El Camino Community College

PROGRAM REVIEW 2022-23

NATURAL SCIENCE

PHYSICS

DEAN:
AMY GRANT

CONTRIBUTOR(S):
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TABLE OF CONTENTS

Contents

SECTION 1
Program Overview

A) Provide an abstract of what your program does, who you serve, your previous successes, and where your program is moving in the next four years. Highlight the most interesting, compelling aspects of your program – your recent achievements and needs.

Program's Mission Statement:

The Mission of the Physics Department is to offer quality educational opportunities for students by providing courses that transfer to four-year institutions and offering associate degree courses that meet general education requirements.

The program serves an average of about 1570 students per year, up from 1400 students per year in 2017, when program review was last submitted.

The El Camino College Physics Department strives to offer a very high level of physics education, on par with and at times exceeding the level offered at any of the University of California campuses. It is our belief that this preparation serves students by giving them the very best foundation for further studies in scientific and engineering fields. This foundation is built on both CONTENT in physics and PROBLEM-SOLVING ability. Serving this end, the department has four full-time, tenured faculty (all holding Doctorate degrees) and a full-time lab technician.

Physics instructors and students from the program have been heavily involved in Onizuka Space Science Day for many years. In recent years, they have run the popular Physics Puzzlers workshop as well as holding Planetarium Shows and Optics and Telescopes demonstrations. Through these presentations, the wonders of physics and astronomy have been shown to a swath of 5th-12th grade students as well as their parents.

The Physics Club (formerly called the Mathematical Physics Club) has had an advisor continuously in the Physics Dept. since its inception in approximately 2013. The club meets weekly and allows students to explore aspects of physics of interest to them, including subjects beyond the scope of their coursework. Students often give presentations on advanced topics, run experiments, or show videos about cutting edge research in physics and technology. The club has organized field trips in recent years to Northrop Grumman, Boeing, the California Science Center, and Mt. Wilson Observatory. Officers in the club have often gone on to great success after El Camino, and former club officers are also invited back as guest speakers to the club. For instance, in Spring 2023, we were visited by a former Physics Club officer who is now a PhD graduate student in astrophysics at Caltech.

Alumni from the physics program transfer to high level programs at UCLA, UC Berkeley and a few at Caltech and MIT. Some continue on for advanced degrees, both masters and doctoral.

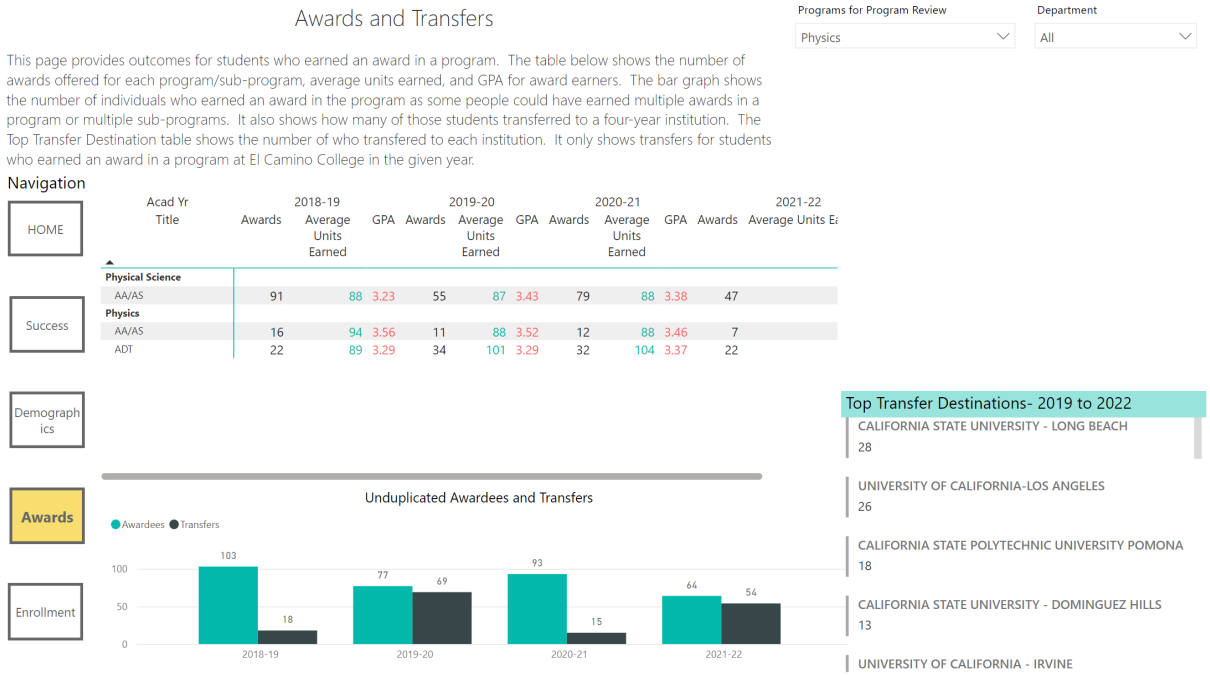
The physics program offers the following types of courses:

- For majors in Engineering, Physics, Chemistry and Mathematics, the Physics department offers four courses: Physics1A- Mechanics; Physics1B-Fluids, Heat, Sound; Physics1C-Electricity and Magnetism; and Physics 1D -Optics, Modern Physics (Modern physics includes physics developed in the 20th century including Relativity and Quantum Mechanics). (About 16 sections offered per year).
- For pre-professionals, Architecture majors, Physical Therapy majors and others transferring to institutions that require algebra-based physics, the department offers Physics 2A and 2B. Physics 2A includes mechanics, fluids, heat and sound, and Physics 2B electricity and magnetism, optics, and modern physics (relativity and quantum mechanics). (About 11 sections offered per year).
- For pre-professionals transferring to institutions that require two semesters of physics with calculus, the department offers Physics 3A and 3B. Physics 3A includes mechanics, fluids, heat and sound, and Physics 3B electricity and magnetism, optics, and modern physics. (About 4 sections offered per year)
- Physics 11 and Physics 12 are offered to meet requirements of transfer students in non-science majors. (About 8 sections offered per year)
- For students preparing to teach at the elementary and middle school level the department offers Physical Science 25, a course which is cross listed in Chemistry. Topics include energy, magnetism, electricity, gravity, the periodic table of elements, as well as physical and chemical changes. (One section offered every year).

B) Describe the degrees and/or certificates offered by the program. Consider addressing what makes your program unique to the college and region.

The Physics Department offers an AS-T degree for transfer. The Associate in Science for Transfer (AS-T) is intended for students who plan to complete a bachelor's degree in a similar major at a CSU campus. Students completing the AS-T are given priority consideration for admission to the CSU system, but not to a particular campus or major. See the chart below for awards in physical science (often including a physics requirement) and for physics specifically over the period from 2018 – 2022. Also included are the top transfer

destinations over that period.



C) Explain how the program fulfills the college's mission. Address the work your program is doing to help the college fulfill its stated mission.

The mission of El Camino College is to make a positive difference in people's lives by providing a comprehensive educational programs and services that promote student learning and success in collaboration with our diverse communities.

The Physics Department fulfills the college mission by offering a strong academic program supported by four full-time instructors and part time instructors, one full time technician and one part-time technician. Instructors aspire to foster a positive learning environment and to deliver quality education in order to facilitate students' educational success.

Instructors enhance students' experience in class by using a variety of experiments and demonstrations of physical phenomena as part of most lectures. To further facilitate student success, the services of LRC tutors are made available to students as well as the services of facilitators in the MESA program. Finally, faculty run physics and astronomy clubs where students can collaborate and enhance their interests in physics and related disciplines.

Overall, the department seeks to form students in the scientific method where hypotheses are tested by experiment, then modified, tested again and finally formed into well-established theories that can be reliably used to make further predictions. In this respect, knowledge is based on observation and experiment, not presuppositions or internal thoughts of individuals. Further, in physics, there is a focus on quantitative predictions. For example, in Newtonian gravity it is not sufficient to understand that the earth is attracted to the sun; one must also include that the force between these two objects depends on each of their masses and the inverse of the distance between them. This perspective fundamentally shapes how a physics student views the world.

D) Discuss the status of recommendations from your previous program review. In the "Notes/Comments" section, please discuss the known impact of a completed recommendation or the rationale for recommendations that are on active, on hold, and/or abandoned.
If more than ten recommendations were presented in the previous program review, expand the enumerated list below as needed.

1. **Recommendation:** More tutors are needed to help students who need review work in courses in which they are enrolled in. Given the difficulty and turnover associated with student tutors, granting release time for faculty to offer multi-course tutoring would likely increase student achievement even more than what is possible for student tutors.
   Status: ACTIVE

Notes/Comments: The physics department has had excellent tutors at Learning Resource Center. Students can also use the services provided by the MESA facilitators, and now at the math tutoring center. Having multiple locations for tutoring (LRC, MESA and Math Tutoring Center) can be helpful for students, but also inconsistent.

Complicating matters is the difficulty of finding skillful tutors by the physics faculty and by Arturo Hernandez, director of the MESA program. In a given year, one tutoring center might be unstaffed while others have excellent tutors, only to lose all tutors at the end of the year when students transfer. Even skilled tutors are often unable to tutor the entire course sequence, with physics 1B, 1C and 1D having specific difficulties. 1B is not always a transfer requirement, so some students skip it, and 1C and 1D are both advanced courses that students typically take just before transferring.

Ideally having a FT faculty with release time or a PT faculty with the equivalent of a 3.0 unit course load available for tutoring may be a way of addressing the continual dearth of qualified tutors. It should be noted anecdotally that instructor office hours are well attended in physics regardless of instructor. Multiple students are often in attendance and instructors use classrooms to accommodate the large number. We believe that additional tutoring time would lead to greater student success.

2. **Recommendation:** Day and evening technicians' job list should be extended to include being available for the first hour in 1A, 2A, 1C, 3B and 2B labs to assist students with equipment that requires extensive individual help. Technician job description should be amended to include the ability to help students in the laboratory at faculty request. Possibly, the technician job could be converted to instructional tech, as is currently in use in industry and technology on campus.
   Status: ON HOLD
   Notes/Comments: No progress has been made on this proposal.

3. **Recommendation:** Acquire equipment for lab work and for demonstrations when funds become available.
   Status: ACTIVE
   Notes/Comments:

ITEM	AMOUNT	PURPOSE

1. Micrometers (0-1 inch)	5	Lab experiments and demonstrations
2. 140 Watt digital power supply WLS-30972-50 (Sargent Welch)	1	Lab experiments and demonstrations
3. Wave Motion Demonstrator SE9600 (Pasco)	1	Lab experiments and demonstrations. Current versions are difficult to display, with important features of this physics lost.
4. UV source for photoelectric effect demo	1	Demonstration
5. Chairs, classroom set	35/class	Chairs in some classrooms are old and falling apart

4. **Recommendation:** Continue to improve the labs and to make up more interesting labs that can be done with reasonably inexpensive equipment by students with little experience. Collect updated labs into final versions of updated lab manuals
   Status: ACTIVE
   Notes/Comments: Faculty are continuously updating labs using modern equipment as well as more clear explanations. This continues to be a priority item. We continue to make improvements. We expect to continue to fulfill this priority as funds become available. The equipment needed is listed in the Facilities and Equipment and Technology and Software part of this document as well as in the Program Plan Builder document.

5. **Recommendation:** Continue to explore new technologies, and improve upon old technologies, with the goal being to enable the instructor to interact more and in a more meaningful way with students.
   Status: ACTIVE
   Notes/Comments: This continues to be a priority item. We use the internet more often in our courses. We have updated some of our labs with new technology we have, for example, improved the way in which students acquire data in Physics 1A, 1B, 1C and 1D labs. We expect to continue to fulfill this priority as funds become available. The equipment needed is listed in the Facilities and Equipment and the Technology and Software of this document as well as in the Program Plan Builder document.

6. **Recommendation:** (Added since last program review) There are clear differences in course level achievement for students based on background. The department has changed course prerequisites/corequisites to increase student success.
   Status: ACTIVE
   Notes/Comments: These recommendations will take effect in the Spring of 2023. Physics 1A will have Math 190 as a prerequisite instead of a corequisite. Physics 1C

has Math 220 as a prerequisite. Physics 1D has Math 220 and Physics 1C as a prerequisite.

7. **Recommendation:** Additional Faculty Member
   Status: ACTIVE
   Notes/Comments: Part time faculty teach a large percentage of courses in physics. Specifically, only 12 of 19 sections are taught by full time faculty (63%). In recent years, quality part-time faculty member obtains full time position at other locations (we have had at least three part time faculty receive full time positions since the last program review). In addition to taking additional time from full time faculty and the division in interviewing new part time faculty, the quality of these faculty has been mixed. Given the number of courses and low percentage covered by full time faculty, an additional full time faculty member is warranted.

8. **Recommendation:** Projectors with HDMI and/or wifi casting to replace the dated VGA cable inputs in classrooms.
   Status: ACTIVE
   Notes/Comments: Projectors in classrooms currently use the VGA standard for connecting a computer to the projector. This method is outdated, as many computers and modern tablets have no such interface. Classroom projectors that can mirror a computer or tablet would enable quick access to video demonstrations, online notes, canvas and live transcription of equations and notes. IT has committed to updating projectors to a newer standard.

SECTION 2
Program Assessment

Program Contribution to Student Success and Equity

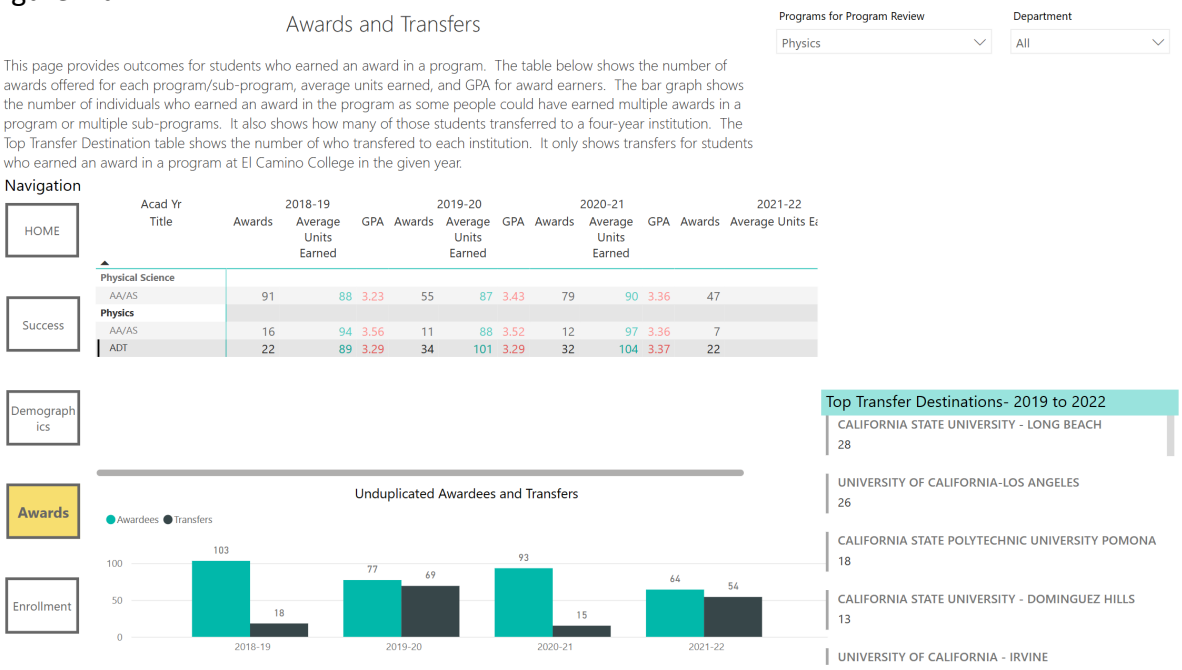
For the program under review, examine the following data for the last four years by:

- **Disaggregating by race/ethnicity, gender, and age where possible.**
- **Discussing internal and external factors contributing to constant, increasing or decreasing trends.**
- **Discuss any known barriers to student success in your program.**
- **Highlighting equity gaps found among different groups of students.**
- **Present and discuss possible action plans about what could be done to address equity and achievement/opportunity gaps.**

❖ *If the program under review is a Career Education Program, please examine a) through k) from the list below.*
❖ *If students taking courses from the program under review end with a degree or certificate issued by the program, please examine a) through h) from the list below.*
❖ *If students taking courses from the program under review do not end with a degree or certificate issued by the program, please examine d) through g) from the list below.*

a) *Degree Completion:* Number/percent of students earning a program degree

Figure 2.a



The above chart shows the number of students earning awards (light green) and transfers (dark green) to four-year institutions in the SAME YEAR the award was earned. Pandemic effects likely contributed to the unevenness of completions. Students that delay transfer to four-year institutions, especially during pandemic years, may also account for the uneven distribution of transfer/program degree ratios. Table of the chart data below.

Awards, Transfers and Percentages (table 2.a):

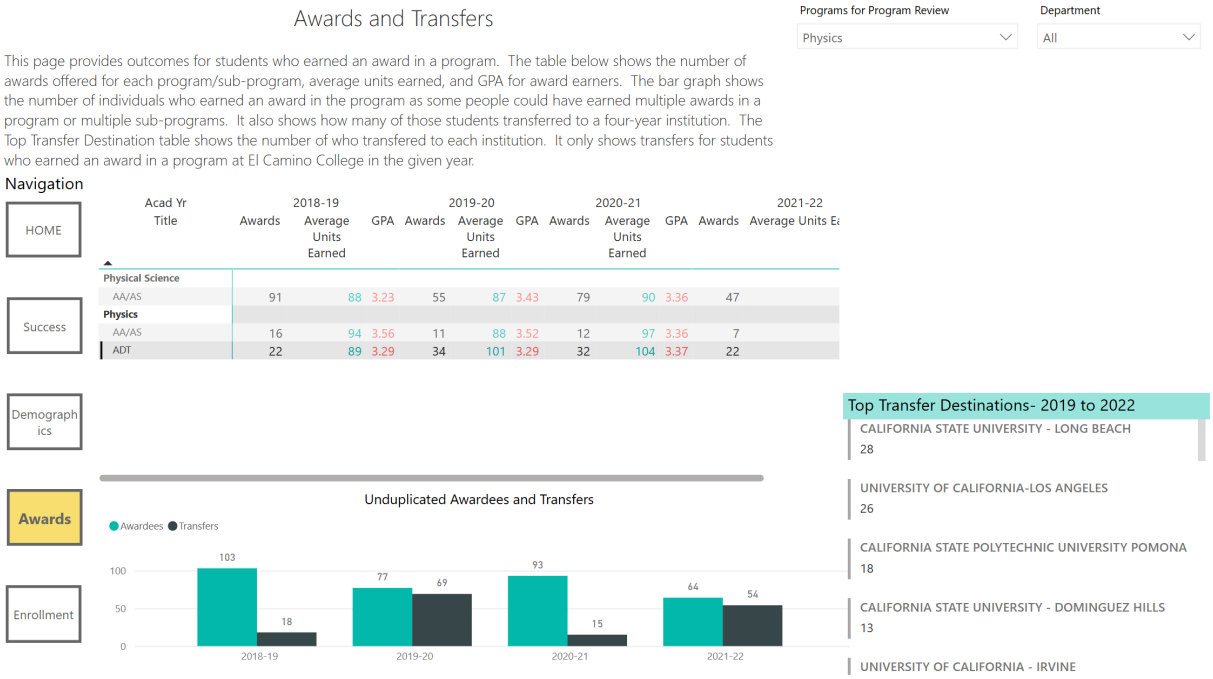
2018-2019			2019-2020			2020-2021			2021-2022		
Awards	Transfers	%	Awards	Transfers	%	Awards	Transfers	%	Awards	Transfers	%
103	18	17.48%	77	69	89.61%	93	15	16.13%	64	54	84.38%

b) *Certificate Completion:* Number/percent of students earning a program certificate

Physics does not offer certificates.

c) *Transfer to a four-year institution*: Number/percent of students transferring to a four-year institution

Figure 2.a (reproduced)



The above chart (identical as is section 2.a) shows the number of students earning awards (light green) and transfers (dark green) to four-year institutions in the SAME YEAR the award

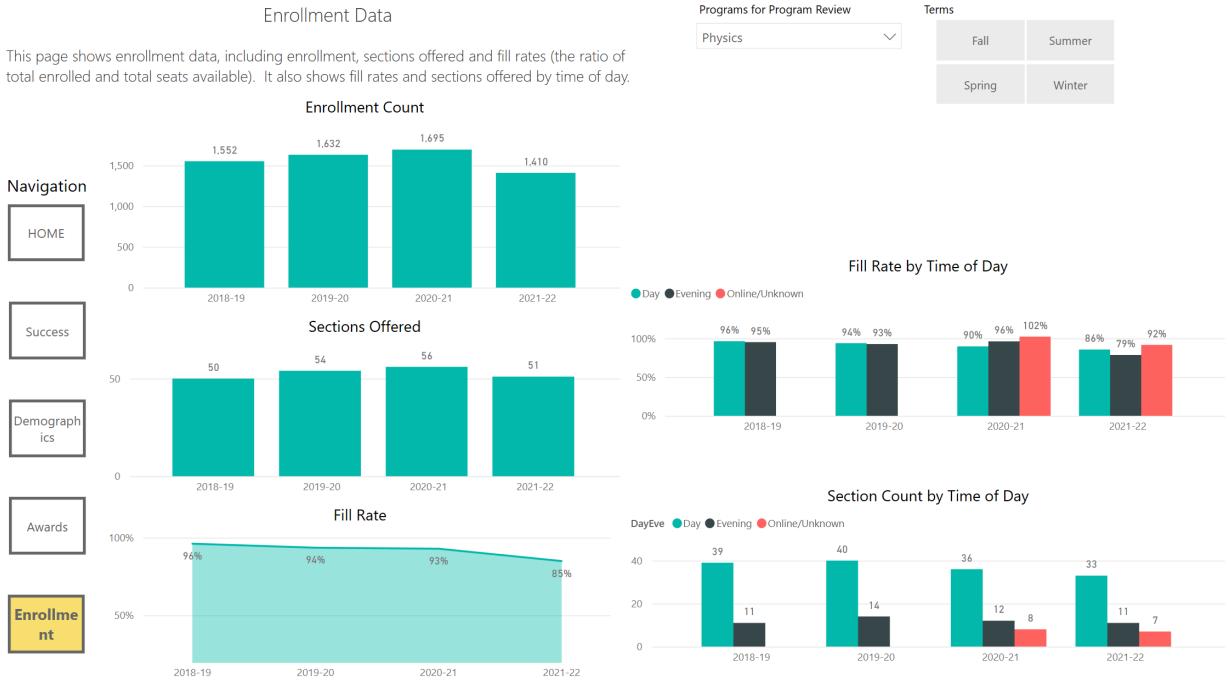
was earned. Students that delay transfer to four-year institutions, especially during pandemic years, may account for the uneven distribution of transfer/program degree ratios for this specific reason. A student may have earned a degree before or during the initial year of the Covid-19 pandemic, then delayed transfer planning on the pandemic passing or to help family during that time.

Awards, Transfers and Percentages (table 2.a reproduced):

2018-2019			2019-2020			2020-2021			2021-2022		
Awards	Transfers	%	Awards	Transfers	%	Awards	Transfers	%	Awards	Transfers	%
103	18	17.48%	77	69	89.61%	93	15	16.13%	64	54	84.38%

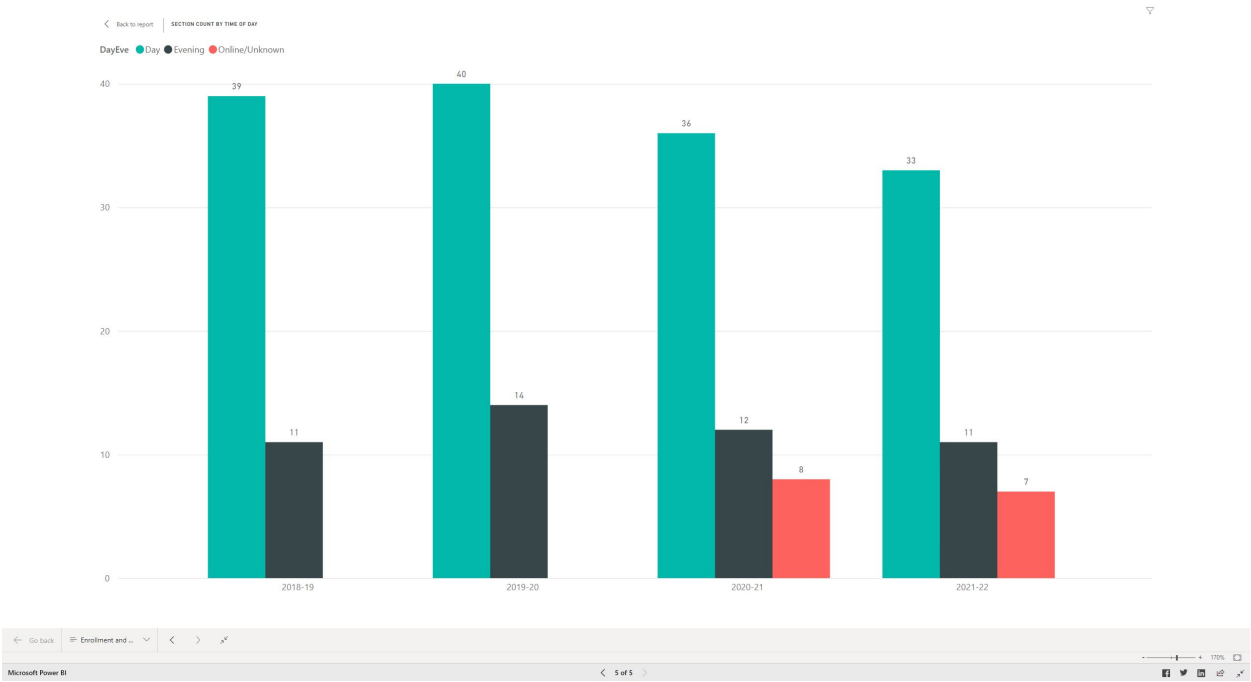
d) *Scheduling of courses:* Percentage of students enrolled in day/evening courses, on campus/online/hybrid courses, days of the week

Fill rate by time of day. Day (light green), evening (dark green), online/unknown (red). Percentages are listed at the top of each bar. Physics did not have online courses prior to 2020 and these constitute a small portion of offered courses (see second chart section 2.d). The chart clearly shows that physics has a high fill rate regardless of time of day. Pandemic effects, where students either hurried or delayed taking physics courses likely contributed to the unevenness of the fill rate (fig 2.d.i).



As shown in the below chart, most sections in physics are offered during the day.

Section count by time of day (fig 2.d.ii):



e) *Fill rate:* Percentage of actual students enrolled in a term in relation to total seats offered

Physics fill rates are typically high, with fill rate falling in the 2021-2022 term. This number can be compared to falling fill rates across the campus. Figure 2.e.

It can also be seen that fill rates in physics are high, even considering recent covid pandemic disruptions. In the Fall of 2022, El Camino Physics offered 20 total sections. This can be directly compared to Cerritos College, which offered 29 total sections and Santa Monica College, which offered 25 total sections (data from the Community College Chancellor's data mart website).

There is a trend with regard to online versus in person courses. Typically, students in the major or a related major (math, engineering, other physics science, etc.) prefer in person classes. This fits well with the instructional element of in person labs using actual equipment to measure real physical systems. At the same time, students taking physics 11, our general education course, prefer classes to be online. We do note that showing demonstrations in person is more convincing, even dramatic, when done in person.

f) *Grade Distribution:* Percentage of students in a course receiving each of the possible grades that can be awarded

See table 2.f.i below for full statistics. Table 2.f.ii, also in this section, shows a summary across all physics courses:

Course	Term	Instructional Method	A	B	C	D	F	Pass	No Pass	W	Total	Course Success	Course Completion
PHYS-11	2018/FA	On Campus	10	18	25	5	5	0	0	15	78	67.90%	80.80%
PHYS-12	2018/FA	On Campus	4	2	1	0	0	0	0	1	8	87.50%	87.50%
PHYS-1A	2018/FA	On Campus	23	23	27	11	7	0	0	47	138	52.90%	65.90%
PHYS-1B	2018/FA	On Campus	8	11	9	2	2	0	0	16	48	58.30%	66.70%
PHYS-1C	2018/FA	On Campus	20	19	15	4	7	0	0	25	90	60.00%	72.20%
PHYS-1D	2018/FA	On Campus	8	3	4	0	0	0	0	7	22	68.20%	68.20%
PHYS-2A	2018/FA	On Campus	24	24	36	9	11	0	0	52	156	53.80%	66.70%
PHYS-2B	2018/FA	On Campus	8	4	4	0	1	0	0	3	20	80.00%	85.00%
PHYS-3A	2018/FA	On Campus	7	13	6	0	0	0	0	6	32	81.30%	81.30%
PSCI-25	2018/FA	On Campus	17	11	3	0	0	0	0	2	33	93.90%	93.90%
PHYS-11	2018/SU	On Campus	7	11	0	2	1	0	0	0	21	85.70%	100.00%
PHYS-1A	2018/SU	On Campus	5	7	10	4	3	0	0	11	40	55.00%	72.50%
PHYS-1B	2018/SU	On Campus	10	12	16	2	8	0	0	11	59	64.40%	81.40%
PHYS-2A	2018/SU	On Campus	18	18	11	4	4	0	0	23	78	60.30%	70.50%
PHYS-11	2019/FA	On Campus	22	22	18	2	9	0	0	12	85	72.90%	85.90%
PHYS-12	2019/FA	On Campus	5	3	0	0	0	0	0	0	8	100.00%	100.00%
PHYS-1A	2019/FA	On Campus	23	33	25	11	12	0	0	63	167	48.50%	62.30%
PHYS-1B	2019/FA	On Campus	4	15	12	0	4	0	0	13	48	64.60%	72.90%
PHYS-1C	2019/FA	On Campus	27	14	29	5	7	0	0	17	99	70.70%	82.80%
PHYS-1D	2019/FA	On Campus	5	3	5	0	4	0	0	8	25	52.00%	68.00%
PHYS-2A	2019/FA	On Campus	27	33	35	5	6	0	0	47	153	62.10%	69.30%
PHYS-2B	2019/FA	On Campus	15	5	1	0	0	0	0	4	25	84.00%	84.00%
PHYS-3A	2019/FA	On Campus	12	10	4	0	0	0	0	11	37	70.30%	70.30%
PSCI-25	2019/FA	On Campus	7	6	7	0	0	0	0	8	28	71.40%	71.40%

PHYS-11	2019/SP	On Campus	17	13	8	4	5	0	0	8	55	69.10%	85.50%
PHYS-12	2019/SP	On Campus	5	0	2	2	0	0	0	0	9	77.80%	100.00%
PHYS-1A	2019/SP	On Campus	18	31	33	11	12	0	0	52	157	52.20%	66.90%
PHYS-1B	2019/SP	On Campus	7	15	21	1	4	0	0	16	64	67.20%	75.00%
PHYS-1C	2019/SP	On Campus	21	21	25	9	7	0	0	12	95	70.50%	87.40%
PHYS-1D	2019/SP	On Campus	15	20	7	2	2	0	0	13	59	71.20%	78.00%
PHYS-2A	2019/SP	On Campus	30	24	41	1	8	0	0	52	156	60.90%	66.70%
PHYS-2B	2019/SP	On Campus	6	9	7	1	2	0	0	8	33	66.70%	75.80%
PHYS-3A	2019/SP	On Campus	9	6	5	2	2	0	0	3	27	74.10%	88.90%
PHYS-3B	2019/SP	On Campus	6	11	10	2	0	0	0	3	32	84.40%	90.60%
PHYS-11	2019/SU	On Campus	10	9	1	0	1	0	0	4	25	80.00%	84.00%
PHYS-1A	2019/SU	On Campus	7	8	1	3	2	0	0	6	27	59.30%	77.80%
PHYS-1B	2019/SU	On Campus	11	13	8	0	4	0	0	6	42	76.20%	85.70%
PHYS-2A	2019/SU	On Campus	22	24	17	3	3	0	0	25	94	67.00%	73.40%
PHYS-2A	2019/WI	On Campus	6	12	11	5	2	0	0	5	41	70.70%	87.80%
PHYS-11	2020/FA	On Campus	29	15	14	2	7	1	0	16	84	70.20%	81.00%
PHYS-12	2020/FA	On Campus	4	0	1	0	1	0	0	1	7	71.40%	85.70%
PHYS-1A	2020/FA	On Campus	25	22	27	8	10	0	3	59	154	48.10%	61.70%
PHYS-1B	2020/FA	On Campus	47	6	4	0	1	1	0	0	59	98.30%	100.00%
PHYS-1C	2020/FA	On Campus	28	14	9	1	6	1	0	10	69	75.40%	85.50%
PHYS-1D	2020/FA	On Campus	10	9	4	1	1	0	0	2	27	85.20%	92.60%
PHYS-2A	2020/FA	On Campus	41	37	28	2	12	1	0	50	171	62.60%	70.80%
PHYS-2B	2020/FA	On Campus	15	10	10	0	0	0	0	0	35	100.00%	100.00%
PHYS-3A	2020/FA	On Campus	31	2	0	0	0	0	0	2	35	94.30%	94.30%
PSCI-25	2020/FA	On Campus	3	16	9	0	0	0	0	4	32	87.50%	87.50%
PHYS-11	2020/SP	On Campus	27	5	5	0	4	0	0	0	41	90.20%	100.00%
PHYS-12	2020/SP	On Campus	4	2	1	0	1	0	0	0	8	87.50%	100.00%
PHYS-1A	2020/SP	On Campus	67	14	13	2	1	2	0	0	99	97.00%	100.00%
PHYS-1B	2020/SP	On Campus	13	14	12	2	2	1	0	0	44	90.90%	100.00%
PHYS-1C	2020/SP	On Campus	39	19	15	1	3	1	0	1	79	93.70%	98.70%
PHYS-1D	2020/SP	On Campus	21	16	13	2	1	1	0	0	54	94.40%	100.00%
PHYS-2A	2020/SP	On Campus	40	30	13	3	8	1	0	0	95	88.40%	100.00%
PHYS-2B	2020/SP	On Campus	29	2	0	0	1	1	0	0	33	97.00%	100.00%
PHYS-3A	2020/SP	On Campus	12	1	5	0	2	2	0	0	22	90.90%	100.00%
PHYS-3B	2020/SP	On Campus	15	11	2	2	1	0	0	0	31	90.30%	100.00%
PHYS-11	2020/SU	On Campus	22	7	1	0	0	0	0	2	32	93.80%	93.80%
PHYS-2A	2020/SU	On Campus	40	21	9	2	3	0	0	10	85	82.40%	88.20%
PHYS-2A	2020/WI	On Campus	19	17	7	0	1	0	0	8	52	82.70%	84.60%
PHYS-11	2021/FA	On Campus	5	10	14	2	5	0	0	1	37	78.40%	97.30%
PHYS-1A	2021/FA	On Campus	22	20	19	4	11	0	2	70	148	41.20%	52.70%
PHYS-1B	2021/FA	On Campus	13	5	6	2	4	0	0	17	47	51.10%	63.80%
PHYS-1C	2021/FA	On Campus	11	15	14	8	4	0	0	23	75	53.30%	69.30%
PHYS-1D	2021/FA	On Campus	4	2	2	1	4	0	0	6	19	42.10%	68.40%

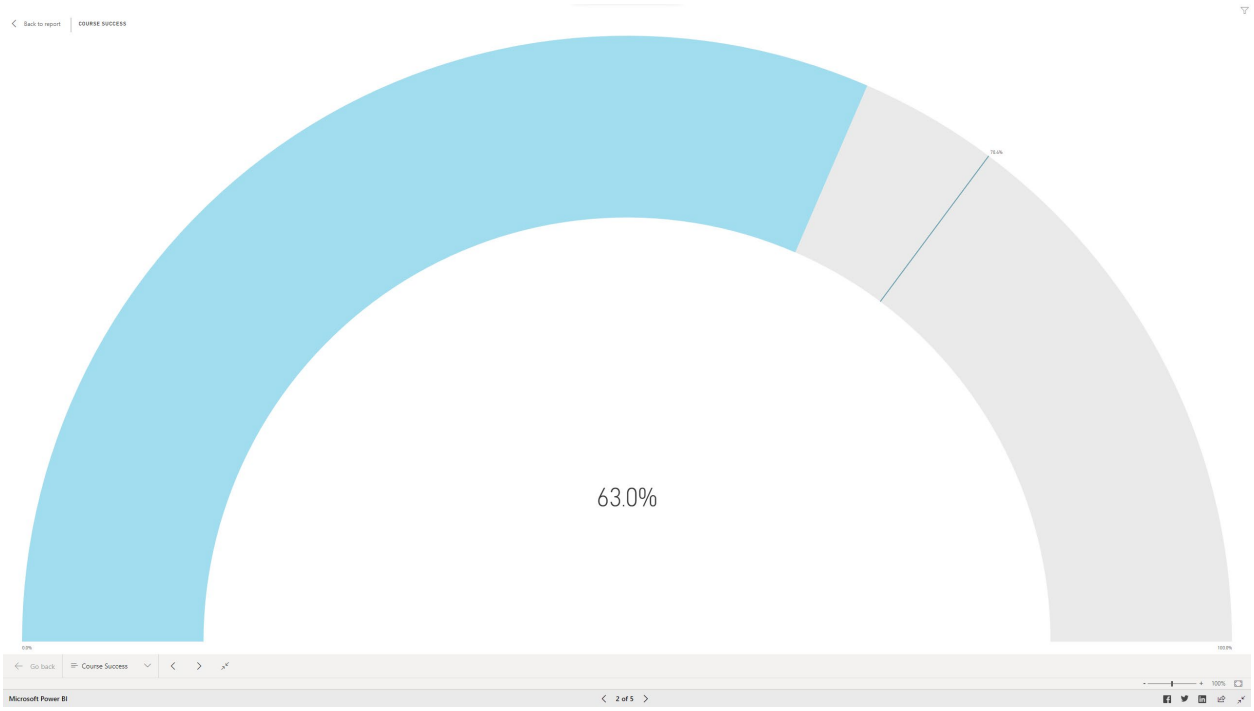
PHYS-2A	2021/FA	On Campus	60	31	17	6	22	0	0	55	191	56.50%	71.20%
PHYS-2B	2021/FA	On Campus	6	7	12	2	2	0	0	7	36	69.40%	80.60%
PHYS-3A	2021/FA	Online	14	11	5	0	1	0	0	6	37	81.10%	83.80%
PSCI-25	2021/FA	On Campus	2	9	10	1	0	0	0	9	31	67.70%	71.00%
PHYS-11	2021/SP	On Campus	10	18	6	1	10	0	0	18	63	54.00%	71.40%
PHYS-12	2021/SP	On Campus	4	0	1	2	3	0	0	2	12	41.70%	83.30%
PHYS-1A	2021/SP	On Campus	6	13	5	8	5	0	0	26	63	38.10%	58.70%
PHYS-1A	2021/SP	Online	7	9	12	13	3	1	0	13	58	50.00%	77.60%
PHYS-1B	2021/SP	On Campus	13	8	17	2	4	1	0	16	61	63.90%	73.80%
PHYS-1C	2021/SP	On Campus	10	14	8	3	1	0	0	25	61	52.50%	59.00%
PHYS-1C	2021/SP	Online	3	16	3	3	2	0	0	3	30	73.30%	90.00%
PHYS-1D	2021/SP	On Campus	12	18	7	0	3	0	0	21	61	60.70%	65.60%
PHYS-2A	2021/SP	On Campus	12	8	6	2	7	0	0	28	63	41.30%	55.60%
PHYS-2A	2021/SP	Online	17	12	9	1	2	0	0	25	66	57.60%	62.10%
PHYS-2B	2021/SP	On Campus	8	15	4	0	1	0	0	4	32	84.40%	87.50%
PHYS-3A	2021/SP	On Campus	23	2	0	0	3	1	0	3	32	81.30%	90.60%
PHYS-3B	2021/SP	Online	14	15	11	0	1	0	0	5	46	87.00%	89.10%
PHYS-11	2021/SU	On Campus	5	4	5	3	0	0	0	2	19	73.70%	89.50%
PHYS-1A	2021/SU	Online	13	9	5	0	1	0	0	3	31	87.10%	90.30%
PHYS-1B	2021/SU	On Campus	19	11	3	0	1	0	0	0	34	97.10%	100.00%
PHYS-2A	2021/SU	On Campus	18	8	3	0	4	0	0	13	46	63.00%	71.70%
PHYS-2A	2021/SU	Online	8	13	10	0	4	0	0	10	45	68.90%	77.80%
PHYS-2A	2021/WI	On Campus	15	9	24	0	14	1	0	19	82	59.80%	76.80%
PHYS-2A	2021/WI	Online	16	18	9	0	2	0	0	11	56	76.80%	80.40%
PHYS-11	2022/SP	Online	31	13	10	5	3	0	0	6	68	79.40%	91.20%
PHYS-1A	2022/SP	On Campus	15	35	26	18	13	0	0	19	126	60.30%	84.90%
PHYS-1B	2022/SP	On Campus	8	16	11	4	1	0	0	20	60	58.30%	66.70%
PHYS-1C	2022/SP	On Campus	5	23	17	7	3	0	0	12	67	67.20%	82.10%
PHYS-1D	2022/SP	On Campus	10	12	9	1	0	0	0	8	40	77.50%	80.00%
PHYS-2A	2022/SP	On Campus	17	15	19	1	13	0	0	57	122	41.80%	53.30%
PHYS-2B	2022/SP	On Campus	11	13	7	0	0	0	0	1	32	96.90%	96.90%
PHYS-3A	2022/SP	On Campus	7	6	2	1	1	0	0	2	19	78.90%	89.50%
PHYS-3B	2022/SP	On Campus	18	8	5	0	0	0	0	0	31	100.00%	100.00%
PHYS-2A	2022/WI	Online	27	4	2	0	2	0	0	4	39	84.60%	89.70%

Summary table 2.f.ii.

	A	B	C	D	F	Pass	No Pass	W	All
Totals:	1606	1301	1057	241	371	17	5	1350	5948
Percents:	27.00%	21.87%	17.77%	4.05%	6.24%	0.29%	0.08%	22.70%	100.00%

g) *Course* Success: Percentage of students enrolled at census who complete the course with a grade of A, B, C, or P

Figure 2.g.i



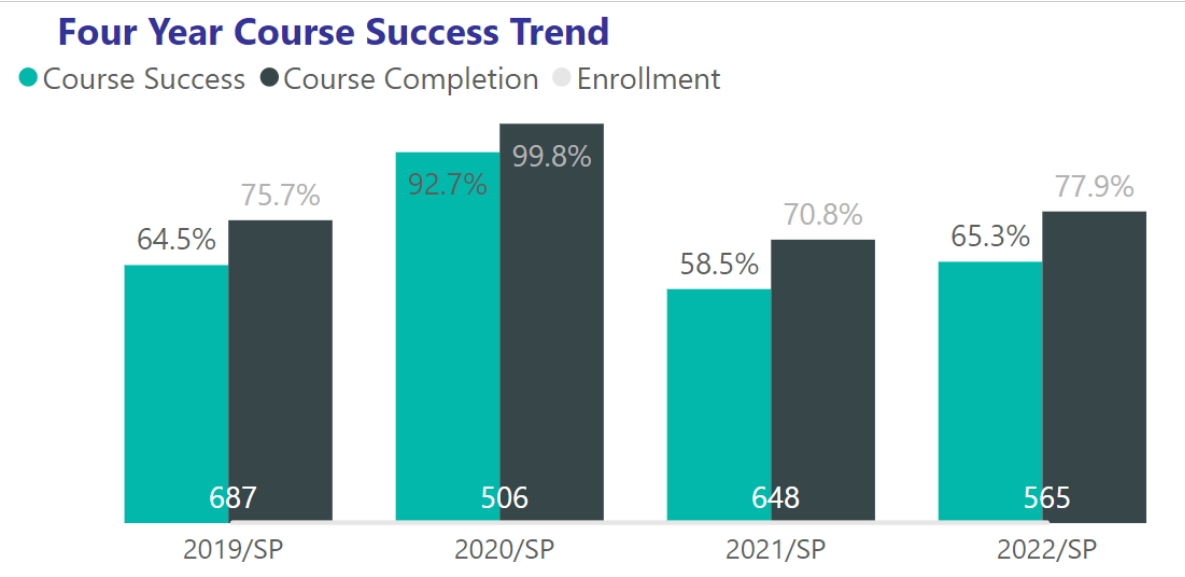
Physics course success lies below the institutional average. It is not clear if this average is a median. Regardless, many departments will lie below either an average or a median, and physics, known to be a difficult subject at any institution, would be expected to lie below this value.

Four years of course success (including the pandemic year). Fig 2.g.spring shows course success for all students for Spring semesters. Spring of 2020 is clearly an aberration and likely tied to the emergency stay at home order of the pandemic and the emergency withdrawal policy. (emergency withdrawals were not included in the data set – see 'Four Year Course Success Trend' graph below).

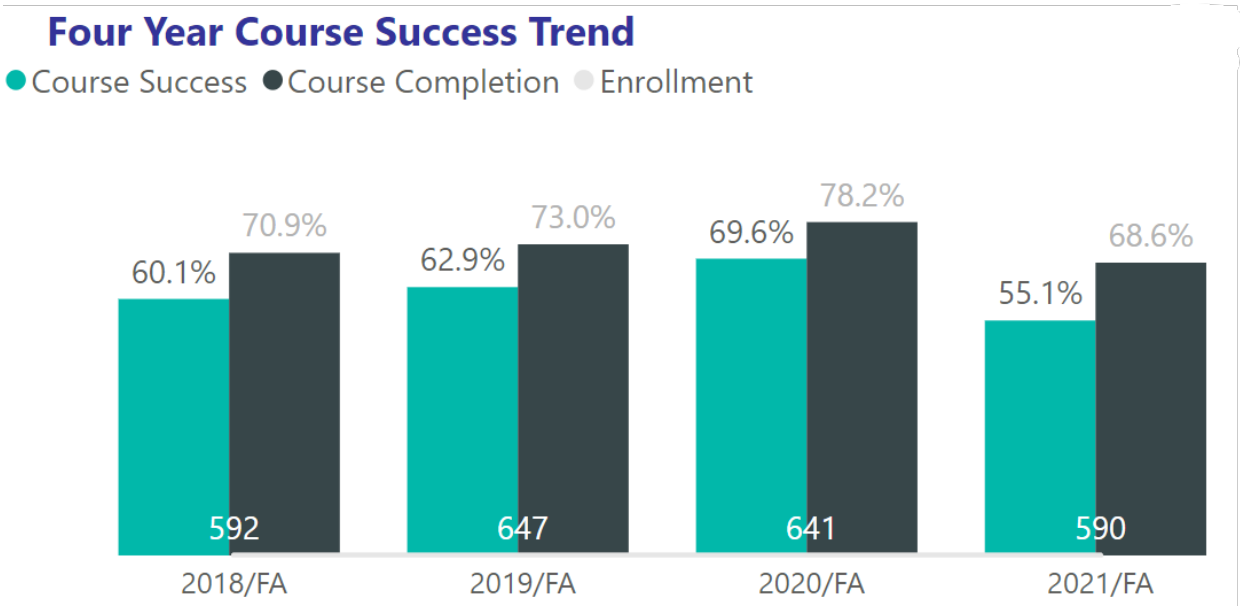
The physics department feels that a serious and high-level approach to physics benefits students after they leave ECC – increasing their success at their transfer institutions. Anecdotal evidence over the collective 40+ years of feedback from program alumni supports this conclusion.

There are two major efforts underway to increase student success. As mentioned above, the department changed the prerequisites to several courses, with the expectation that the new requirements would lead to students taking courses with the proper background and thus, higher success rates. Secondly, the department is tracking the downstream success of students based on instructor in our own introductory courses. The high turnover rate of part time faculty since the covid pandemic may lead to less effective

teaching/learning at the start of students' physics studies. It should be emphasized that these are introductory efforts and no conclusions have yet been drawn.

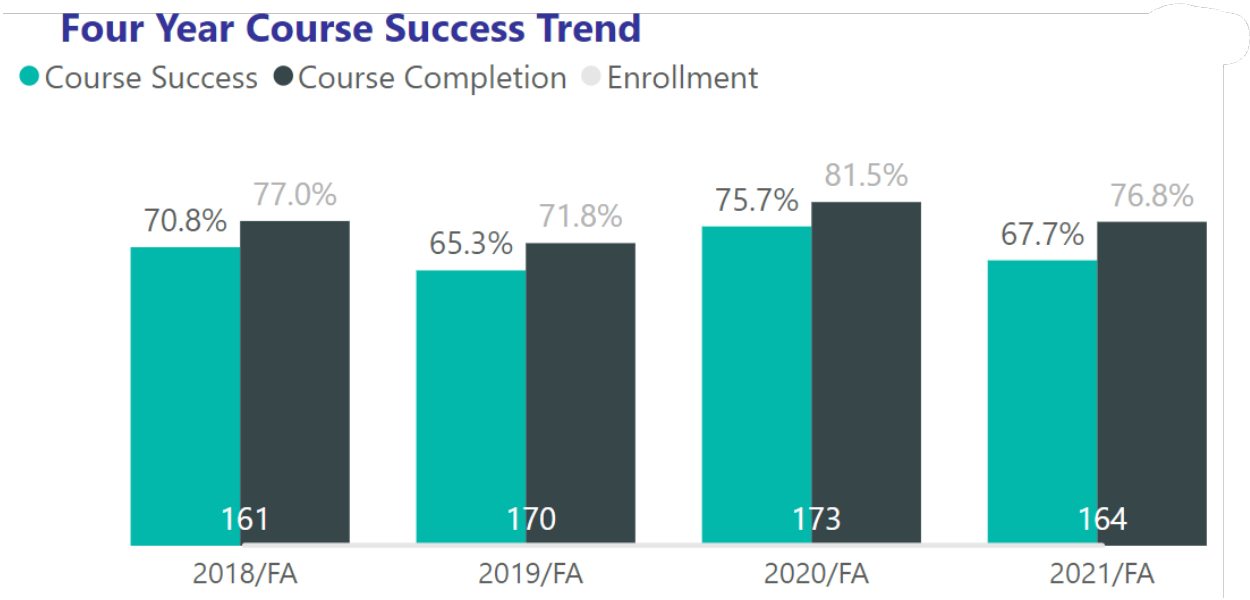


Fall semester distributions, unlike spring semesters, are remarkably consistent. Fig 2.g.fall shows course success for all students for Fall semesters.

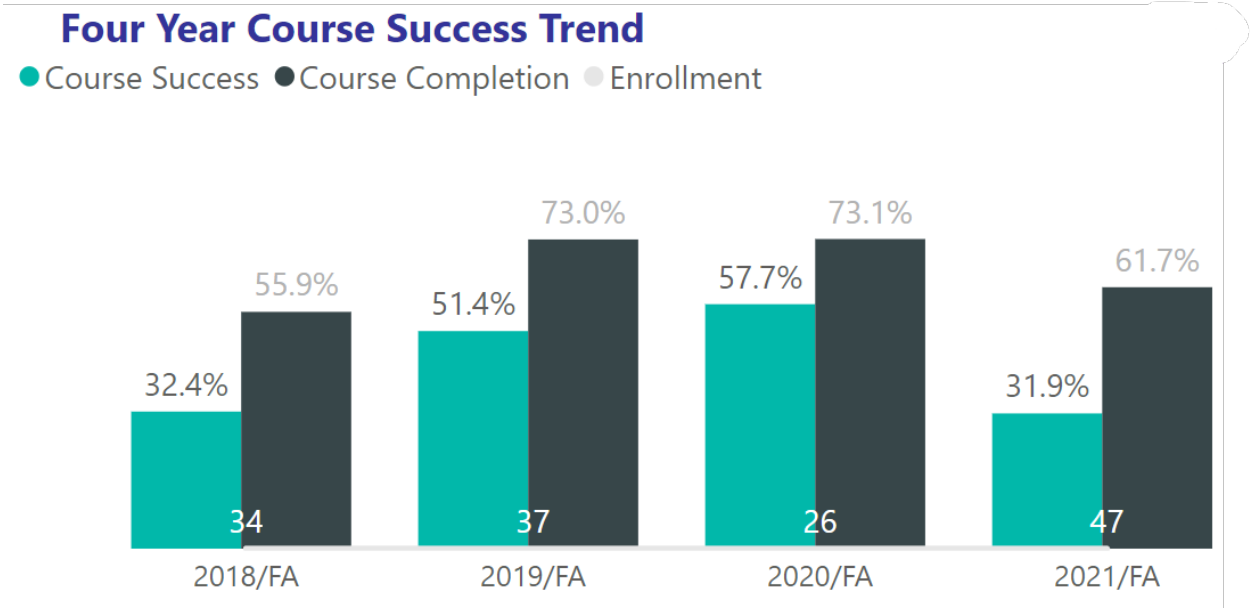


All comparisons below will use the more consistent data from the fall semesters.

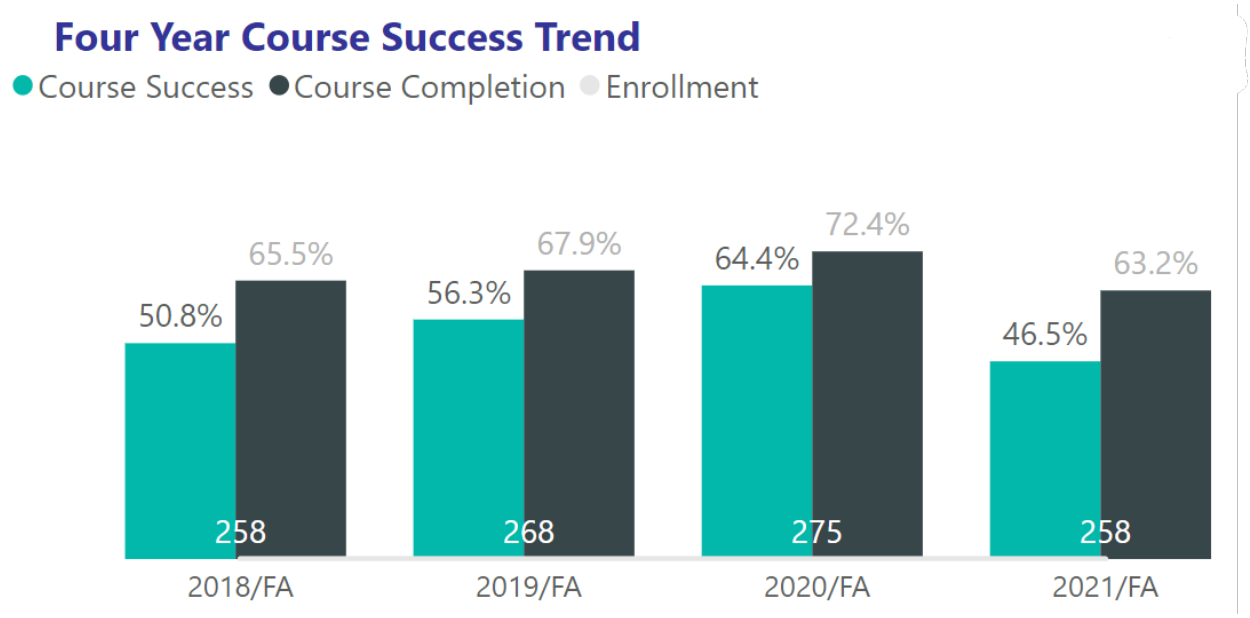
Breaking down the data by the four most populous ethnic groups (not including "unknown") we obtain the following success trends:
Students of Asian race/ethnicity performed the best out of the examined groups. Fig 2.g.asian



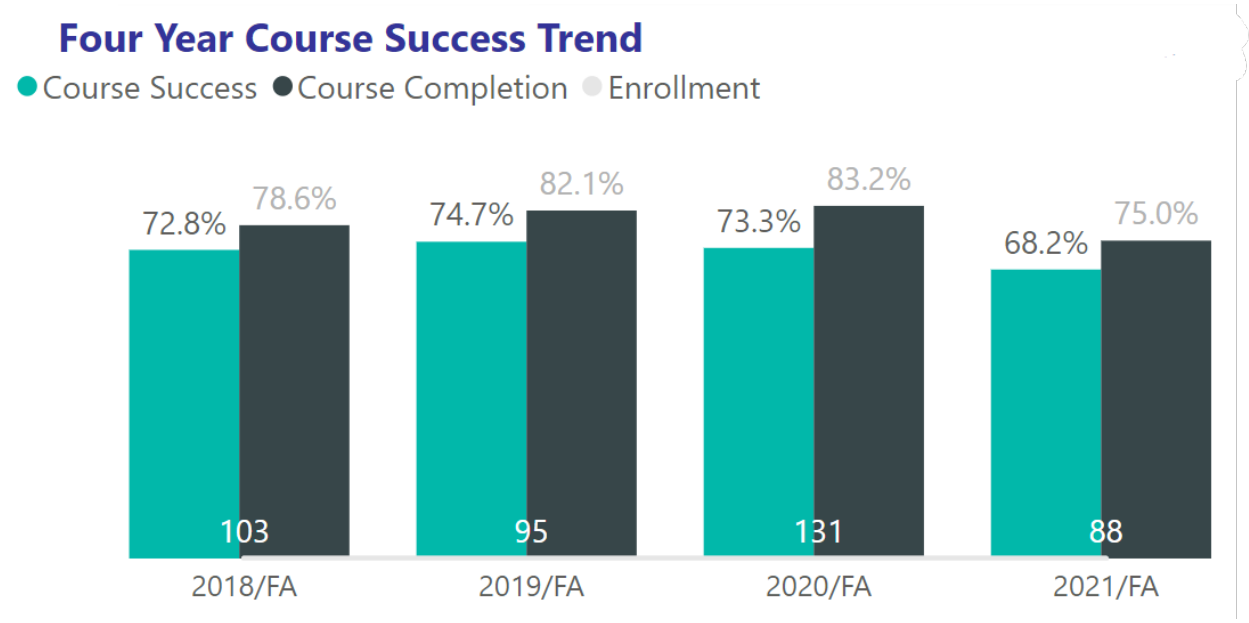
Students of Black or African American race/ethnicity performed the worst out of the examined groups. Fig 2.g.black_aa



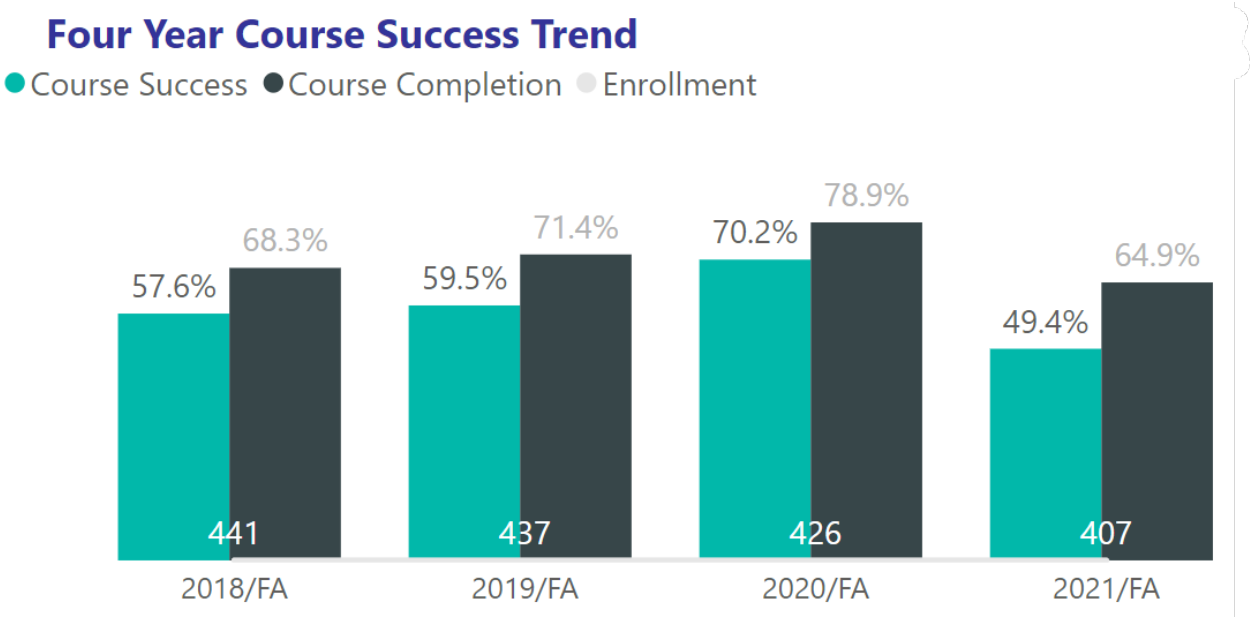
Students of Latino race/ethnicity performed worse than average. Fig 2.g.latino



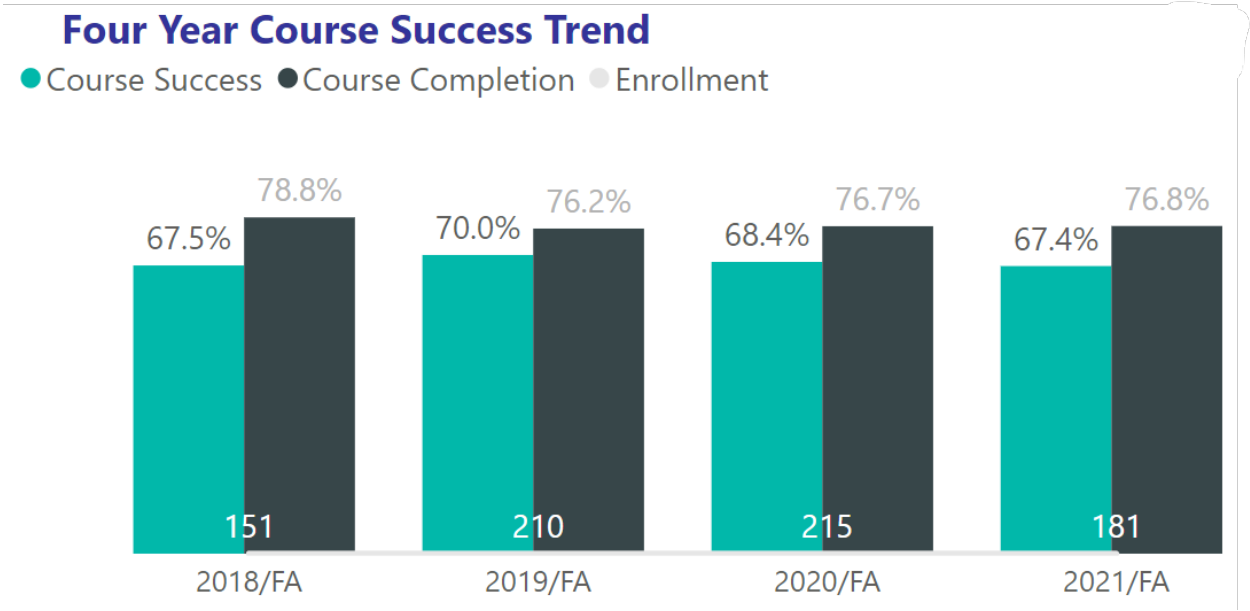
Students of White race/ethnicity performed above average. Fig 2.g.white



Breaking the data down by gender reveals the following results:
Students of Male gender performed slightly below average. Fig 2.g.male.

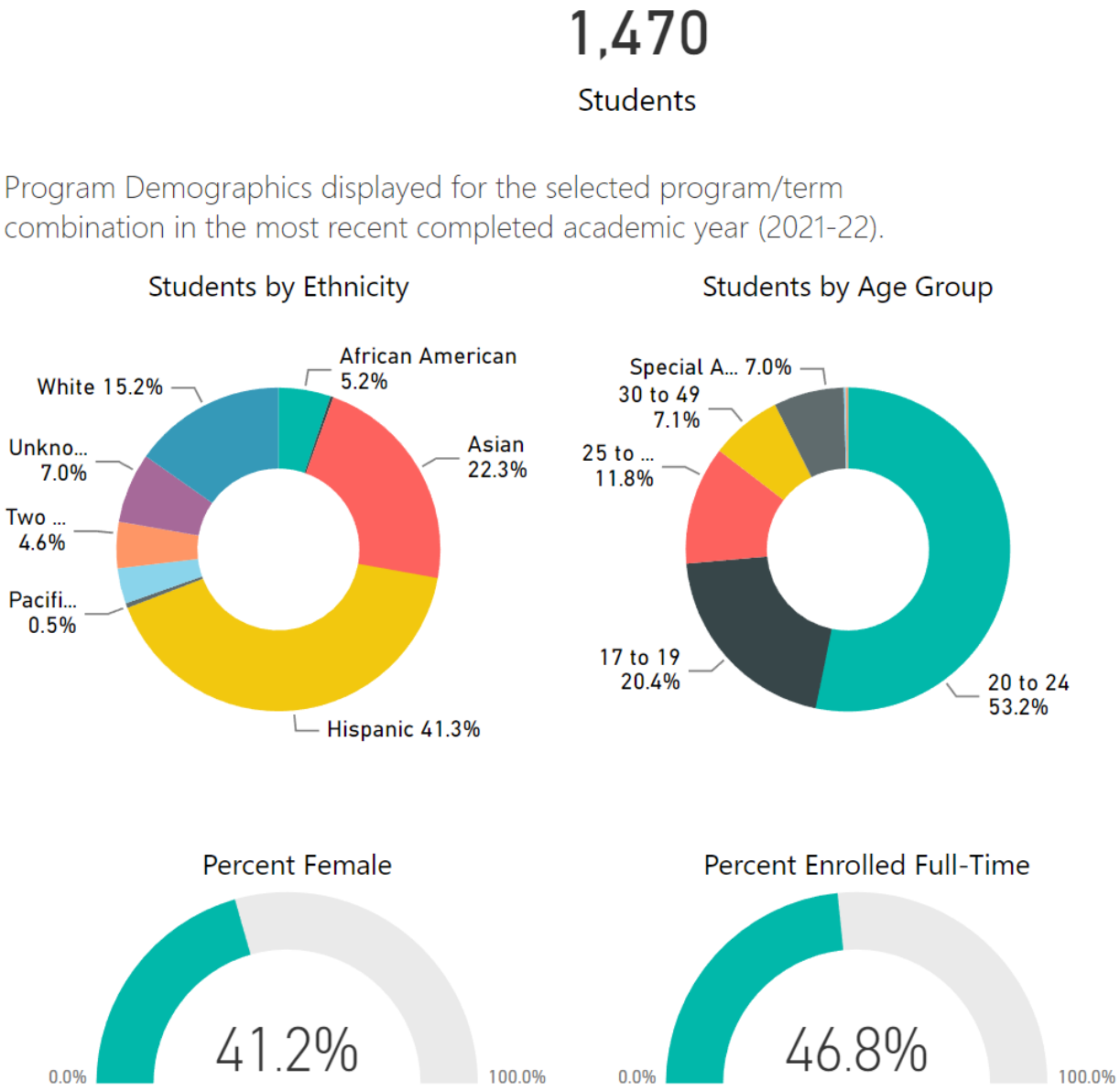


Students of Female gender performed slightly above average. Fig 2.g.female.



Program demographics show that the most populous group is Hispanics (41.3%), followed Asian (22.3%), then White (15.2%) and African American (5.2%). Obviously, these are the appropriate weights to give to each group's overall program course success statistics. The program is 41.2% Female.

Fig 2.g.demographics



h) *Unit Accumulation:* Number of units accumulated by students working towards a program degree/certificate. Discuss whether students who take units beyond the requirements for their educational goals serve educational purposes or not. Focus on general trends, not on particular courses within the program.

Most students in physics either transfer as science majors, engineering, or computer science. The requirements for transfer include many units. In general, few students take units beyond the requirements for transfer. XXXX why these success rates? What can be done?

Acad Yr / Title	2018-19 Awards	2018-19 Average Units Earned	2018-19 GPA	2019-20 Awards	2019-20 Average Units Earned	2019-20 GPA	2020-21 Awards	2020-21 Average Units Earned	2020-21 GPA	2021-22 Awards	2021-22 Average Units Earned	2021-22 GPA
Physical Science												
AA/AS	91	88	3.23	55	87	3.43	79	88	3.38	47	79	3.43
Physics												
AA/AS	16	94	3.56	11	88	3.52	12	88	3.46	7	81	3.41
ADT	22	89	3.29	34	101	3.29	32	104	3.37	22	81	3.54

i) *Annual earnings:* Median annual income of alumni who attended the program under review (or the closest related sector)

According to the salarysurfer supplied by the California Community Colleges website, the median annual salary of a student 2 years after graduation is $21,407 and 5 years after is $69,639. XXXX ask Caroly for salary data. (47:13 comment in video)

STOP HERE!

j) *Living Wage Attainment:* Percent of alumni who attended the program under review (or the closest related sector) and earn living wage

Living wage in Los Angeles County, CA is $45,536 for 1 Adult with 0 Children. The typical salaries quoted in 2.i all lie above this value.

If more details are desired, see the publicly available statistics from MIT at https://livingwage.mit.edu/counties/06037. An alternate table of typical annual salaries based on occupational area is also available, as is a further breakdown of expenses for multiple adults and adults with children.

Typically, alumni of our program (who complete their degrees after transfer and obtain work in their field) exceed the minimum living wage in the Los Angeles area.

***k) Job in Field of Study: P*ercent of alumni who pursued a career education path with a job related to their field of study.**

The physics department has only anecdotal evidence for the career paths of alumni. One issue lies in having continued communications for graduates of the program, as well as the unwillingness of transfer institutions to provide data of the success or failure of specific community college physics programs. It is worth noting that students who complete a physics education are better prepared for work in higher technology sectors – including work in areas related to the recent CHIPS act and the Build Back Better Act.

Curriculum and Outcomes Assessment

a) **Examine the program curriculum using an equity lens by responding to the following questions: To what extent does the curriculum:**
   - **Prepare students to actively engage in a diverse society?**

The physics curriculum at ECC emphasizes the scientific method of having a hypothesis and then testing it with experiments, then modifying the hypothesis. Of particular interest in physics are quantitative measurements of physical phenomena, which determine the result of experiments. A central goal is to ensure that the measurement measures the desired quantity, and is not some arbitrary metric made up by the researcher. Ultimately, tested hypotheses are collected into an overarching theory that includes the relationship between different, measurable quantities. For example, F = ma relates three quantities, force, mass and acceleration. This scientific approach, coupled with the rigor of applying well established theory to a given problem gives students the tools to engage a diverse society and analyze the various elements of that society.

   - **Include multicultural content?**

Physics itself, and its primary language, mathematics, constitutes its own culture. In this sense, it is an adjacent, limited, culture of its own. To the extent that sample problems can use multicultural elements physics does include multicultural content. For example, the textbook uses multicultural and multigender names in problems, which fosters inclusivity.

   - **Respond to diverse students' learning needs?**

With respect to efforts to connect students of different cultures to the material, faculty seek to use neutral examples, free from race or gender bias. As mentioned above, the department is constantly assessing whether students are successful in learning the skills taught in their courses. One specific action of the department was to change the prerequisites of several courses to improve student success by keeping unprepared students out. A second specific action is to hire the best possible faculty, both full time and part time, for our students.

   - **Encourage instructors and students to investigate their own views, biases and values and discuss multiple perspectives different from their own?**

Because physics relies on the results of experiments and, as taught in our courses, well established theories, the department constantly challenges students to overcome their (poor) physical intuition by posing questions in class. Similarly, the large variety of demonstrations challenge student assumptions and though processes, especially when students are quizzed beforehand to "guess" the result. For example, we can ask if a feather falls more slowly than a coin (the feather, obviously), then alter the situation by creating a vacuum and doing the same demonstration. Anyone who wishes to have their preconceptions challenged should attend the, "Puzzlers in Physics," presentation on Onizuka day.

   - **Use critical/equity-oriented pedagogy?**

By its nature, physics has a narrow focus, which is inherently critical (theories change based on measurements). In our courses, we teach well established theories, but do address how these theories are sometimes incomplete (Newton's law fail at speeds close to the speed of light, general relativity is incompatible with quantum mechanics, solutions to fluid flow equations cannot be fully solved for real systems). Faculty do acknowledge the history of physics and its Western European (~1600 – 1950) origins. The focus is on the theories themselves, not the history, but occasional mention of important figures like Emmy Noether or Marie Curie are included along with their male counterparts.

- **Ensure creating an empowering classroom environment?**

The physics department works to ensure that all students feel welcome in the classroom – regardless of race, gender or other factors. An important aspect of students feeling empowered is that they possess the proper background for the course – hence the change in prerequisites and the focus on hiring good faculty, both full-time and part-time.

- **Use multiple evaluation techniques sensitive to the diverse ways students can demonstrate understanding?**

Physics uses multiple evaluation techniques, within the confines of the discipline. This is seen in the program PLOs, which include the following:

- PLO 1: Students' ability to identify appropriate physical principles relevant to physical phenomena. For example, currents in wires arise due to electromagnetic forces, while currents in fluids arise from pressure differentials (or stead state flow, as appropriate).
- PLO 2: Students must be able to use mathematics appropriate to the physical principles to successfully solve for the behavior of the given physical system. For example, the use of either Ohm's laws for circuits or Faraday's law to find the electric current in a wire or the use of Bernoulli's law for the flow of fluids in a tube.
- PLO 1: Finally, students should be able to use appropriate instruments in order to collect data, as well as analyzing and interpreting that data.

These PLOs all fit into the overall use of scientific method which emphasizes the importance of formulating hypotheses (loosely, notions of how phenomena work or come about) then testing these hypotheses using well designed experiments and measurements which can validate or invalidate the hypotheses (PLO. Of course, in physics, much of this work has already been done, with hypotheses formulated over many years and then collected into well-established physical theories that form the basis of powerful predictions. As much as possible, this framework provides a restriction on preferring one culture over another. It does give a rubric for the interpretation of instructor or student biases. For students living in a society shaped by technology, physics prepares students to live in that diverse society, including the ability to think through popular headlines and news articles.

b) Summarize SLO and PLO assessment results over the past four years for key/gateway courses. Gateway courses are determined by your department & division – contact your Dean. For your gateway courses, present the raw data (number of students who participated in each assessment, number of students who met the standard in each assessment, what success rate for each SLO was for each

assessment). This data is in Nuventive. Contact your Division Facilitator and/or Campus SLO Coordinator for assistance.

See answers to section c) below.

c) **Discuss programmatic factors contributing to constant, increasing or decreasing trends in the results for SLO and PLO assessment within the previously examined courses. What do you see that is contributing to increasing, decreasing, or stable success in each SLO analyzed?**

Physics 2A and 1A serve as our gateway courses. From Nuventive:

Phys 2A, SLO 1:
Four different sections of 2A were taught in the spring of 2018. A variety of concepts were assessed including the conservation of momentum in two dimensions, wave interference in space, simple harmonic motion and conservation of energy of a swinging pendulum and heat transfer with phase change and rise in temperature. In this case we were able broadly test for overall student ability in applying physical principles to various situations. 30% of students correctly identified the concept. 74% of students were either successful or moderately successful. 26% failed to correctly identify the concept. (number of students not recorded)

Phys 2A, SLO 2:
A total of 107 students participated in this SLO.
29.0% achieved “excellent”. 56.1% achieved “moderate” or above. 43.9% were unsuccessful. We have increased the targets for success for this assessment. Previously the standard was met, this time it was not. We should further examine if we need to better tune our assessment method/standards.

Phys 1A, SLO 1:
The students were given a multiple choice quiz in canvas that covered forces, free body diagrams, acceleration, etc. 21% of students scored 74% or higher achieving "correct identification of concept". 55% of students scored 55% or higher achieving "moderately correct...".

There was an issue with the administration of this SLO, where the provided figure did not render correctly on all devices. We plan to address this in the next round of SLO 1 assessment.

Number of Students who Participated in this Assessment 71
Number of Students Who Successfully Met the Standard for this Assessment 39
% of Success for this SLO 55

Phys 1A, SLO 2:
A total of 60 students participated in this SLO.
36.7% achieved “excellent”. 30% achieved “moderate” or above. 33.3% were unsuccessful. We have increased the targets for success for this assessment. Previously the standard was met, this time it was not. We should further examine if we need to better tune our assessment method/standards.

SLOs are assessed every 4 years.

d) Highlight equity gaps found in SLO and PLO assessment results among different groups of students.

Per requirements at the time when SLO's and PLO's were taken, Physics does not disaggregate SLO and PLO data for different groups of students. The department is in the process of putting SLO data onto canvas.

SECTION 3
Program Vision and Future Planning

Program Vision

A) Describe the vision of the program for the next four years considering the assessment reported in the previous section, student groups that are underrepresented in the program's field, and any relevant changes within the program field/industry. A vision statement describes the desired future state of the program.

Continue to offer the best possible educational opportunities to our students to help them to be successful at transfer four-year institutions and to continue to offer associate degree courses that meet general education requirements.

The following skills will continue to be emphasized in several of our Physics courses so that students have multiple opportunities to learn them throughout their physics experience:
1. Basic knowledge of the major fields of physics
2. Experimental skills:
Students should have basic experimental skills that include:
a) data collection, especially using modern acquisition methods
b) data analysis, including error analysis, at minimum using excel
3. Information handling/problem solving skills.
4. Prioritizing information and gleaning most important points.
5. Scientific method and approach.
6. Organizational skills
7. Ability to handle the rigor and discipline required to be an excellent science student.

Future Planning

A) Based on the assessment reported in the previous section, develop program goals to be completed during the next four years in relation to:

- **Adjusting the curriculum for coherence and alignment with students' workforce needs**
- **Advancing towards a more equitable program to close equity gaps among groups of students**
- **Clarifying students' paths to completion, further education and employment**
- **Helping students explore options and build foundation skills**
- **Helping students stay on the path**
- **Integrating applied learning experiences**

Physics has recently completed a multi-year effort to align prerequisites and corequisites for the 1-series courses. Changes were made based on data that demonstrated better student success across all groups. For example, students taking math 190 at the same time as physics 1A had a decidedly lower success rate compared to students that had completed math 190. Changes were

made to prerequisites and corequisites to physics 1A, physics 1C and physics 1D based on data. Our department believes that these changes will reduce equity gaps for students and make the program more coherent.

These changes are completely new, taking effect in the Spring of 2023. Physics needs to assess the success of these changes for the overall student population taking physics as well as individual groups taking physics.

Beyond the changes in prerequisites and corequisites made to improve student achievement, physics recommends adding a full time faculty member as outlined in section 1.D. It cannot be emphasized enough that this will improve student equity, since part time faculty typically teach lower level courses (out of necessity).

B) What projects will the program complete to achieve the desired goals? Please specify at least two for each goal.

Together with institutional planning, physics will keep track of student success in our courses.

C) When the next program review is due, how will the program determine if the goals have been met? Please specify at least one quantitative target or qualitative accomplishment for each goal.

Physics will directly compare future success numbers with those found in this program review.

Program Resources

In the following areas, what are the resources needed by the program to meet the goals for the next four years? Include any recommendations from the previous Program Review that are still active or on hold.

List resources in order of priority. Prioritize them within each category and/or develop an overall prioritized list of resources. Explain how these resources contribute to the College's equity goals.

a) Staffing

Currently physics is staffed with four full time faculty, one full time technician, and part of one part-time technician (shared with astronomy and biology). Part time faculty staff 7 of the 19 sections offered by physics.

b) Facilities and Equipment

The Physics Department uses four classrooms that are used for lectures as well as for labs. Each classroom has a projector and a computer. The Physics Department has shop facilities that are used to build, repair, and maintain equipment. We have a wide assortment of lecture

demonstration equipment and lab equipment. Some of the equipment has been constructed over the years by our technicians and instructors, and all of the labs are routinely maintained and improved by technicians and instructors. In addition, our technicians sometimes assist other departments in the Natural Sciences Division to repair equipment. The department also needs sufficient budget to maintain the current level of demonstrations and laboratory equipment as devices age and newer/better/cheaper equipment becomes available as part of a natural replacement cycle.

c) Technology/Software

Each classroom has a projector, document cameras, and a computer with access to the internet. In addition, new wireless routers provide internet access for students in the classroom as well as for the lab computers. Projectors with HDMI and/or wifi casting will update the (dated) vga input currently in use.

d) Contracts/Services

APPENDIX A
CAREER EDUCATION (CE) SUPPLEMENTAL QUESTIONS

CE programs must conduct a full program review every 4 years. The comprehensive program review includes responses to the CE supplemental questions below. Every two years (once between full program reviews) these supplemental questions must be answered and submitted to Academic Affairs for posting on the College website.

Use labor market data, advisory committee input/feedback, and institutional and program-level data to respond to the following questions:

1. **How strong is the occupational demand for the program?** In your response, describe any changes in demand over the past 5 years and discuss the occupational outlook for next five (5) years. Provide applicable labor market data (e.g., US Bureau of Labor Statistics, Employment Development Department) that address state and local needs.

2. **How does the program address needs that are not met by similar programs in the region?** In your response, identify any distinctive components of the program (e.g., curriculum, facilities, resources) and/or describe any unique contributions the program or its students/graduates make to the community served.

3. **What are the completion, success, and employment rates for students in the program?** In your response, identify the standards set by the program and discuss any factors that may impact completion, success, and employment rates among students in the program. Describe the status of any action plans for maintaining/improving rates relative to such benchmarks.

4. **List any licensure/certification exam(s) required for entry into the workforce in the field of study and report the most recent pass rate(s) among program graduates.** In your response, identify any applicable performance benchmarks set by regulatory agencies and describe the status of any action plans for maintaining/improving pass rates relative to such benchmarks.

5. **Are the students satisfied with their preparation for employment? Are the employers in the field satisfied with the level of preparation of program graduates?** Use data from student surveys, employer surveys, and other sources of employment feedback to justify your response.

6. **Is the advisory committee satisfied with the level of preparation of program graduates? How has advisory committee input and feedback been used in the past two years to ensure employer needs are met by the program?** Describe the status and impact of any advisory committee recommendations.

   California Education Code 78016 requires that the review process for CE programs includes the review and comments of a program's advisory committee. **Provide the following information:**

   a. Advisory committee membership list and credentials.

   b. Meeting minutes or other documentation to demonstrate that the CE program review process has met the above Education Code requirement.