from CSLO assessment tools and collect more data. We will be able to examine the students' outcomes more accurately in the next review period.

5.0 Other Areas of Program Effectiveness

5.1 Your Department and General Education.

The physics department offers mainly three General Education courses. ESC 116F Astronomy, ESC 116HF Astronomy Honor, ESC 116LF Astronomy lab, and Physics 130F Elementary physics. Other physics courses also served as general education courses. 22 % of ESC 116 F were online courses. But, all other classes were in-person classes before the covid-19 pandemic. We also offer 18~ 46% of classes in the evening.

Astronomy classes are the most popular GE classes we offer. 2,256 students enrolled in ESC 116 F (Appendix A 5.1), 494 students took ESC 116LF over the past 5 years. Also, 350 students took physics 130 F for their GE requirement. However, we could not offer ESC 116 LF and Physis 130 F in AY 20/21 due to the covid-19 pandemic. We also reduced the number of GE classes because of the pandemic. We plan to offer more GE courses next year.

5.2 Outside Influences on Your Department

The physics department has Astronomy Associate in Arts Degree (AA) and Physics Associate in Science Degree for Transfer (AST) programs.

AB 705 does not apply directly to physics and astronomy programs. However, the majority of physics and astronomy classes have math prerequisites. Thus, the physics program is indirectly influenced by AB 705. To help students who are not prepared in mathematics, we need additional resources. The natural sciences division plans to start the STEM center, and it will be a great resource for students.

5.3 Your Program's Active and Applied Learning and High-Impact Practices

The physics department had been running Peer Assisted Tutoring (PAL) program to help students who need additional assistance for their success in the courses. We hire 2~3 STEM tutors, and they lead discussions in a small classroom and support students in physics and chemistry courses.

This program is an in-person tutoring program that has helped many students in STEM courses. However, the program was suspended due to the covid-19 pandemic. We will restart the program in spring 2022. Previously, the PAL program only served physics and chemistry students, but we will expand the program to other natural sciences in the future. However, this space and funding are limited, and we need a STEM center to serve more students.

6.0 Planning

6.1 Progress on Previous Strategic Action Plans

Previous Strategic Action plans

We had two previous SAPs in the previous review cycle.

1. Hire two new full-time faculty members, i.e., one more in addition to the one to be hired for fall 2018.
2. Repair or replenish equipment for lab activities

We accomplished the action plans, but we need further plans to resolve new issues. We hired four new full-time faculty members. However, 5 adjunct faculty left the department, and two full-time faculty members retired. We need additional instructors to provide more courses. We repaired and replenished equipment for lab activities successfully. We will continue to improve lab equipment.

6.2 New Strategic Action Plans

We will have the following new SAPs.

1. Hire new instructors to provide more physics courses.

   Currently, the department does not have a demand for new full-time faculty, but more adjunct instructors are required to increase the number of sections back to the covid-19 pandemic. We will see the trend of the students' demand next year and hire 2~3 new adjunct instructors. The physics department will continue to practice equitable and inclusive hiring processes.

2. Develop a systematic CSLOs and PSLOs assessment plan.

   The past SLO assessment method is outdated. Instructors assessed SLOs individually instead of using the centralized system, eLumen. We will develop better assessment tools such as implementing Force Concepts Inventory (FCI) and using eLumen to record the assessments.

3. Develop new experiment activities and repair or replenish equipment for lab activities.

   Physics and astronomy instructors will continue to use their experience to develop new laboratory activities and improve upon existing ones. This would include incorporating more modern digital data collection and analysis techniques such as MATLAB and Python coding, which are the current standards in industry and research. Using the actual tools that researchers and scientists use will better prepare students for careers in STEM.

   Some additional equipment would also be useful for our faculty to design and construct new demos and labs in-house. A small CNC laser cutter (e.g., a Glowforge) would be a valuable tool in this regard. It could also allow us to repair/replace certain equipment for which replacement parts are either expensive or no longer available. These devices are also simple enough for students to use with minimal training and faculty supervision, which will generate high-impact learning opportunities where students can gain experience with modern manufacturing processes.

4. Create a Campus STEM Resource Center.

Strategic Action Plan (SAP) # 1

Describe Strategic Action Plan.	**Hire new instructors to provide more physics courses.** Currently, we do not have a demand for new full-time faculty, but we need to hire adjunct instructors to increase the number of sections back to the covid-19 pandemic. We will see the trend of the students' demand next year and hire 2~3 new adjunct instructors. We will continue to practice equitable and inclusive hiring processes.
List College goal/objective the plan meets.	**Goal #1: Promote success for every student.** **Objective 2:** Enhance workforce training opportunities **Objective 4:** Increase completion of courses, certificate and degree programs, and transfer-readiness **Goal #2: Cultivate a culture of equity.** **Objective 2:** Increase equity in hiring and training **GOAL #4: Commit to Accountability and** continuous quality improvement. **Objective 3:** Provide professional and career development opportunities for students, faculty and staff
Explain how the request helps the college attain student equity.	Diverse instructors can provide effective teaching and motivate students.
What measurable outcome do you anticipate for this SAP?	More general education and major courses can be offered.
What specific aspects of this SAP can you accomplish	This plan is highly dependent on funding and facilities.

without additional financial resources?	

If additional financial resources would be required to accomplish this SAP, please complete the section below. Keep in mind that requests for resources must follow logically from the information provided in this self-study.

Type of resource	**Requested dollar amount**	**Potential funding source**
Personnel		College Fund
Facilities		
Equipment		
Supplies		
Computer hardware		
Computer software		
Training		
Other		
TOTAL requested amount		

Strategic Action Plan (SAP) # 2

Describe Strategic Action Plan.	**Develop a systematic CSLOs and PSLOs assessment plan.** The past SLO assessment method is outdated. Instructors assessed SLOs individually instead of using the centralized system, eLumen. We will develop better assessment tools such as implementing Force Concepts Inventory (FCI) and use eLumen to record the assessments.
List College goal/objective the plan meets.	**Goal #1: Promote success for every student.** **Objective 1:** Create a clear pathway for every student **Objective 2:** Enhance workforce training opportunities **Objective 4:** Increase completion of courses, certificate and degree programs, and transfer-readiness **Goal #2: Cultivate a culture of equity.** **Objective 1:** Remove institutional barriers to student equity and success **Objective 2:** Increase equity in hiring and training **GOAL #4: Commit to Accountability and continuous quality improvement.** **Objective 1:** Promote transparency in the shared governance structure and decision-making processes
Explain how the request helps the college attain student equity.	More accurate SLO assessment can improve the analysis of the student equity status in the classroom. More effective curriculum improvement will be possible.

What measurable outcome do you anticipate for this SAP?	CSLO and PSLO assessments will be done more systematically and more frequently. The assessment result will be used to improve the curriculum.
What specific aspects of this SAP can you accomplish without additional financial resources?	This SAP does not need additional financial resources.

If additional financial resources would be required to accomplish this SAP, please complete the section below. Keep in mind that requests for resources must follow logically from the information provided in this self-study.

Type of resource	**Requested dollar amount**	**Potential funding source**
Personnel		
Facilities		
Equipment		
Supplies		
Computer hardware		
Computer software		
Training		
Other		
TOTAL requested amount		

Strategic Action Plan (SAP) # 3,

Describe Strategic Action Plan.	Develop new experiment activities and repair or replenish equipment for lab activities Physics and astronomy instructors will continue to use their experience to develop new laboratory activities and improve upon existing ones. This would include incorporating more modern digital data collection and analysis techniques such as MATLAB and Python coding, which are the current standards in industry and research. Using the actual tools that researchers and scientists use will better prepare students for careers in STEM. Some additional equipment would also be useful for our faculty to design and construct new demos and labs in-house. A small CNC laser cutter (e.g., a Glowforge) would be a valuable tool in this regard, and could also allow us to repair/replace certain equipment for which replacement parts are either expensive or no longer available. These devices are also simple enough for students to use with minimal training and faculty supervision, which will generate high-impact learning opportunities where students can gain experience with modern manufacturing processes.
List College goal/objective the plan meets.	**Goal #1: Promote success for every student.** **Objective 1:** Create a clear pathway for every student **Objective 2:** Enhance workforce training opportunities **Objective 3:** Improve student critical thinking skills **Objective 4:** Increase completion of courses, certificate and degree programs, and transfer-readiness **Goal #2: Cultivate a culture of equity.** **Objective 1:** Remove institutional barriers to student equity

	and success **Objective 2:** Increase equity in hiring and training **GOAL #4: Commit to Accountability and continuous quality improvement.** **Objective 2:** Ensure financial, physical, and technological resources are available to maintain necessary services and programs **Objective 3:** Provide professional and career development opportunities for students, faculty, and staff
Explain how the request helps the college attain student equity.	Underprepared, low-income, and/or minority students often do not have the opportunity to work with the latest research software and lab equipment. Advanced data analysis software and new lab equipment will give students hands-on experience of the latest technology.
What measurable outcome do you anticipate for this SAP?	The student success rate will be improved.
What specific aspects of this SAP can you accomplish without additional financial resources?	This plan is highly dependent on funding and facilities.

If additional financial resources would be required to accomplish this SAP, please complete the section below. Keep in mind that requests for resources must follow logically from the information provided in this self-study.

Type of resource	**Requested dollar amount**	**Potential funding source**
Personnel		College Fund
Facilities		
Equipment	$30,000/year	College Fund
Supplies		

Computer hardware		
Computer software		
Training		
Other		
TOTAL requested amount	$30,000/year	

Strategic Action Plan (SAP) # 4

<table>
<tr>
<td>Describe Strategic Action Plan.</td>
<td>

Create a Campus STEM Resource Center.

The proposed Campus STEM Resource Center will need a suitable facility to house it. There are several possible locations for the Center, which include the land adjacent to the native plant garden and the former Math Lab in the 600 building. Additionally, the STEM Center will require the services of a full-time dedicated counselor and a full-time classified staff member to run the Center. The Center’s staff would have the following duties:

- Identify STEM majors and develop a database for tracking
- Develop contact folder and meet with STEM majors once a semester
- Identify potential majors and recruit them
- Counsel STEM majors
- Assist STEM majors with the educational plan, resume, and statement of purpose
- Coordinate with Institutional Research and Basic Skills offices to identify trends and opportunities
- Match STEM majors with faculty mentors for increasing connectivity to the college
- Identify scholarship, internship, and employment opportunities in STEM fields
- Develop “environmental scan” (job market) in LA/OC
- Identify, promote, and assist undergraduate research opportunities
- Assist STEM majors with applications for scholarships and internships
- Update STEM calendar of events
- Develop/Maintain/Update STEM website
- Manage STEM tutors hiring/scheduling
- Assist with tutoring and supplemental instruction
- Develop and assist with STEM experience activities
- Act as liaison between STEM programs

</td>
</tr>
</table>

	- Act as liaison with CSU/UC STEM departments - Coordinate STEM seminar series - Develop funding opportunities for STEM Communicate/market STEM programs to campus and community
List College goal/objective the plan meets.	<u>College Goals</u>: Goal #1: Promote success for every student. Goal #2: Cultivate a culture of equity. Goal #3: Strengthen connections with our community. <u>Objectives</u>: 1.2: Enhance workforce training opportunities. 1.4: Increase completion of courses, certificate and degree programs, and transfer readiness. 2.1: Remove institutional barriers to student equity and success. 2.4: Foster a sense of belonging where all are welcome and basic student needs are addressed. 3.1: Create and expand partnerships with local K-12 and higher education institutes. 3.2: Create and expand relationships with local businesses and civic organizations. 3.3: Be a cultural hub for the local community.
Explain how the request helps the college attain student equity.	The proposed STEM center will help attain student equity in many ways. It will give STEM students a place to go where they feel as though they belong and can be with other STEM

	students. It will be a place where students from underserved communities can be recruited and given resources and help. It will be a place where students can get assistance with educational plans, resume building, and a statement of purpose. It can be a place where faculty mentors can meet with students. It will serve as a way to promote student-to-student interactions outside of the classroom and increase opportunities for adjunct and full-time faculty to meet with students. The STEM center can help to bridge equity gaps by being a centralized location for programs that empower students to be a resource for other students through mentorship, office liaisons, and more.
What measurable outcome do you anticipate for this SAP?	• Increased number of STEM degrees/certificates • Increased number of STEM majors transferring • Increased recruitment of underrepresented groups to STEM majors • Increased success rate of STEM students • Increased persistence and retention of STEM students • Increased number of students attending tutoring and SI sessions • Creation of a STEM Alumni Network • Increased placement of students in research and internship programs • Increased opportunities for students to participate in community service • Increase the amount of grant money to support student/faculty research opportunities • Greater connectivity and partnerships with area STEM industries • More interdisciplinary coordination among STEM departments

What specific aspects of this SAP can you accomplish without additional financial resources?	This plan is highly dependent on funding and facilities.

If additional financial resources would be required to accomplish this SAP, please complete the section below. Keep in mind that requests for resources must follow logically from the information provided in this self-study.

Type of resource	**Requested dollar amount**	**Potential funding source**
Personnel	\$200,000/yr ongoing	General Fund
Facilities	\$150,000	
Equipment	\$10,000	Instructional Equipment
Supplies		
Computer hardware		
Computer software		
Training		
Other		
TOTAL requested amount	\$360,000	\$960,000 over 4 years

6.3 Long Term Plans

Most physics and astronomy classes are small-sized classes with about 25 students in each section. Thus, if one more student passes a course successfully, the success rate increases by 4%. Our long-term plan is to have one more successful student in each class. This goal will be more challenging than it sounds. Generally, a student on the verge of failing a course has various obstacles. We will develop better pedagogies for students. However, an extra effort by instructors is not enough to achieve this goal. We need natural sciences division-wide support. The physics department highly supports the natural sciences division-wide STEM center. We need more individualized and flexible tutoring options for students' success.

Coding is rapidly becoming an essential workplace skill for those interested in STEM fields, with an increasing push to incorporate coding into the K-12 curriculum. One of the Physics Department's long-term goals is to increase the incorporation of coding into our track for physical science and engineering majors (Phys 221, 222, and 223). However, this will not be a simple task due to the general lack of coding literacy among our incoming students. Achieving this goal will likely require additional tutoring support/supplemental instruction to assist students in programming-based assignments. An expansion of the Physics department's course offerings to include a course in programming for natural science (perhaps similar to ENGR 220F) would also contribute to this goal.

8.0 Publication Review

The college wants to maintain integrity in all representations of its mission, programs, and services. Please help this effort by reviewing your publications: professional social media profiles, websites, brochures, pamphlets, etc. Please tell us the date they were last reviewed and if you found them to be accurate in all representations of the College and program missions and services. Information on the college's graphic standards is available here.

For publications that you have identified as inaccurate, please provide the action plan for implementing corrections below.

Appendix A. See attached document.

Appendix B. CSLOs Assessment data.

Section 4.2 Summary

PSLO Assessment(All physics classes)	2017-2018	2021-2022
	Meets expectations (%)	**Meets expectations (%)**
1. Students will be able to determine qualitative outcomes by applying deductive reasoning with the appropriate laws and principles of physics	49%	50%
2. Students will be able to determine quantitative outcomes by applying algebra, trigonometry, geometry, and calculus with the appropriate laws and principles of physics.	39%	46%
3. Students will be able to investigate various physics scenarios experimentally and explain the results in terms of the appropriate laws and principles of physics.	55%	60%

Section 4.3.1 Physis 130 SLO assessments

CSLO Assessment Physics 130(Fall 2016, Spring 2017, Spring 2019)	Meets expectations	It does not meet expectations	Meets expectations (%)
Determine qualitative outcomes of various physical scenarios by applying deductive reasoning with the appropriate laws and principles of physics.	50	49	51%
Investigate various physical scenarios experimentally and explain the results in terms of the appropriate laws and principles of physics.	15	7	68%
Produce, interpret, and predict graphs showing the relationship between two physical quantities.	18	4	82%

Section 4.3.2 Physis 206 SLO assessments

CSLO Assessment Physics 206(Spring 2021)	Meets expectations	Does not meet expectations	Meets expectations (%)
Determine the applicability and non-applicability of equations in particular situations involving electricity, optics, and modern physics, describe the approximations and limitations involved, and systematically evaluate the usefulness of various equations by making lists of known and unknown quantities	14	10	58%
Analyze electrical circuits using voltage and current.	5	6	45%
Compare theoretical physical models of electricity, optics, and modern physics to real-world systems in the laboratory, test theory via experiments, and recognize and analyze deviations from idealized theoretical behavior.	7	4	64%

Section 4.3.3 Physis 211 SLO assessments

CSLO Assessment Physics 211(Spring 2021)	Meets expectations	Does not meet expectations	Meets expectations (%)
Determine the applicability and nonapplicability of equations in particular situations involving electricity, optics, and modern physics, describe the approximations and limitations involved, and systematically evaluate the usefulness of various equations by making lists of known and unknown quantities.	14	4	78%
Analyze electrical circuits using voltage and current.	16	2	89%
Compare theoretical physical models of electricity, optics, and modern physics to real-world systems in the laboratory, test theory via experiments, and recognize and analyze deviations from idealized theoretical behavior	15	3	83%

Section 4.3.4 Physis 221 SLO assessments

CSLO Assessment Physics 221(Fall 2016, Spring 2021)	Meets expectations	Does not meet expectations	Meets expectations (%)
Determine qualitative outcomes of various mechanics scenarios by applying deductive reasoning with the appropriate laws and principles of physics.	38	54	41%
Determine quantitative outcomes of various mechanics scenarios by applying algebra, trigonometry, geometry, and calculus with the appropriate laws and principles of physics	17	47	27%
Investigate various mechanics scenarios experimentally and explain the results in terms of the appropriate laws and principles of physics.	44	34	56%

Section 4.3.5 Physis 222 SLO assessments

CSLO Assessment Physics 222(Spring 2021)	Meets expectations	Does not meet expectations	Meets expectations (%)
Determine qualitative outcomes of various electromagnetic scenarios by applying deductive reasoning with the appropriate laws and principles of physics	12	7	63%
Determine qualitative outcomes of various electromagnetic scenarios by applying deductive reasoning with the appropriate laws and principles of physics.	12	7	63%
Investigate various electromagnetic scenarios experimentally and explain the results in terms of the appropriate laws and principles of physics	12	8	60%

Section 4.3.6 Physis 223 SLO assessments

CSLO Assessment Physics 223(Fall 2016)	Meets expectations	Does not meet expectations	Meets expectations (%)
Determine quantitative outcomes of various physics scenarios by applying algebra, trigonometry, geometry, and calculus with the appropriate laws and principles of physics.	13	14	48%
Determine qualitative outcomes of various physics scenarios by applying deductive reasoning with the appropriate laws and principles of physics.	19	8	70%
Investigate various physics scenarios experimentally and explain the results in terms of the appropriate laws and principles of physics.	13	14	48%

Section 4.4.1 Physis SCLOs ethnicity data

CSLOs ethnicity data	Meet expectations		Does not meet expectations	
Ethnic group	**Number of students**	**Percentage**	**Number of students**	**Percentage**
African American	1	12.50%	7	87.50%
American Indian/Alaskan Native	6	100%	0	0%
Asian	196	56.65%	150	43.35%
Filipino	26	45.61%	31	54.39%
Hispanic	174	48.88%	182	51.12%
Pacific Islander	3	50%	3	50%
White Non-Hispanic	102	56.04%	80	43.96%
Unknown	1	50%	1	50%
Unspecified	0	0%	3	0%

Section 4.4.1 Astronomy SCLOs ethnicity data

CSLOs ethnicity data	Meet expectations		Does not meet expectations	
Ethnic group	**Number of students**	**percent**	**Number of students2**	**percent3**
African American	0	0.00%	3	100.00%
American Indian/Alaskan Native	3	100%	0	0%
Asian	49	79.03%	13	20.97%
Filipino	31	88.57%	4	11.43%
Hispanic	351	82.01%	77	17.99%
Pacific Islander	0	0%	0	0%
White Non-Hispanic	127	88.19%	17	11.81%
Unknown	3	100%	0	0%
Unspecified	0	0%	0	0%