CPR - Instructional

A. Program Description

1. Describe your program's purpose and identity/focus, noting any changes since the last review.

The Physical Sciences Department at SMC consists of three distinct disciplines: Chemistry, Engineering, and Physics. At peak enrollment in 2018-2019, our department offered 255 sections of 26 unique courses accounting for nearly 6,000 student enrollments, corresponding to more than 1400 weekly teacher hours. Just as College enrollment has declined, the department has experienced a significant decline. In 2022-2023, our department offered 206 sections of 25 unique courses to 4,000 students, corresponding to just over 1200 weekly teacher hours. Despite enrollment declines, our department has consistently ranked as the fourth largest department on campus from a variety of measures.

Approximately 85% of our students are intending to transfer to a four-year university and almost half identify as first-generation college students. In general, the percentage of STEM and Health and Wellness students has increased over the review period, with nearly 60% identifying as STEM or Health and Wellness in Fall 2017 and nearly 70% identifying with one of those groups in Fall 2023. This represents a shift in the demographics in the department that is likely the result of fewer students enrolling in our non-majors GE courses.

2. What are the critical ways your program advances the college's mission, vision, and goals?

The Department advances the College's mission by offering a wide array of Chemistry, Engineering, and Physics courses designed to prepare students for transfer, graduate, or professional school, and in their future careers. We offer quality instruction and provide a supportive environment for students to thrive in their courses. Our aim is to impart students with the knowledge, skills, and confidence to compete successfully with their peers in future careers and academic pursuits.

We offer courses to support many educational paths, these include:

Chemistry

Chemistry 9 is a course to promote scientific literacy through the framework of chemistry in everyday life. It is intended for non-science majors to complete a general education requirement.

Chemistry 10 serves as the steppingstone to General Chemistry for STEM majors. It is an introductory course that is used to prepare students for Chemistry 11.

Chemistry 19, first offered in Fall 2016, prepares students for nursing and allied health programs. The course covers the fundamentals of general, organic, and biological chemistry. Chem 19 is a terminal course.

Chemistry 11 and 12, together, make up the first year of university level chemistry: General Chemistry. Nearly all STEM majors take both Chem 11 and 12.

Chemistry 21, 22, and 24, together, make up the second year of university level chemistry, commonly known as Organic Chemistry. Students focusing on Chemistry, Biology, and pre-medical programs will take the Organic series of courses.

Chemistry 31, Biochemistry, is often taught at university in the third year. Students planning to transfer as biochemistry majors, or related disciplines, as well as post-baccalaureate students would take this course. Enrollment has significantly declined and it was last offered in Spring 2020.

Engineering

Engineering 1 is an introductory course for students interested in engineering. Students learn study skills, work on a basic engineering design project, and learn about various fields of engineering.

Engineering 11 provides instruction in engineering drawing and design principles for mechanical engineering students.

Engineering 12 and 16 are capstone courses for mechanical engineering students. They cover the topics of statics and dynamic systems, respectively.

Engineering 21 and 22 are lecture and lab, respectively. These two courses, together, provide electrical engineering students with instruction in circuit analysis and design.

Physics

Physics 12 and 14 are courses designed to promote scientific literacy through the framework physics principles. Physics 14 has a laboratory component, while Physics 12 does not. These courses are intended for non-science majors to complete a general education requirement.

Physics 6 and 7, together, are considered university level physics courses for students in life sciences or other majors that do not require a calculus-based physics background. The two semester long courses treat the principles of physics using algebra and trigonometry.

Physics 20 is a new course, first offered in Spring 2019. It is intended for students that plan to take Physics 8 or 21. The course focuses on helping students develop study skills that will improve success in future Physics classes through the framework of studying physics concepts. Enrollment has remained low and the class has struggled to take off, most likely due to the challenges of launching it right before the pandemic started. There are currently two full-time faculty working on relaunching the course.

Physics 8 and 9, together, represent a one-year, university level, calculus-based physics series that is designed to meet the needs of students in non-engineering majors. Often pre-med students will take this series.

Physics 21, 22, 23, and 24, often taken over 3 – 4 semesters, offers the most in-depth examination of calculus-based physics. Mostly commonly, students intending to major in either Physics, Engineering, or other Physical Sciences will take this series.

General Science

Science 10 is an introductory course in research methods taken primarily by students in the SMC STEM program. This course has been taught by all three disciplines, Chemistry, Engineering, and Physics. Students will learn the fundamentals of scientific research methodologies, participate in conducting novel research, and presenting their findings at the end of the semester either by oral presentation or poster session.

B. People Involved – Your Students

Population and Demographics:

3. What are the key characteristics that define your program's student population? Compare your program's population to the overall college population, and discuss the extent to which your program's student makeup (including subgroups who are over or under-represented) currently aligns with your program's intended target populations.

From Fall 2016 to Fall 2023, both the Department and the College have experienced a decline in enrollment. Examining overall student headcount, both the College and Department enrollment appears to have bottomed out in Fall of 2022 and have rebounded slightly. The net loss in student headcount is 21.8% for the College and 29.4 % for the Department.

	Fall 2016	Fall 2022	Fall 2023	% Decline
College	34,226	25,516	26,762	21.8%
Department	2,405	1,640	1,697	29.4%

With decreased enrollment, the race/ethnicity demographics have shifted in our Department. In Fall 2016, 32.8% of our students identified as Latine/x and in Fall 2023, 42.0% identified as Latine/x. To complement this shift, in Fall 2016, 24.1% of our students identified as Asian and in Fall 2023, 12.4% identified as Asian. In contrast, at the College level, the Latine/x group remained relatively constant at ~37% and the Asian group declined from 14.8% to 9.2% over the seven-year period. The decline in Asian student enrollment is due, at least in part, to fewer international students attending SMC. In our department, we saw international student enrollment drop from 17.5% in Fall 1016, to 10.4% in Fall 2023.

The demographic shift described is significant for our department. In part, because our student demographics more closely match the College demographics now, but it also signifies a need to change how we approach instruction. Students from Asia tend to have a strong math background, which supports their success in math heavy courses like chemistry, engineering, and physics. In contrast, students that grew up in and around Los Angeles tend to have a less solid foundation in mathematics. Additionally, the implementation of AB 705 and AB 1705 has created an environment where students do not have access to basic skills math classes that would otherwise support their success in entry level chemistry and physics classes. Interestingly, we found that since the rollout of AB 705/1705, the number of students entering Chemistry 10, our Introductory Chemistry course, without taking a math class at SMC has increased from 62.2% in 2019-20 to 74.3% in 2022-23 (no Spring). Success rates, which will be discussed later, have been affected by this change. In summary, students entering our math-intensive courses are collectively less math ready than they were five years ago and require greater supplemental math support.

The Black student population in our Department has remained relatively unchanged over the last six years at about 6%. The College Black student population has remained fairly constant at about 8%. As a Department, we would like to increase the Black student population to match that of the College.

Measures: Headcount

	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023
Measures	2,461	2,488	2,400	2,472	2,142	1,640	1,697

Outreach and Planning:

4. What opportunities do your analyses reveal about your current and future student outreach and planning efforts?

We anticipate that with the renewed effort by the College to recruit international students, we will see the percentage of international students enrolling in our courses increase. It would be prudent to collaborate with the SMC International Education Center to support international student enrollment in our courses.

As mentioned previously, enrollment of Black students has consistently been lower than that of the College. We have found it difficult to have productive conversations on Black student success when the number of Black students each year could range from 0 to a handful of students. One goal for the next six years is to work collaboratively with other programs on campus, like Black Collegians and The Men of Color Action Network (MOCAN), to increase representation. Our effort may also go beyond the College campus to do outreach at local middle

schools and high schools. Our hope in doing outreach would be to generate interest in Physical Sciences at a time when students start thinking about their future.

Our largest effort in the next six years will be centered around supporting students in the classroom to increase retention and success. As noted above, with fewer students taking math prior to enrolling in our classes, we need to be innovative in the way we provide instructional support and, in particular, math support. This could include limiting the number of students in a classroom so that instructors can provided more individualized support as well as developing math support materials in collaboration with Math faculty. Alternatively, we could develop non-credit support courses that would be taken concurrently with our entry-level courses, like Chem 10 or Physics 21.

C. People Involved – Your Staff

Population and Demographics:

5a. Discuss your program's staff (PT/FT faculty, non-faculty, and classified).

Over the last six years, on average, our department has consisted of ~20 full-time faculty, 30 - 35 part time faculty, and 4 classified staff.

Of the full-time faculty, 13 teach chemistry, 1 teaches engineering and physics, and 6 teach physics. About half of the part-time faculty teach chemistry, 3 teach engineering, and the remainder teach physics.

More recently, one full-time chemistry instructor passed away unexpectedly, and two other full-time chemists have been struggling with health issues and are considering retirement. With these recent developments, soon, our department may consist of 10 full-time chemistry instructors, 1 engineering instructor and 6 physics instructors.

Our program is supported by an administrative assistant that is shared 50/50 with the Life Sciences Department, two Chemistry Laboratory Technicians, and one Physics Laboratory Technician. The Chemistry Technicians work two different shifts, morning/early afternoon and afternoon/evening.

5b. How reflective of your program's student population is your staff?

Using a snapshot of data, comparing the Fall 2023 department staff to the 2022-23 Physical Sciences student headcount, we find that the two populations are different. When comparing students to faculty, the most notable differences are in Lantine/x and White representation. The percentage of Latine/x students is 40.5% and the Latine/x faculty is 7.1%. The percentage of White students is 10.7% and the percentage of White faculty is 52.4%. Notably, this year we hired a new full-time chemistry instructor that identifies as first generation, Latine/x and she started her academic career at a community college. Her story has resonated well with her students and her perspective will be valuable useful as we look to update practices and create new curriculum. We look forward to future recruitments that will allow us to continue diversifying our faculty representation.

	% All Faculty	% Students
Asian	26.2%	12.1%
Black	4.8%	6.6%
Latine/x	7.1%	40.5%
Native Am	0.0%	0.1%
PI	0.0%	0.1%
Two or More	2.4%	4.4%
White	52.4%	10.7%
Unreported	7.1%	25.6%

Staffing Changes:

6. Discuss your program's staffing changes since the last review. How have these changes impacted your program's ability to achieve its desired student outcomes?

The department has seen four full-time faculty retirements since Fall 2016. In general, as the faculty have retired, we have been able to replace them with new full-time hires, which has minimized disruptions. In contrast, with the last six months, we have had three full time faculty go out on medical leave. One has passed away, one remains on medical leave through the end of 2024 and the third hopes to return to teaching in Fall 2024. Both faculty on medical leave plan to retire in the near future. Unfortunately, these unexpected absences have created disruptions in the continuity of instruction for the students enrolled in their classes and the departmental service workload is now being shared by fewer full-time faculty.

The 2023-2024 academic year has also been a period of great loss regarding part-time instructors. As enrollment has declined, we have been asked to scale back the number of sections being offered. This change has directly impacted the number instructional hours being taught by part-time instructors. In Fall 2016, the ratio of FT to PT instructional hours was 52.9% FT to 47.1% PT. At the start of Fall 2023, the ratio was 69.8% FT to 30.2% PT. While the department is coming much closer to the goal set in 1988 by Assembly Bill 1725 to have at least 75% of all hours of for-credit class instruction taught by full-time faculty, it comes at the cost of losing part-time faculty. Part-time faculty often taught the evening classes. As a result, we now offer fewer evening sections. Some of these faculty are also employed full-time in industry and brought a wealth of practical knowledge to the classroom.

The department continues to maintain our student outcome goals, but we have lost and continue to lose a wealth of experience when we are unable to offer assignments to our part-time faculty. As we lose full-time faculty in the department, the same level of departmental and institutional service work is being shared by fewer faculty which creates an environment that we fear will lead to burnout.

Staffing Challenges:

7a. Looking ahead to the next review period, discuss any staffing challenges you anticipate. How is your program planning to address these challenges?

Our department's administrative assistant has faithfully served both Physical Sciences and Life Sciences, 50/50, for most of her career. At the end of 2023, the Board of Trustees approved the creation of a second administrative assistant position so that both Life and Physical Sciences will each have an administrative assistant, 100%. While this is wonderful news for both departments, we anticipate that before our department's next six-year review, our administrative assistant will retire and take 40+ years of institutional knowledge with her. The College needs to work proactively to hire a second administrative assistant with enough time for our current administrative assistant to share her 40+ years of experience with the new hire.

As noted earlier, our department recently lost a full-time chemistry instructor unexpectedly. We also anticipate that at least two additional full-time chemistry instructors will retire before the next program review cycle. Starting this program review cycle with 13 full-time chemistry instructors, three of which are probationary, losing one unexpectedly, and factoring in the retirements of two others, it is of note that the Chemistry program is in the middle of a period of great change. Discussions are ongoing to determine the future of the Chemistry program and how best to support it.

In Spring 2017, the department offered two new Engineering courses, Engineering 1 and Engineering 11. Prior to this time, the only Engineering course on record was Engineering 12. Since then, three additional classes have been approved for instruction: Engr 16, 21, and 22. Additionally, our one and only, full-time engineering faculty lead the effort to build an Engineering Fabrication Lab, also known as the Maker Space. The Maker Space is set to open in Fall 2024 and will be piloted by instructors teaching Engineering 1 and Science 10. The Maker Space is located on the ground level of Drescher Hall in a space previously occupied by the automotive repair program. Presently, we plan to open the Maker Space to students during class time under the supervision of their instructor. Eventually, we hope to offer open hours for students to work on their engineering projects independently. To accomplish this goal, we hope to hire someone to staff and maintain the Maker Space as well as serve as the Engineering Lab Technician. This is a role that currently does not exist but is much needed. Presently, our full-time engineering instructor is doing the work of a lab technician. She manages stocking and ordering supplies, maintains all the engineering equipment, prepares materials and kits for all the engineering courses, and provides support to our part-time faculty when they are developing new projects. These are all tasks that a lab technician should be doing to support our instructional faculty.

As noted above, the burden of developing, running, and supporting the engineering program has fallen squarely on the shoulders of one FT engineering/physics faculty; the remainder of the courses are taught by part-time faculty. Long term, we plan to hire an engineering lab technician and a second FT engineering/physics faculty to carry more of the load to run the program.

By the end of 2024, the new Math & Science Complex will open for instruction. We are excited to move our Organic Chemistry lab classes into the new Organic Laboratory and our Physics 7, 9, and 23 courses into the new Physics – Optics lab. With the opening of the new labs we are faced with questions about how to staff the new chemistry and physics stockrooms.

The new Organic Lab will have a dedicated stockroom specifically for storing reagents needed for Organic Chemistry. Our plan is to migrate all organic chemistry reagents to the new stockroom and store all the Intro/General Chemistry reagents in the existing stockroom. Our two Chemistry Stockroom Technicians spend their day preparing reagents for the instructional labs, delivering reagents to the instructional laboratories, and being available to support students at the service window. Our Lead technician also manages the inventory and orders instructional supplies for both Physics and Chemistry. Our second technician supports our safety and equipment maintenance programs by completing monthly inspections of the lab spaces and biannual inspections of the equipment. There is very little overlap between technicians, with one working the morning/early afternoon shift and the other working the afternoon/evening shift. In addition, long term we are looking to develop a CTE programs in Applied Chemical Sciences and Environment, Health and Safety professions. The former will require that we purchase and maintain new analytical instrumentation that will likely overburden our current stockroom technicians. Given that the chemistry stockroom technicians cannot support two stockrooms at the same time, and the potential for expansions in our program, the Chemistry program would be best supported by hiring an additional stockroom technician to work part time in the Organic stockroom.

Regarding the Physics stockroom, we currently have one physics stockroom technician supporting all of the physics courses. In 2022-2023, he supported 59 sections consisting of 11 unique courses. With the additional lab space and growth in physics enrollment because of our engineering program, the Physics program would be best supported by hiring a second technician that could work part time in the new stockroom and train with our current technician, who is celebrating his 35th anniversary at the College this year.

We intend to work in collaboration with the College administration on a solution that supports both new and existing infrastructure, our students, and staff.

7b. What institutional support does your program need to address these challenges?

As outlined in the previous section, the department largely needs to maintain full-time faculty support and add to our classified staff to support our growing programs and increased footprint on campus. In an ideal situation, we would like to see the Life Science FT administrative assistant hired quickly, so that our current administrative assistant can allocate 100% of her time to supporting Physical Sciences. This will also give the new Life Science administrative assistant time to train with the current administrative assistant before she retires.

We would like a part time Chemistry Lab Technician that could support the Organic Chemistry stockroom. In the future, we could see this person support the development of CTE programs by maintaining the instrumentation for the Applied Chemical Sciences program. We need a Physics Lab Technician to support the growing Physics program and the new stockroom in the Math and Science Complex. We need an Engineering Lab Technician to support the Engineering program and Maker Space. It could make sense to hire a technician that could work

50/50 to support Physics and Engineering. The hires for the Maker Space and the organic chemistry stock room will need specialized experience. In particular the technician for the Maker Space should be someone with experience working safely with power tools and the organic chemistry technician should be someone with chemical safety training, experience in handling organic compounds, and a background in analytical instrumentation would be a bonus.

During the next round of full-time faculty hiring requests, we plan to request an additional physics/engineering full-time faculty hire as well as a full-time chemistry instructor. The physics/engineering instructor is needed to share the responsibilities of running the growing engineering program, building the program, and preserving the institutional knowledge of the program. The chemistry instructor is needed to (1) replace the loss of our long-time colleague and (2) support the chemistry program as, collectively, they innovate to attract students back to SMC to take chemistry.

8. What key elements of your department culture facilitate and impede your program's ability to achieve its desired student outcomes?

Our department has never done any sort of formal assessment to understand departmental culture. This year, in collaboration with Institutional Research, we have completed our first departmental culture survey to gather feedback. In total, 21 faculty responded (14 full-time and 7 part-time). Most of the respondents reported general satisfaction with working in the department: 57% reported either extremely or very satisfied and an additional 28.6% reported being moderately satisfied. Most faculty reported that they feel their input and opinions are valued by the department, with 61.9% reporting extremely or very valued and additional 14.3% reported moderately valued. Most faculty reported having positive interactions with department colleagues, with 71.4% reporting very or somewhat positive interactions.

When asked about various culture statements like "our department has clearly defined goals that relate to student learning and success", most respondents agreed or strongly agreed, with the average at ~60%. One statement stood out: "Department policies, practices, and procedures help to provide the best teaching, learning, and engagement for all students." Only 47.6% agreed or strongly agreed. In the open comments section of the survey, respondents noted that the department should create and/or communicate clear departmental policies, practices, and procedures to ensure the department runs effectively. Another comment included that the department should create equitable workloads by reevaluating what a "full load" means across courses. This comment is in direct response to how chemistry courses are often scheduled with multiple lecture sections meeting together to increase capacity and improve efficiency. This scheduling practice has been found to be unhelpful for student success and will be addressed in greater detail later. In summary, while many faculty feel that our department is a great place to work and their opinions and input are valued, it seems that the department needs to create space to discuss and update our policies, practices, and procedures.

Staff Support and Professional Development:

9a. Discuss how your program involves and supports its staff (classified, non-faculty, and PT/FT faculty).

Our faculty and staff are involved at all levels of planning and implementation within the department. We have two to three department meetings each semester, Fall/Spring, where classified staff, part-time faculty, and full-time faculty are invited and welcome to attend and participate. The classified staff meet monthly with the department chair, their administrative supervisor, and the Director of Safety and Risk Management to discuss ongoing concerns and projects within the department. Faculty, both part-time and full-time, have 2 – 3 program meetings each semester, Fall/Spring, to discuss timely topics related to their subdiscipline. We have our subdiscipline groups split into Chem 9/10, Chem 11/12, Chem 19/21/22/24, and Physics/Engineering.

While Chemistry is split into three separate subdiscipline groups, many of our students will take Chem 10, 11, 12, 21, 22, and 24. As a result, we often have conversations across the groups about how to better support our students and our colleagues in future pipeline classes. With declining enrollment, we have observed how starting with 41.1% less students in Chem 10 in Fall 2022 as compared to Fall 2016 has affected the rest of the chemistry pipeline: it is shrinking. As a group, we are working and supporting each other to (a) increase the number of students enrolling in Chem 10 and (b) adapt and improve instructional practices to increase success and retention so that more students move on to Chem 11 and beyond.

Physics and Engineering faculty are working in collaboration to clean and organize the physics stockroom to create space to develop new labs. While the Physics faculty do not teach Engineering, they are supporting our engineering faculty's efforts to get the Maker Space up and running for Fall 2024.

Our classified staff are instrumental in keeping our programs running. Our administrative assistant submits countless work orders for all the never-ending building issues and IT tickets for many of the full-time faculty and all the part-time faculty. She ensures that the basic infrastructure needed for instruction is functioning. Our lab technicians prepare the tools, instruments, and reagents needed for every lab that we run. When asked, our lab technicians join program meetings to discuss updates to lab preparations and procedures.

Everyone has a part to play in our department. We all make an effort to stay in communication with each other and to support each other.

9b. What roles do your program's staff play on campus and in the off-campus community?

Our faculty and classified staff serve in many capacities both on and off campus. In the appendix to this report, an extensive list of activities is provided. Our staff actively participate in both the Faculty Association and Academic Senate. Collectively, we have served on at least seven shared governance committees, seven in-department hiring committees, seven in-department probationary committees and at least four out-of-department probationary committees. Additionally, one of our full-time chemists serves at the STEM AoI Team Faculty Leader.

Many of our full-time faculty serve in leadership roles within the department as subdiscipline program leaders for Chem 9/10, Chem 11/12, Chem 19/21/22/24, and Physics/Engineering. They organize 2 – 3 meetings per semester and set priority projects for their programs. Their role is instrumental in managing a large, multi-disciplinary department such as ours.

Our department has updated our course outlines of record to include hybrid or online instruction for 17 courses, so that 19 of our 31 courses on record can be taught in either the hybrid or online format. We are in the exploratory phase of creating Career Technical Education

program(s). Two programs being explored are Applied Chemical Sciences and Environment, Health, and Safety. Upon completion of the program, students would earn a Certificate of Achievement in Applied Chemical Sciences or Environment, Health, and Safety. With a certificate in Applied Chemical Sciences, students would be able to enter the workforce in their field of study before earning a bachelor's degree. With a certificate in Environment, Health, and Safety students could upskill their degrees in chemistry, biology, or physics to become safety professionals.

During the pandemic, all of our faculty responded nimbly and learned how to provide quality instruction in Chemistry, Physics, and Engineering which required development of countless hours of video to provide instruction and replace in-lab experiences that cannot be safely completed at home. Faculty developed new materials for effective assessment in an online environment and, in some cases, innovative at-home labs using household items.

Seven full time faculty have mentored students as club advisors to five different clubs including Astronomy Club, Chemistry Club, Engineering Club, Robotics Club, and the National Society of Collegiate Scholars club.

Eight full time faculty have completed, or are on track to complete training in the NSF-Equity Program - Fostering an Equity-minded Student Success Culture in STEM Through Faculty Development. One of our faculty served as a Co-PI on the grant and two faculty served as equity coaches in the program.

Two full-time faculty served as equity coaches to our department for the two-year Equitizing Gateway Courses program. In total, 6 full time faculty and 4 part time faculty participated in the EGC program.

Counting participation in both the NSF-Equity program and the EGC program, 12 of our 22 full-time faculty have participated or will participate soon in at least one of these major equity training programs.

Seven faculty reported participating in various training workshops including the SMC Online Teaching and Design for Canvas course, the Teaching Men of Color course, as well as other equity and online teaching workshops.

Our faculty have published several scientific articles in peer reviewed journals and presented at conferences like NCORE, the American Chemical Society, and the American Association of Physics Teachers meetings. At least 6 of our full-time faculty are members of the American Chemical Society, at least 2 full-time faculty are members of the American Association of Physics, and our one full-time engineering faculty regularly participates in the California Engineering Laison Council. Forouzan Faridian is currently the Chair of the American Association of Physics Teachers' Committee on Physics in Two-Year colleges and Tram Dang is planning to host the Spring 2024 California Engineering Laison Council meeting at SMC.

Sehat Nauli has served as a judge for the prestigious Regeneron International Science and Engineering Fair and Jamey Anderson collaborated on the NSF INCLUDES grant with faculty at UCLA to diversify the professoriate for STEM faculty and Community College faculty.

In summary, our staff are very engaged in departmental work, institutional work, and participate in their respective professional organizations.

9c. Discuss how your staff's professional activities since the last review period have positively impacted your program.

As was noted in the previous section, our faculty and staff are engaged in a wide variety of activities throughout the College. We have a wealth of leadership and support within the department to lead and engage in constructive conversation about our students, courses, programs, and policies. We have staff representing our department and our perspective as a STEM program on campus. It is worth acknowledging that our students' experiences in college can be quite different from non-STEM students. With this in mind, our staff advocate for our students and our programs at the College level. In return, our staff bring back a wealth of knowledge about how other parts of campus operate. By participating at regional and national meetings, either by attending or presenting, our staff make connections with other institutions, stay current in their subject area, and learn new approaches to instruction, all of which are incredibly valuable to keeping our programs in Physical Sciences current and relevant.

9d. What additional areas of professional development and trainings are needed for your staff?

Enrollment in Physical Sciences has declined at a faster rate than the College (College: (-19.6%), Department (-31.0%)). General Education courses, like Physics 12 and 14, have experienced a significant drop from running four sections every Fall in 2016 to barely filling one section in Fall 2022. While enrollment in Chemistry 9 has remained steady, we observed that the international student demographic dropped from 56.7% in Fall 2016 and to 10.5% in Fall 2022. Presumably, we have lost a significant number of students that used to take Physics to some other science GE course. As the international student population returns to SMC, ideally, we should see an increase in international students enrolling in Chem 9, which should result in a net gain of students. We believe that in both scenarios a coordinated public relations effort is needed to bring students back to Physics 12/14 and Chem 9.

The department needs data on current student interests to target our GE courses to be more attractive to students. The department also needs support with marketing and public relations strategies. In our history, we have never needed to promote or market our classes and we could benefit from some training. Social media could be a valuable tool in connecting with our current and future students and training to use it effectively to market our programs would be beneficial.

The department is also looking at ways to update our curriculum to be more student centered and targeted towards the majors our students are pursuing. In the next six years, we plan to explore the possibility of designing a new series of courses specifically for biology majors, in collaboration with the Life Sciences Department. The first step in this process will be to evaluate its practicality and viability. The ability for our faculty to attend local conferences, meetings, and trainings to learn and network with faculty teaching the similar courses at other institutions would an important component in our exploratory phase.

Several of our Physics faculty are very involved in the American Association of Physics Teachers, where they meet regularly throughout the year to discuss trends, current and evolving approaches to instruction, and new curriculum materials. Support for more faculty to participate in these meetings would be beneficial to our ongoing effort to update the physics lab curriculum.

In collaboration with the College's Director of Safety and Risk Management, Daniel Phillips, and the Department of Life Sciences, we are in the early stages of developing a comprehensive safety program for our laboratories. Our departments use some of the highest risk materials on campus, but collectively, we do not feel adequately trained in safety to fully understand the hazards of the materials we work with. We are committed to building a robust safety program that includes regular training and routine inspections and audits, but this project will take time, effort, and training to create good safety culture and develop the formalized infrastructure needed to make the program self-sustaining.

If applicable:

10a. In what professional organizations does your program's staff participate?

Many of our faculty are members of the (6+ FT faculty) American Chemical Society, the (2+ FT faculty) American Association of Physics, and the (1 FT faculty) California Engineering Laison Council.

10b. Discuss your staff's grant-funded research and projects.

Tram Dang, our FT Engineering faculty person, has been involved in a number of grants in the last six years, including:

- NSF Equity Grant Co-PI and coach (2020- present)
- Teagle Grant PI (2019-2023)
- Office of Naval Research Grant Co-I (2018-2022)
- NASA MUREP M3CI Grant Co-I (2015-18)

10c. Discuss your program's partnerships with regional educational institutions.

n/a

10d. Discuss your program's industry partnerships and relationships.

n/a

10e. Discuss how your faculty are upskilled to address industry and/or curricular changes.

As a result of the pandemic, most of our staff had no choice by to upskill and they did it well. Everyone in our department is proficient at using Zoom, many faculty have learned best practices for online instruction. Faculty completed basic and advanced training on using Canvas effectively.

10f. Provide your program's advisory board membership and meeting dates since the last review period.

n/a

D. Curriculum, Courses, and Scheduling

11. Analyze your program's enrollment trends disaggregated by modality and other course attributes. Reflect on the extent to which your current course offerings and class scheduling practices maximize student success. Include any evidence to support your points. Discuss any changes your department plans to better respond to students' needs.

Declining enrollment

Overall, department enrollment has declined significantly from a total headcount in Fall 2017 of 2,461 to 1,697 in Fall 2023. This represents a 31.0% decrease in enrollment over the six-year period. As noted earlier, our department is composed of three unique disciplines, Chemistry, Engineering, and Physics. In the table below, overall enrollment has been disaggregated by discipline. Both Chemistry and Physics have experienced significantly larger decreases in an enrollment than the College. Notably, all three disciplines appear to be on the rebound, with a 3.7% increase in enrollment in Chemistry, 6.4% increase in Engineering, and a 7.0% increase in Physics.

Fall	2017	2018	2019	2020	2021	2022	2023	% Change	Rebound
College	33,302	32,567	31,492	29,334	26,784	25,516	26,762	-19.6%	4.9%
Department	2,461	2,488	2,400	2,472	2,142	1,640	1,697	-31.0%	3.5%
Chemistry	1,827	1,870	1,755	1,763	1,547	1,165	1,208	-33.9%	3.7%
Engineering	80	77	98	100	96	94	100	25.0%	6.4%
Physics	681	671	672	720	619	446	477	-30.0%	7.0%

% Change represents the overall change from 2017 to 2023

Rebound represents the increase in enrollment from Fall 2022 to Fall 2023

In the interest of determining if SMC Physical Sciences is alone in experiencing a decline in an enrollment, data on gateway courses were collected from two neighboring colleges that had outward facing section and seat cap data available. Below, we present data from Pasadena City College and LA Pierce College. The gateway courses were Introductory Chemistry (Chem 10), General, Organic, and Biological Chemistry (Chem 19) and Calculus Based Physics for Engineers and Scientists (Physics 21).

Chemistry 10 is the first class that students take in preparation for most STEM majors. Chemistry 19 is the first class students take in preparation for nursing and allied health majors and was first offered in Fall 2016. Since it's launch, Chem 19 has grown significantly. Chem 19 started with two sections and 56 seats available. By Fall 2023, we offered eight sections with 448 seats available. Prior to offering Chemistry 19, nursing and allied health students took Chem 10. As such, we believe that some of the Chem 10 enrollment decline is due to

students opting to take Chem 19 instead. As a result, the Chem 10 and Chem 19 seats available are combined to evaluate overall change in our chemistry gateway courses compared to other colleges. Physics 21 is the first in a series of physics classes that physics, engineering, and chemistry majors all must take for degree requirements.

Seats available in Introductory Chemistry (Chem 10) + General, Organic, and Biological Chemistry (Chem 19), Fall 2017 - Fall 2023

Fall	2017	2018	2019	2020	2021	2022	2023	% Change
SMC	924	980	1008	952	896	756	648	-29.9%
PCC	594	594	675	678	600	675	702	18.2%
Pierce	360	400	420	440	480	420	440	22.2%

Seats available in Calculus Based Physics for Engineers and Scientists (Physics 21), Fall 2017 - Fall 2023

Fall	2017	2018	2019	2020	2021	2022	2023	% Change
SMC	140	168	168	196	196	196	224	60.0%
PCC	192	192	216	252	140	252	224	16.7%
Pierce	40	40	40	40	40	60	60	50.0%

Interestingly, SMC appears to be unique in trending downward in enrollment for gateway Chemistry classes, but not for Calculus Based Physics for Engineers and Scientist (Physics 21).

Regarding Chemistry, PCC now offers more seats for the entry level chemistry classes than SMC. Additionally, both PCC and Pierce have seen approximately 20% increases in number of seats offered, while SMC offers 29.9% less seats than in Fall 2017. This might suggest that students who would have previously enrolled at SMC are now enrolling elsewhere in response to several factors including those related to the rising cost of living and long commutes. Anecdotally, students often share that they commute 1 – 2 hours each way to SMC using public transit or unreliable vehicles. If students have realized that they can get an equivalent educational experience closer to home, it's an easy choice to enroll at PCC or Pierce, avoid the 101/405 freeway traffic, and save money by minimizing commuting expenses. Since Chem 10 serves as prerequisite to Chem 11 and Physiology 3 and Chem 11 serves at the prerequisite to Chem 12 and Bio 21, the many of the STEM pathways are affected by the 30.0% decrease in Chem 10 enrollment. In total, enrollment and success in Chem 10 directly affects enrollment in Chem 11, 12, 21, 22, 24, Biology 21 and Physiology 3.

It is of note that while Physics enrollment as a discipline has experienced a 30.0% decrease in enrollment, Calculus Based Physics for Engineers and Scientists has experienced tremendous growth from Fall 2017 to Fall 2023. This is likely due the College's investment in our Engineering program and financial support from the Department of Education STEM grants that have funded the STEM Program and development of the Engineering program over the last 13 years. As mentioned in previous sections of this report, our first full-time engineering faculty started teaching in Fall 2015. At the time, we only had one engineering course on record: Engineering 12. Today, we have a total of six engineering courses on record and we offer five of them every Fall and Spring. These courses are the first to fill during enrollment season and our Calculus Based Physics sequence (Physics 21 – 24) greatly benefits from students enrolling at SMC for our Engineering program. While SMC, PCC, and Pierce all appear to be growing in enrollment, SMC appears to serve significantly more students than Pierce and about as many students as PCC.

To explain the overall decline in enrollment within Physics that is inconsistent with the significant growth of Physics 21, it is worth looking at the non-majors GE courses: Physics 12 and Physics 14. Physics 12 is a lecture only, non-majors survey course. Physics 14 is a lecture and lab, non-majors survey course. Combined, the department served 138 students in Fall 2017, but only 48 students in Fall 2023. This represents a 65.2% loss. It is not clear why students have lost interest in taking Physics for their GE requirement, but it has created an opportunity for the physics faculty to reimagine them to be more exciting for non-STEM students.

Total headcount in Non-Majors Physics, Fall 2017 - Fall 2023

Fall	2017	2018	2019	2020	2021	2022	2023	% Change
Physics 12	50	83	63	50	47	28	22	-56.0%
Physics 14	88	89	99	104	68	13	26	-70.5%
Total	138	172	162	154	115	41	48	-65.2%

Chemistry scheduling modality

With fewer students enrolled in Chem 10, and the rest of the chemistry pathway depending on students succeeding in Chem 10, success rates become critical for the overall health of the chemistry program. The average success rate in Chem 10 has hovered around 50%, from Fall 2017 to Fall 2023, with Fall 2021 excluded from the calculation because the "excused withdrawal" policy significantly inflated success rates. Most recently, the Chem 10 success rate was 48% in Spring 2023 and 50% in Fall 2023.

Interestingly, due to enrollment decline, more of our Chem 10 classes are being offered as single section lecture meetings and preliminary data suggests that single section meetings are better for success. Historically, in Chem 10, to meet student enrollment demand and room availability, we have needed to schedule two sections to meet for lecture together and then they split up into single sections for lab meetings. We call these double sections. In the double section lecture meetings, a total of 56 students will meet together. In contrast, a single section lecture meeting will max out at 28 students because our labs have a seat cap of 28. In both Spring 2023 and Fall 2023, a few instructors have taught both a double section lecture and a single section lecture, often on the same day, using the same lecture materials and very similar exams. Essentially, the double section lecture could be thought of as the control group and the single section lecture is the test group. Comparing the control group to the test group, the success rate for the single section lecture modality is 8.1% higher than that of the double section lecture modality.

Chemistry 10 Success and Retention by Lecture Modality

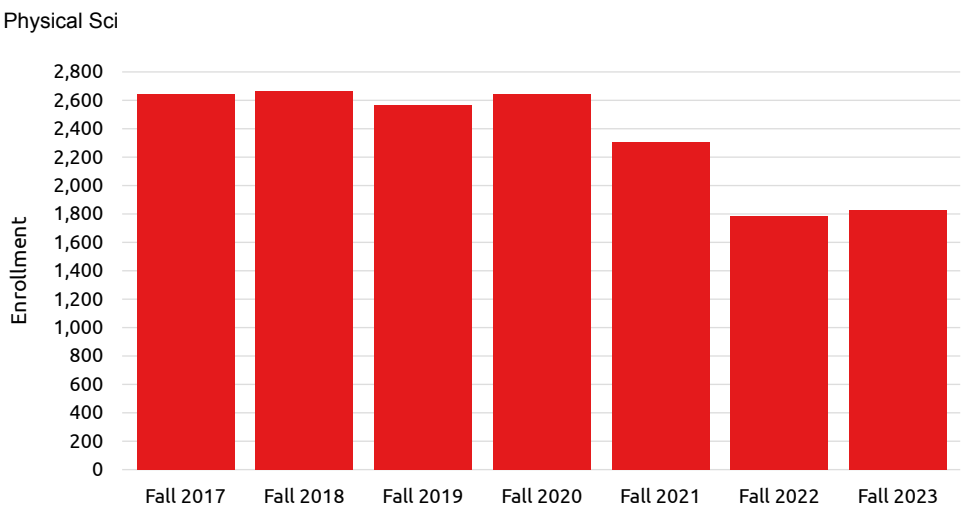
	Total Students	Students Retained	Students succeeding	% Success	% Retention
Single Section Modali	94	63	40	42.6%	67.0%
Double Section Moda	197	139	68	34.5%	70.6%
Total	291	202	108	37.1%	69.4%

Of note, while investigating PCC and Pierce, both colleges primarily offer the single section lecture modality for their Introductory Chemistry courses, with seat caps set at 27 and 20, respectively. Pierce keeps all of their chemistry sections capped at 20 seats. PCC caps their Chem 19 equivalent at 27 seats, their Chem 11 and 12 equivalents at 24 seats, and Chem 21 and 22/24 equivalents at 21 seats. Additionally, at SMC, most Physics and Life Science classes with labs are scheduled as single section lectures with a 28 seat cap for Physics, 24 seats in Microbiology, and 32 seats for Cell Biology (Biol 21). It is not surprising that the lower instructor to student ratio in a single section allows instructors to give more individualized attention. As mentioned before, Chem 10 is a math intensive course and due to AB 705/1705, fewer students are math ready than they used to be. With fewer students in the classroom, instructors can give students in class work to support their math and quantitative reasoning skills and have the capacity to connect with a greater percentage of their students when the seat cap is lower. With this in mind, the chemistry faculty have agreed that in future semesters, as the schedule allows, single section lectures will be prioritized in the schedule for Chem 10 and other Chemistry courses that would benefit from higher success rates.

Online/hybrid modalities

Prior to the pandemic, Physical Sciences did not offer online or hybrid versions of our courses. After spending time teaching online because of the pandemic, the department sought Curriculum approval to offer some classes as either hybrid or online. As it stands right now, lab meetings must remain in person for all non-GE courses because many of the local universities will only continue to accept our courses if the labs are taught in person. As such, all non-GE classes are offered as on-ground or hybrid, only. In Fall 2023, we offered 4 online sections, 13 hybrid sections, and 61 on-ground sections. With only a few semesters of data to analyze, it is too soon to determine if hybrid modality for non-GE courses is yielding comparable success rates relative to the on-ground sections. We will continue monitoring success in the hybrid modality.

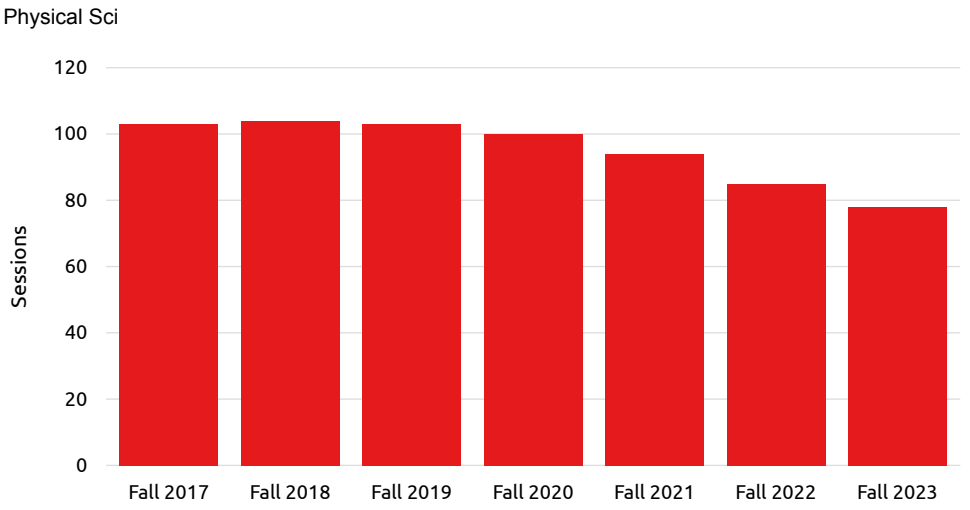
Course Enrollment



Measures: Enrollment

	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023
Measures	2,643	2,666	2,568	2,645	2,304	1,782	1,830

Section Offerings



Measures: Sessions

	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023
Measures	103	104	103	100	94	85	78

12. What institutional support do you need to create a more equity-minded and student-centered curriculum, course offerings, and class schedules?

Enrollment Data

In order to create a more student-centered schedule, we need more data. Currently, we schedule classes using historical data from the previous academic year. For example, we offered six sections of Chem 12 in Spring 2023 with a fill rate of 73%. We were encouraged to cut our section offerings to four sections in Spring 2024, to match the headcount from the previous year. However, this sort of planning does not factor in the possibility that enrollment overall is on the rebound, nor does it account for the fact that enrollment could be higher if classes were scheduled more strategically. In fact, 15 days after enrollment started for Spring 2024, all four sections of Chem 12 were full and the department requested that a fifth section be opened. This additional section was full on the first day of Spring 2024. The fundamental issue with the current scheduling strategy of starting the schedule lean and adding sections back is that by the time we are able add sections back, students have already found the course they needed somewhere else; not at SMC.

Additionally, students will often take two to three STEM classes in a semester and these classes will compete for the same time slot in the schedule. So, despite having an education plan where students are planning to take Chem 11 and Math 7, they may have to pause one of those classes because they are offered at the same time. This issue has become increasingly prevalent as we have reduced the number of sections of each course being offered.

The College recently invested in the dynamic enrollment management and scheduling platform Stellic, which if used as demonstrated to interested parties last year, department chairs would have the data they need to schedule the correct number of classes at optimal times to meet student need. The platform has the potential to be transformative and our hope is that enrollment services will include academic affairs and the department chairs in the pilot program to determine if we could truly build student centered course schedules.

Math readiness and support

While building a student-centered schedule will allow students to get into the classes they need, the next layer of the puzzle to address is increasing retention and success. To address retention and success, faculty need additional support. As noted earlier in question 3, the demographics of our students starting out in the entry-level courses has shifted. Due to changes in Math because of AB 705/1705, students can no longer take basic skills math courses like Math 31, which has served as the prerequisite to Chem 10. While we are unable to track the number of students that are enrolled in Chem 10 without the desired level of math readiness, we can show that in 2019-2020 62.0% of Chem 10 students had not completed at math course at SMC before enrolling and that number rose to 74.3% in 2022-2023 (not including Spring). In 2019-2020, the Chem 10 success rate was 63.0% for students that had previously taken a math class at SMC and 60.0% if they had not taken a math class. In contrast, in 2022-2023 (not including Spring) 61.3% of students succeeded if they had taken a math class, but only 51.3% of students succeeded while not having taken a math class prior to Chem 10 enrollment.

Course Success Rate in CHEM 10 by Math Completion Status x Academic Year

	Completed Math - Yes				Did Not Complete Math			
CHEM 10 Course Success Rate	Success	Non-Success	Total Enrolled**	% Success Rate	Success	Non-Success	Total Enrolled**	% Success Rate
2019-2020	272	160	432	63.0%	438	292	730	60.0%
2020-2021	353	138	491	71.9%	457	297	754	60.6%
2021-2022	213	92	305	69.8%	382	215	597	64.0%
2022-2023 (no Spring 2023)	92	58	150	61.3%	223	212	435	51.3%
Total	930	448	1378	67.5%	1500	1016	2516	59.6%

*Success grades include A, B, C, and P
**Excludes EW grades

Presently, students can start their math sequence at Math 2: Precalculus, either taking just the course or the course plus additional support. In Fall 2017, the success rate for Math 2 was 48%. In Fall 2023, the success rate was lower, at 41%. In Chem 10, 19, 11, and 12, instructors all note anecdotally that student students are struggling with quantitative reasoning skills and ability to perform basic algebraic functions. Unfortunately, we no longer have the option to suggest completing the Math prerequisites for our Chemistry courses. Additionally, in Fall 2025, the Math department will no longer be able to offer Math 2, 3, or 4. As such, the College no longer has the ability to offer our STEM students the option to refresh or outright learn the math skills necessary to succeed in our chemistry classes and engineering 11. While most high schools offer algebra, geometry, and precalculus, unfortunately, not all students take and pass these classes. Without the option to take these classes after high school, entering Math 7: Calculus 1 is a daunting challenge, which will likely lead to lower enrollment in Math 7 and 8, leading to a direct impact on enrollment and success in our Physics and Engineering classes. In the table below, we list the math prerequisites for each of the courses we offer in Physical Sciences. While Math 7 and 15 will still be available after Fall 2025, the lack of preparatory classes like Math 2/3/4 will affect students attempting Math 7 and succeeding in Math 7. Ultimately, this policy change will likely affect the remainder of our higher level courses, including Engr 12, 21, 22 and Physics 21 – 24.

Physical Science Course with Math Prerequisites

Course	Math Prerequisite	Available
Chem 10	Math 31 or 49	No longer available
Chem 11	Math 20	No longer available
Chem 12	Math 2 or Math 3+4	Will sunset Fall 2025
Chem 19	Math 31 or 50	No longer available
Engineering 11	Math 2 or Math 3+4	Will sunset Fall 2025
Engineering 12	Math 7	
Engineering 21	Math 15	
Physics 21	Math 7	
Physics 22	Math 8	
Physics 23	Math 8	
Physics 24	Math 8	

It has become clear that Physical Sciences and Math need to work together to support our students quantitative reasoning and math skills creatively. One idea is to utilize noncredit courses to create “math and quantitative reasoning for chemistry” and “math and quantitative reasoning for physics/engineering” classes that students can enroll if they recognize that they need additional support.

Another option would be to create a support course that would run concurrently with classes like Chem 10, which have notoriously low success rates. In past years, some Chem 10 faculty have had success running a Chem 10 Bootcamp that provides additional practice, instruction, and support for students that voluntarily participate in the Bootcamp sessions. The program has been difficult to sustain because it relies on faculty to meet with a classroom full of students for 3 – 4 hours every week in addition to their contract load and office hour requirements. While some students are able to make it to these 3 – 4 hour sessions, it's voluntary and many will opt out of attending for various reasons, despite how good it can be for their success.

Improved student to instructor ratios

As mentioned in the previous section, scheduling more of our classes with a lower instructor to student ratios has already shown increases in student success. It would be helpful for the College to support scheduling more single section modality courses in Chemistry, which will require additional weekly teacher hours.

New program development

Finally, to address significant declining enrollment in the Chemistry pathway, Chem 10, 11, 12, 21, 22/14, as well as the department, we are exploring ways to attract students come back to SMC. Our department needs career centered programs, similar Engineering, that will draw students to SMC for STEM. Ideas that we are considering include exploring CTE certificates in areas like Applied Chemical Sciences, Water Technology, and Environment, Health, and Safety. There is also interest in exploring and collaborating with the Education and Early Childhood Development Department to create certificates for TK-6 educators to become proficient at teaching science in their classrooms. Our hope is that if better science curriculum is taught in TK-6, students will more seriously entertain STEM career pathways in high school and college. Finally, in collaboration with the Life Science Department, we will explore a new chemistry sequence to support life science majors, where the number of chemistry courses is reduced, and the content is centered on topics needed to support understanding life science topics. A similar sequence is offered at UCLA (Chem 14a - 14d). All these efforts will require significant support from the College. At a minimum, we ask that the College support our exploration and development of these courses by serving as the "snow plow" team, helping us remove unnecessary barriers to develop and bring these courses online. Often, our colleagues report that the most challenging part of developing new programs is the red tape at the administrative level. In an ideal world, the College would support our department by providing release time for faculty to dedicate more of their time during the semester to create new courses, certificates, and programs. Additionally, this type of work is often carried out by full-time faculty. With the recent loss of a full-time chemistry instructor due to his unexpected passing, as well as a few retirements on the horizon, we ask that the College continue to support our department by maintaining our current full-time instructional staffing numbers.

13. Document any substantial changes to your program curriculum since the last review and discuss what prompted these changes. Looking forward, what changes to the curriculum do you plan based on the emerging needs of your discipline, industry, student population, etc.

In 2016, four new engineering classes were approved for instruction: Engineering 1, 11, 21, and 22. In 2020, Engineering 16 was also approved for instruction. These classes were added to our curriculum to support our growing Engineering program. In Fall 2019, as reported in the previous 2019-2020 Program Review, all of our Course Outlines of Record were updated to reassign lecture and laboratory time so that the calculated course units match the Carnegie units listed in the COR. The Chem 12 COR was also updated to include coordination chemistry and nuclear chemistry. These updates were made to obtain C-ID's or Course Identification Numbers so that the General Chemistry series, Chem 11 and 12, can satisfy the chemistry requirement for the associate degree for transfer in Geology. The CID's requests were approved in 2022.

As a result of the pandemic and experiencing online instruction, we submitted several courses to be approved for online or hybrid instruction. These included Chem 9 (online or hybrid), Chem 10 (hybrid, only), and all of the Physics classes for hybrid instruction. Physics 12 and 20 are approved for online instruction. Engineering 1 and 21 are approved for online instruction.

Looking to the future, the department is in the exploratory phase of identifying new courses to offer to meet the emerging needs of industry. At a recent presentation cohosted by SMC Career Services and the Department of Physical Sciences, Laboratories and Scientific Services, the scientific, technical, and forensic arm of Customs and Border Protection reported that they are looking to expand their team of scientists from ~300 employees to nearly 500 in the next few years. At another presentation, hosted at El Camino College by the West Basin Municipal Water District, it was reported that the water industry anticipates mass hiring over the next 10 to 15 years due to needing to replace their aging workforce.

E. Evaluation, Effectiveness, and Equity:

Course Success and Retention: Indicate your program's chosen level of analyses for the review (choose one):

Gateway Course(s)

14a. Analyze your program's course success and retention against your program's institution-set standards (minimum threshold) and improvement goals. Discuss any significant changes/trends over time. Include your program's plans to improve course success and retention.

In this section, the report will focus on Gateway courses. In Chemistry, those include Chemistry 10 and Chemistry 19. In Physics those include Physics 6, 8, and 21.

Chemistry 10 serves as the first course in the STEM majors sequence of chemistry courses. Often students will go on to take Chemistry 11, 12, 21, 22, and 24 after completing Chemistry 10. Chemistry 10 is intended to be a preparatory course.

Chemistry 19, first offered in Fall 2016, is intended as the first and only chemistry course taken by students interested in pursuing allied health professions like nursing or respiratory therapy. The course covers general, organic, and biological chemistry. Prior to offering Chemistry 19, students would often complete the full chemistry sequence, Chem 10 through Chem 31, to satisfy their prerequisites. We anticipated that as Chem 19 gained traction in our department, Chem 10 enrollment would decline as this student population shifted into a more appropriate course. Indeed, Chem 10 enrollment did decline as Chem 19 enrollment increased.

Physics 6 is the first class in a two semester, algebra and trigonometry based, physics sequence. This class is often taken by life science majors that do not need calculus-based physics.

Physics 8 is the first class in a two semester, calculus-based physics sequence. This class is often taken by pre-med students that need a year of calculus-based physics for their medical school applications.

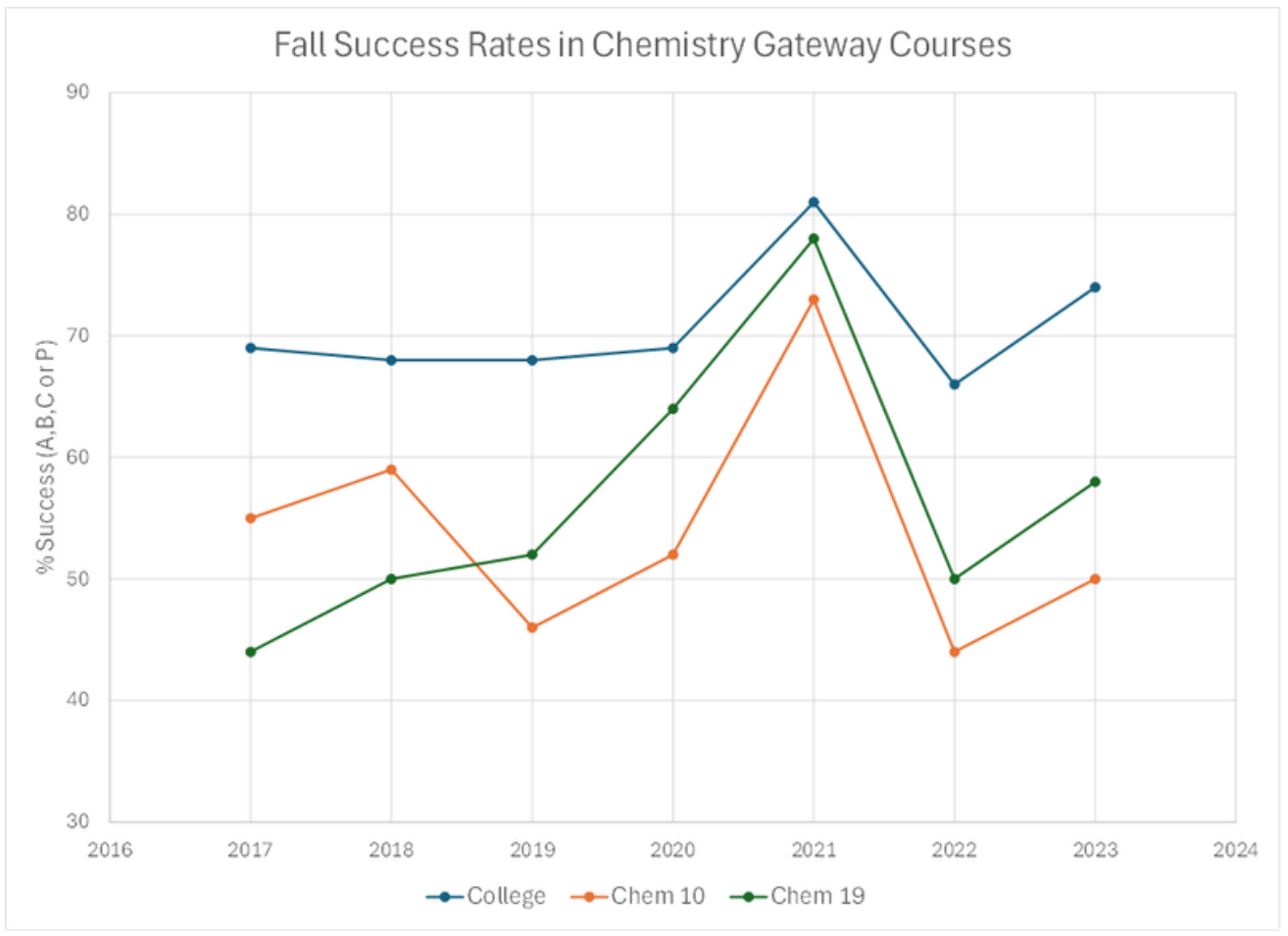
Physics 21 is the first class in a four semester, calculus-based physics sequence. This class is taken primarily by physics and engineering majors that require an in-depth calculus treatment of physics concepts.

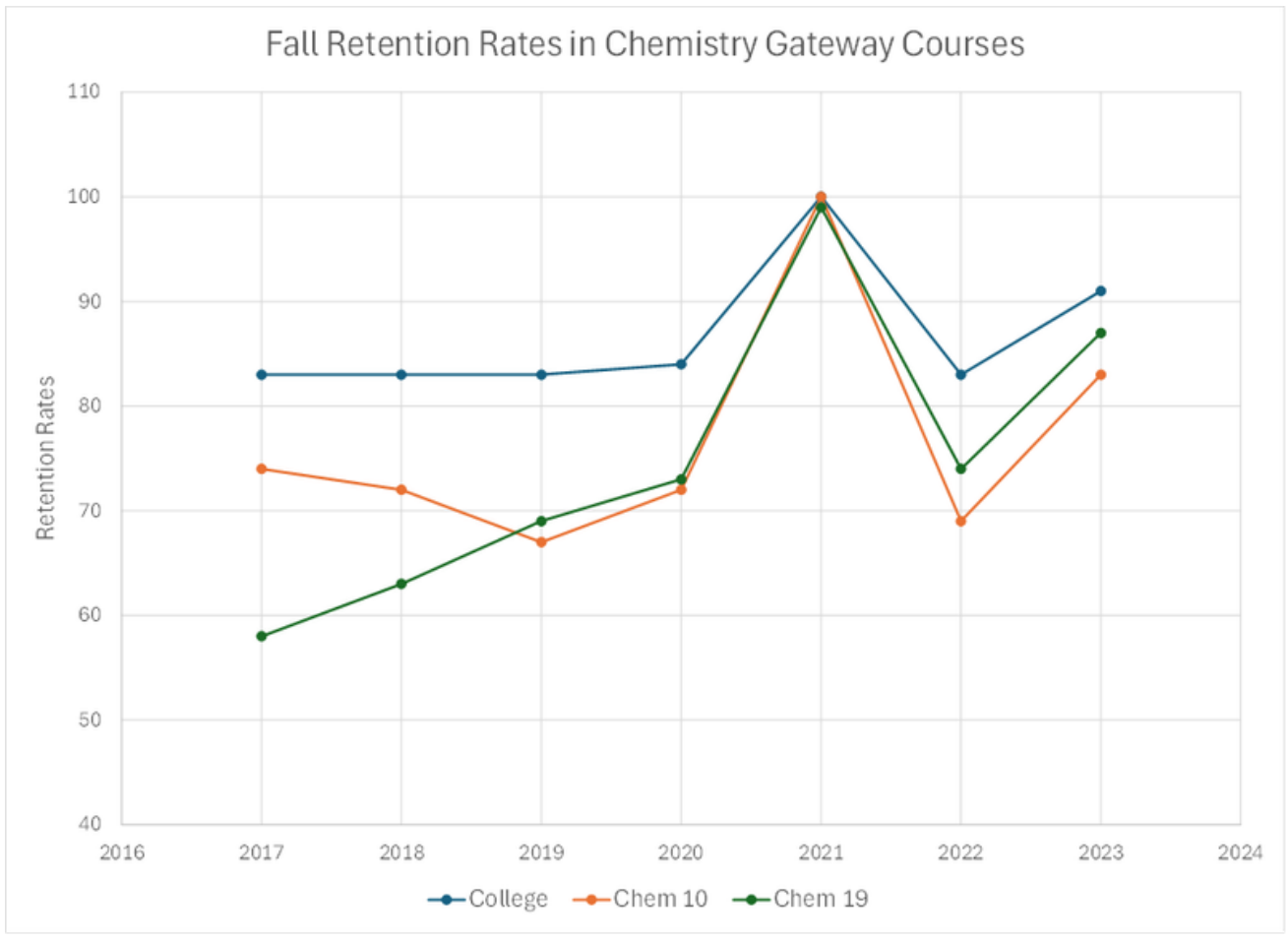
Chemistry

Looking at success and retention in Chem 10 and Chem 19, the overall trend seems to follow the same pattern as the College from Fall 2020 and beyond, albeit at a lower rate. From Fall 2017 to Fall 2019, Chem 19 success and retention rates climbed as the course became more established. In Fall 2021, rates were exceptionally high because of the EW policy which artificially increased success and retention rates. In Fall 2022, success and retention rates dropped to pre-pandemic levels, or slightly lower, as our classes returned to in-person instruction. Then, they appear to be on the rebound with both success and retention rates sitting higher in Fall 2023 than Fall 2019. Notably, retention rates in both Chem 10 and Chem 19 are higher than the have ever been in the review period and beyond. We speculate that this may be due the many efforts on campus, including those of the instructors and support programs, like the STEM program, to make students feel welcome and that they belong in our classes.

Interestingly, success rates in Chem 10 dropped notably in Fall 2019. This happens to coincide with the rollout of AB 705/1705 in Math, which meant that students could self-place out of basic skills math courses and directly into Math 2, 3/4. Within a short time after Fall 2019, basic skills math courses were no longer offered at SMC because of AB 705/1705. The prerequisite for Chem 10 is Math 31: Elementary Algebra. Students entering Chem 10 are expected to have basic algebra skills mastered and without taking Math 31, many of these students are not math ready to succeed in chemistry. We suspect that the change in math policy adversely affected student success in Fall 2019 and beyond.

During the pandemic, success rates rose even in semesters when EW's were not applied automatically, like in Fall 2020. This is likely due to how difficult it is to write a chemistry exam that adequately assesses student comprehension when it is incredibly easy to search out the answers on the internet during remote instruction. This is why after returning to in-person instruction, all Physical Science exams are administered in person for most of our classes. Only Chem 9, Physics 12, Engineering 1, and Engineering 21 are authorized for online instruction and permitted to use online assessments.





With lower than “College” level success rates in Chem 10 and Chem 19, it is imperative that we continue to invest in support services for this demographic. There are several resources that beginning chemistry students benefit from once they know they exist: namely the Learning Resource Center (LRC) and the STEM program. The LRC serves as a central hub for STEM tutoring and well as providing access to chemistry model kits and computers. The space is always busy and savvy students will tap into these free resources right away. Both Chem 10 and 19 students benefit from regularly using the LRC. The STEM program is another incredible resource for STEM students, including Chem 10, but unfortunately not Chem 19. Since the STEM program is funded by the Department of Education for supporting student success in STEM related fields but not nursing or allied health programs. As such, the STEM program is not able to fund support resources for Chem 19.

Chem 10 students benefit from the wraparound support from tutoring, Supplemental Instruction, peer navigators, academic counselors, a dedicated psychotherapist, and all the professional development workshops hosted by the program. All these resources continue to improve our students’ sense of belonging in STEM and likely contributes to the improvements we observe in Chem 10 retention. The current program is funded by a grant set to expire in 2026 and we hope to work with the College to find alternative funding solutions to maintain the program as it currently operates. Additionally, allied health students would greatly benefit from having a similar support system custom designed for their unique experiences and challenges. We hope to work with the College and other departments that support allied health students to identify a way to create a similar program for students in the Health and Wellness AoI.

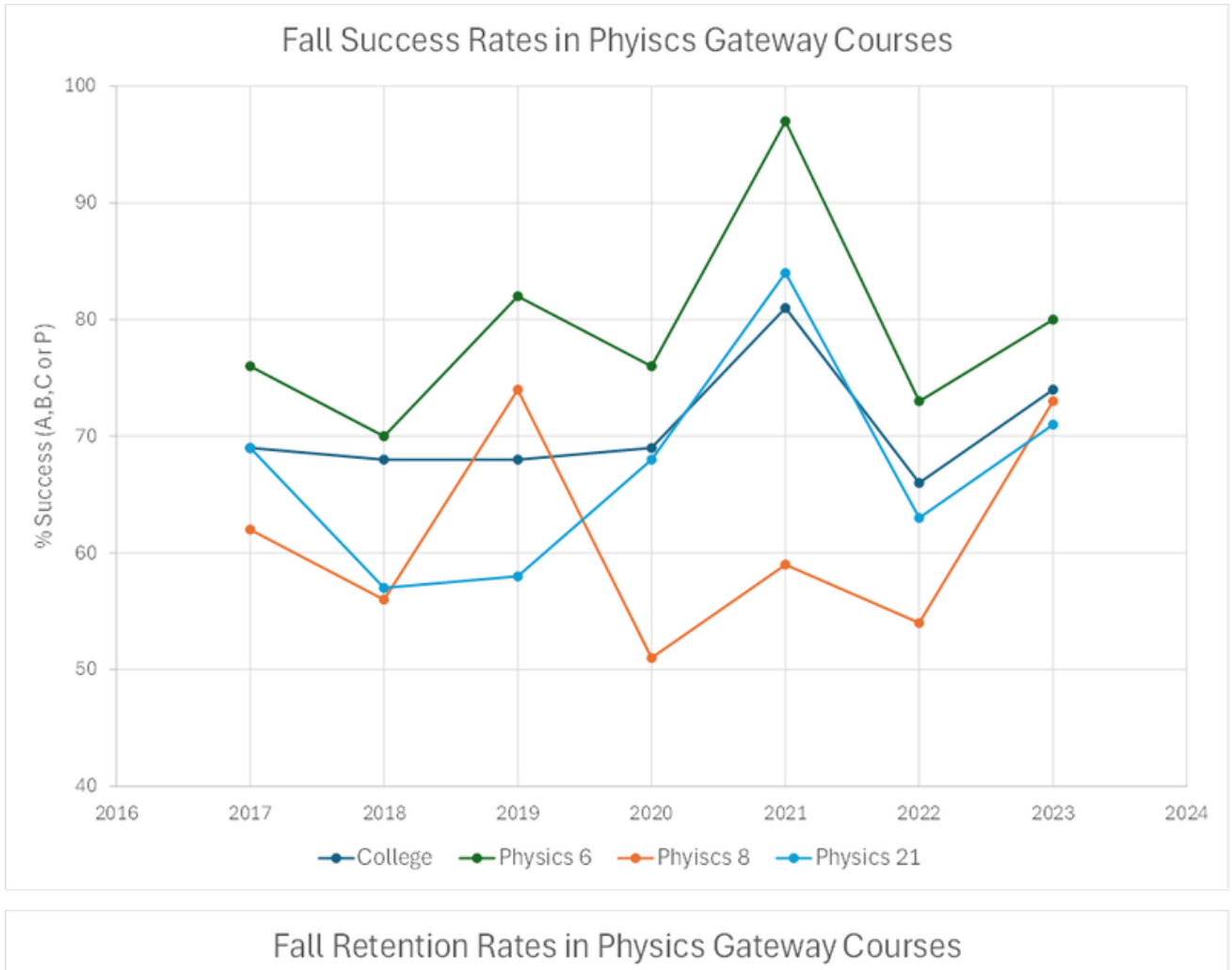
Beyond the wraparound support services, students in Chem 10 and Chem 19 struggle with their math skills. Given that the Math department is no longer able to offer Math 31 or the other prerequisite math courses (Math 20 and soon Math 2/3/4), our department will collaborate with the Math department to explore developing courses to support student math-readiness. One option would be to develop non-credit math courses for “math readiness in chemistry” or to develop a more holistic support course to run concurrently with Chem 10 and Chem 19.

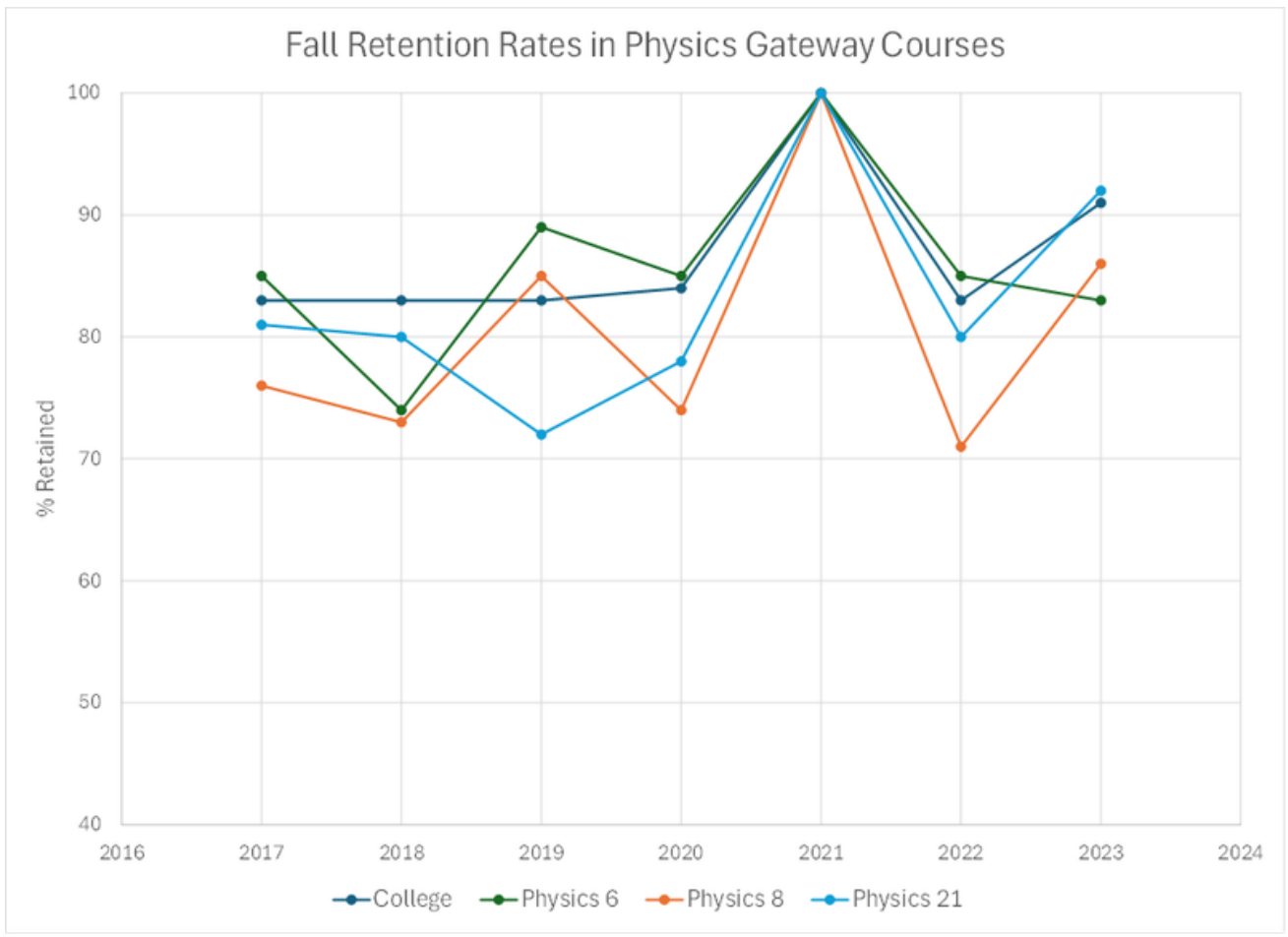
In our 2019-2020 program review, we described how some Chem 10 faculty had success using the Chem 10 Bootcamp model where students are given access to additional practice, instruction, and support. The program has been difficult to sustain because it relies on faculty to meet with students 3 – 4 hours per week, in addition to their contract load and office hour requirements, which can lead to burnout. Once the main instructor running Bootcamp had to step away from running the program, it was no longer offered due to the issues described. Foreseeably, this model could be developed into formal curricula for Chem 10 and Chem 19 and offered as non-credit concurrent enrollment support courses that focus on math readiness, effective study skills, growth mindset, and ample time for practice and instruction. By offering this support as a course that could be included as part of the faculty load, it would alleviate the workload issues. By offering the support as a course, students would unknowingly be carving out more time for study.

Whether the Chem 10 and Chem 19 programs decide to pursue a math-readiness course or a support course, it will be critical to collaborate with academic counselors to recommend that students enroll in both the main course and the noncredit course so that students dedicate time in their schedule get the support they need to succeed in Chem 10/19.

Physics

Looking at success and retention for the three gateway physics courses, 6, 8, and 21, all three seem to mirror the success rate pattern observed at the College level from Fall 2020 to Fall 2023, although Physics 6 has higher success rates than the College, Physics 21 closely matches the College, and Physics 8 is below the College. Retention rates for Physics 6 are very similar to the College for Fall 2020 – Fall 2023, but decline for Fall 2023. Retention rates for Physics 8 follow the College’s pattern but are noticeably lower throughout Fall 2020 – Fall 2023. Physics 21 retention rates start out lower than the College rates in Fall 2020, but nearly match the College rates in Fall 2022 and Fall 2023.





Physics 6 has been taught largely by the same faculty for the duration of the review period and it is interesting to note the success rates: the overall success rate is, on average, 7% points higher than the College success rate (excluding Fall 2021 for issues with EW rate inflation). The explanation for this higher success rate is complicated to untangle, but there are a variety of factors that may contribute to these success rates including: (1) students will often delay taking physics until they are close to transfer and will benefit from developing better study habits along the way; (2) approximately half of the students identify as Asian or White and these two demographics tend to have greater math readiness when they start at SMC; (3) combining the first two explanations, students will take additional math while at SMC and may take Physics 6 after completing additional math courses. In the future, it would be helpful to do a study in collaboration with Institutional Research to examine student success in Physics 6 as a function of highest Math course completed at SMC. Despite the high success rates, retention fluctuates from semester to semester. Notably, Physics 6 is the only gateway course being reviewed that experienced a decline in retention in Fall 2023. We will wait to evaluate Spring 2024 data to determine if there is an overall downward trend occurring or if it's a natural fluctuation like in previous semesters.

Physics 8

Physics 8 has experienced an overall decline in enrollment prompting us to cut the course offering from two sections in Fall 2017 to one section in Fall 2023. As a result, the number of students being analyzed is quite small. With two sections, there was some variety in who would teach the course. Starting in Fall 2020, the course was taught by a single instructor and has continued through Fall 2023. During the pandemic when the course was taught by online instruction, success rates were notably lower. Since returning to in-person instruction, success rates have improved to the point of nearly matching the College success rate in Fall 2023. This suggests that the course material is delivered more successfully in an in-person environment and would be a basis for continuing to offer the course as an "on-ground" only modality in the future. In Fall 2017 and 2018, retention rates fluctuated. From Fall 2020 onward, retention rates began mirroring the College retention rates, although at a bit lower percentage. Overall, the Fall 2023 retention rates have returned to the pre pandemic, Fall 2019 rate. Most likely this increase is correlated with students using support programs, like the STEM program, and faculty's efforts to improve sense of belonging on campus and in the classroom.

Physics 21

As noted in previous areas, the number of Physics 21 sections have grown from five sections being offered in Fall 2017 to eight in Fall 2023. Interestingly, starting in Fall 2020 through Fall 2023, success rates in Physics 21 have nearly matched the College success rates. This is of note because many other STEM classes, including Chemistry, have consistently remained below the College success rate. Similarly, while

Physics 21 retention rate was 6% lower than the College in Fall 2020, it nearly matched the College in Fall 2022 and surpassed the College in Fall 2023. While there are many explanations that are likely intertwined, we will put forward a few: (1) the math prerequisite is Math 7, which is still taught at SMC and taking Math 2 and 7 may serve as a filter for students entering Physics 21; (2) students often put off taking physics until after completing some or most of their math requirements so they are more math ready, they have more mature study skills, and they have tapped into the support resources on campus including the STEM program; and (3) in the past few years, several of the full-time physics faculty have participated in the NSF – Equity Training Program: Fostering an Equity-minded Student Success Culture in STEM Through Faculty Development. As part of the NSF-STEM program, instructors made changes to the way they instruct students. In fact, four of the eight Physics 21 sections were taught by instructors that have completed the program. Additionally, these faculty have also participated in or served as coaches for the College sponsored EGC program: Equitizing Gateway Courses. As noted below, the success and retention rates for Physics 21 courses taught by instructors that participated in the equity training program were 76.8% and 97.0%, respectively. The success rate was 6.0% higher and the retention rate was 12.3% higher than the courses taught by instructors that did not participate in the equity training program.

In future semesters, it will be worth studying student success in subsequent physics courses, like Physics 22, 23, and 24, to determine if students are equally prepared compared to the students coming from sections taught by instructors that have not participated in an equity training program.

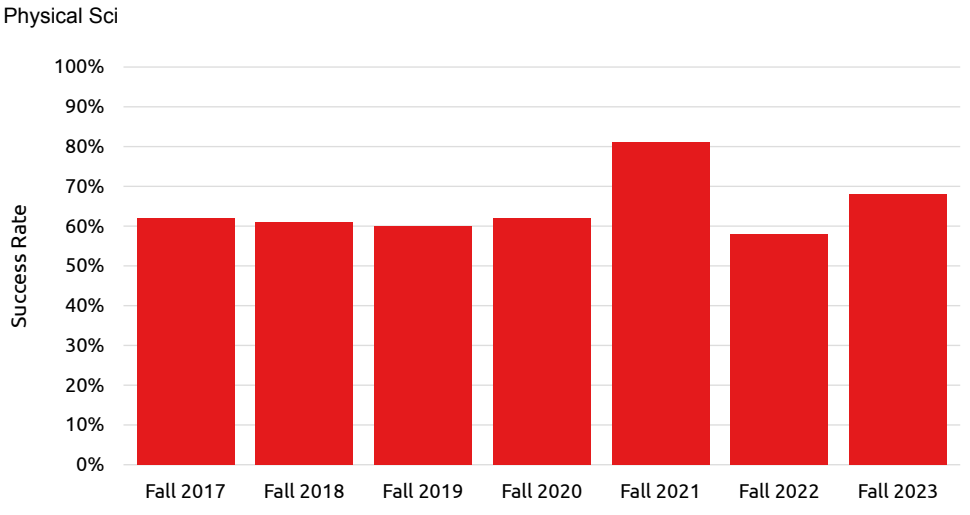
Fall 2023, Physics 21 Success and Retention by Instructor Equity Training

	Total Students	Students Retained	Students succeeding	% Success	% Retention
Taught by instructor with NSF-Equity Training	99	96	76	76.8%	97.0%
Taught by instructor without NSF-Equity Training	72	61	51	70.8%	84.7%
Total	171	157	127	74.3%	91.8%

Overall, the physics gateway courses appear to be on track to have success rates similar to the College. Retention rates for Physics 6 and 8 are still lower than those of the College and would benefit from some improvement. In future Physics program meetings, it may be beneficial for there to be greater discussion about the equity centered practices that instructors are using in Physics 21 so that they can be utilized in other physics courses, like Physics 6 and 8.

Course Success Rates

Physical Sci



Measures: Success Rate and Success Count and Attempts

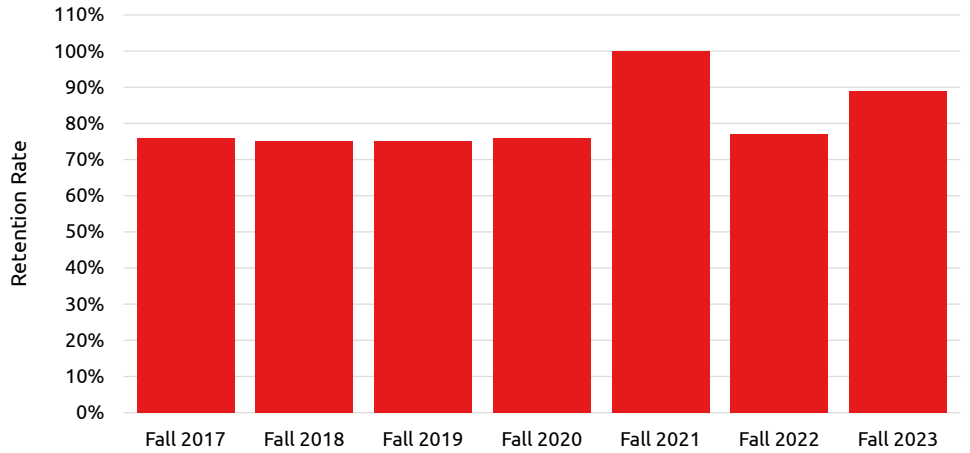
	Fall 2017			Fall 2018			Fall 2019			Fall 2020			Fall 2021			Fall 2022	
	Success Rate	Success Count	Attempts	Success Rate	Success Count	Attempts	Success Rate	Success Count	Attempts	Success Rate	Success Count	Attempts	Success Rate	Success Count	Attempts	Success Rate	Success Count
Measures	62%	1,646	2,643	61%	1,621	2,637	60%	1,532	2,568	62%	1,640	2,643	81%	1,306	1,605	58%	1,039

Credit Courses Only

Course Retention Rates

Physical Sci

Limits: **Course Credit Type** Credit, Degree Applicable, Credit, Not Degree Applicable **Course Retention** Not Retained, Retained



Limits: **Course Credit Type** Credit, Degree Applicable, Credit, Not Degree Applicable **Course Retention** Not Retained, Retained

Measures: Retention Rate

	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023
Measures	76%	75%	75%	76%	100%	77%	89%

Credit Courses Only

14b. Disaggregated data: Which racial/ethnic student group completes their courses at the highest rates? Which racial ethnic groups experience the largest gaps when compared to the highest performing group? Analyze the trends across the last review period.

Chemistry

Prior to the pandemic, Asian and White students completed Chem 10 and 19 at the highest rates, often the designation of “highest performing group” oscillated between the Asian and White groups. In contrast, Black and Latine/x students completed Chem 10 and 19 at much lower rates. For the sake of simplicity, the tables shown below reports success rates for Asian, Black, Latine/x students. We present these groups because Asian and White students tend to be designated as the highest performing group and Black and Latine/x students are the most disproportionately impacted groups and have a large enough headcount so that we can engage in statistically meaningful discussion about their success rates. The Fall 2017 semester is reported as a starting point, Fall 2023 represents our current point, and Fall 2019 represents the semester when AB 705/1705 went into effect and basic skills math was no longer required. All other terms were removed from the tables to simplify the discussion.

As noted in previous sections, when AB 705/1705 went into effect, success in Chem 10 dropped dramatically. Looking at the success rates by race/ethnicity the problem intensifies. In Fall 2019, the success rate for Black students dropped 15% from 43% to 28%. While the success rate has returned to 43% in Fall 2023, it is still notably lower than the highest performing group, White at 69%. Even more troubling is the fact that the success rate for Latin/x students dropped 19%, from 52% in Fall 2017 to 33% in Fall 2019, and it has not improved. In Fall 2023, the Latin/x success rate was 36%. The Latine/x student population represents nearly half (46.1%) of all students enrolled in Chem 10 in Fall 2023. Notably, the Asian group has often been designated the highest performing group but success dropped to 55% in Fall 2023, 14% lower than the White students. Overall, there are clear equity gaps that need to be addressed.

Fall Student Success Data in Gateway Chemistry Courses by Race/Ethnicity

	College			*Chem 10*			*Chem 19*		
	2017	**2019**	**2023**	**2017**	**2019**	**2023**	**2017**	**2019**	**2023**
Asian	77	75	78	68	63	55	86	86	50
Black	55	54	63	43	28	43	36	53	63
Latine/x	61	60	67	52	33	36	29	35	50
White	76	75	78	72	62	69	50	78	79

Chemistry 19 was first offered in Fall 2016 and as the course has matured, it appears that instruction has evolved to better support historically marginalized student groups like Black and Latine/x students. In the three terms examine, the number of Black students enrolled remained steady at 14, 14, and 12, respectively. Notably, the success rates for Black students have improved from 36% in Fall 2017 to 63% in Fall 2023. In contrast, Asian student enrollment remained steady at 21, 22, and 18 but the success rate fell from 86% in Fall 2017 to 50% in Fall 2023. At this time, it is unclear why Asian student success had declined, but success rates will be monitored to determine if this is an ongoing trend.

Latine/x enrollment is responsible for most of the enrollment growth in Chem 19, with 62 students enrolled in Fall 2017 to 126 students in Fall 2023, while the headcount of Asian, Black and White students remained nearly constant. Not only did the Latine/x student population grow from Fall 2017 to Fall 2023, but success improved as well from 36% to 63%. It will be interesting to see if the trend holds for Latine/x and Black students to continue experiencing success rates in the 50-60% range, which is comparable to the overall success rate in Chem 10. While equity gaps still exist between the highest performing group and the Black and Latine/x students, the gaps are closing and this is a promising trend. Should this trend continue, it would be worth exploring how instructors approach teaching Chem 19 to see if there are any overlapping principles that could be applied to Chem 10 instruction to promote greater success for Latine/x and Black students in Chem 10.

Physics

Studying equity gaps for Black students in Physics has been challenging because there is an access issue that needs to be addressed. As case in point, enrollment headcounts are reported for Black students in all three gateway courses below. While we will report success rates for Black students in gateway physics courses in this section of the report, it is difficult to draw significant conclusions based on the performance of a five or fewer students in all but one course in one semester. Overall, the Physics Program has noted that outreach to local middle and high schools and collaboration with programs like Black Collegians and MOCAN will be an important part of increasing the number of Black students that enroll in our gateway physics courses.

Black students enrolled by headcount in Gateway Physics Courses

Fall	**2017**	**2019**	**2023**
Physics 6	4	3	2
Physics 8	2	1	2
Physics 21	5	5	8

In Physics 6, as noted previously, success rates are often higher than those of the College. Often, Asian or White students would be designated the highest performing group based on percentage and number of students enrolled. The few Black student enrolled in Physics 6 did very well, with success rates of 75-100% over the three semesters reported. Latine/x students have historically done very well in Physics 6 with an ~80% success rate, however, in Fall 2023 the success rate was 55%. This drop in success comes as Latine/x enrollment has increased with 15, 20, and 24 students enrolled in Fall 2017, 2019, and 2023, respectively. In the coming semesters, it will be important to continue monitoring Latine/x success in Physics 6.

Fall Student Success Data in Gateway Physics Courses by Race/Ethnicity

	College			Physics 6			Physics 8			Physics 21		
	2017	2019	2023	2017	2019	2023	2017	2019	2023	2017	2019	2023
Asian	77	75	78	64	100	100	75	86	100	62	55	68
Black	55	54	63	75	75	100	100	100	0	80	60	50
Latine/x	61	60	67	80	78	55	29	38	50	62	35	60
White	76	75	78	90	85	86	75	85	86	81	71	87

In Physics 8, success rates have been quite high for Asian, Black, and White students. In contrast, Latine/x students had a success rate of 29% in Fall 2017 and 50% in Fall 2023. While this improvement is significant, it represents a very small population of students. Latine/x headcount was 7, 13, and 5, in Fall 2017, 2019, and 2023, respectively. While Latine/x enrollment has increased throughout the department, it has declined in Physics 8. This may be due to self-placement into other physics courses like Physics 6 or 21, which have both experienced increased Latine/x enrollment. Overall, Physics 8 should be monitored to determine if Latine/x enrollment continues to decline and/or success improves to determine what course of action should be taken to shift outcomes.

In Physics 21, White students would be designated as the highest performing group. Interestingly, all reported groups experienced a notable drop in success in Fall 2019 and success has rebounded in Fall 2023. The most concerning change was the 27% drop in success for Latine/x students in Fall 2019. Looking at the previous year Latine/x student experienced a 43% success rate in Fall 2018. Additionally, enrollment headcount dropped as well. Latine/x enrollment was 29, 21, 15, and 29, for Fall 2017, 2018, 2018, and 2023. While it's possible that success dropped as a result of enrollment dropping, it begs the question why did fewer Latine/x students enroll in Fall 2018 and 2019 and how does that affect success? To date, we don't have a clear explanation. Fortunately, this trend has not persisted, and Latine/x success rates and enrollment have bounced back to 60% and 29 enrolled in Fall 2023. While this still represents an equity gap of 27% it is far better than Fall 2019. More work needs to be done to close the gap.

Interestingly, in Physics 21, Asian students also experienced lower success rates than their White counterparts, averaging about 20% lower success than White students for the semesters reported. This is an interesting finding because in most other classes in our department, Asian and White students experience similar success rates. In the next six years cycle, the faculty teaching Physics 21 will need to invest time in (1) recruiting more Black students and (2) identifying areas for improvement to address the equity gaps that exist for both Asian and Latine/x students.

14c. Equity Gaps: What factors are contributing to the equity gaps? Consider factors that relate to people, programs, practices, and policies in the classroom, program, or college.

The factors contributing to equity gaps are complicated and extensive. As students grow up and learn about science and mathematics in the K-12 system, it would seem that science is taught more as an elective rather than a core subject that everyone should be literate in. People, in general, are intimidated by physical sciences as evidenced by the way people outside of our fields react when you tell them in conversation that you teach a physical science like chemistry, engineering, or physics. Mathematics is a core subject that is taught and assessed in K-12, but without adequate support students will often avoid or struggle through prealgebra or algebra courses in middle and high school. With this in mind, many students fully capable of becoming STEM professionals shy away from the subjects because they are "too hard" or they are "too much work". We also live in a society where people believe that learning should come easy, and if it does not come easy then it is not the right subject for you. When we talk with students, they are often surprised to learn that most of their instructors struggled or had to work hard at learning chemistry/engineering/physics. Students assume that because we teach the subject, we must have always been good at it. Addressing the equity gap requires addressing the misconception that STEM learning should be easy and if it is not, then you are in the wrong field.

Shifting to academic preparation, in the 2019-2020 program review we reported that from Fall 2016 – Spring 2019, 40.3% of the 11,857 students attempting Chemistry 10 were identified as "basic skills". Basic skills was defined as a student requiring Math or English preparation at a level below college level Math or English. For Math this would translate to placing into Math 20: Intermediate algebra, or lower. Given this information, we might assume that at the point of completing high school, they were not "math ready" for Chemistry 10/19. Due to implementation of AB 705/1705, we no longer have data to determine how many students would be considered math ready at the time of enrolling in Chem 10 or Chem 19. However, Institutional Research assembled a study to examine student success in Chem 10 when students have completed a math course at SMC or not. Examining data spanning Fall 2016 – Spring 2019, we found that students designated as "basic skills" had a 44.0% success rate in Chem 10 and students beyond "basic skills" had a success rate of 64% in Chem 10. Looking at data post-AB705/1705, which spans Fall 2019 – Winter 2023, we found that students enrolled in Chem 10 without having completed a Math course at SMC had a success rate of 59.6%. While the post-AB705/1705 rate was higher than the basic skills data, this is likely because this groups of students is a mixture of basic skills and beyond-basic skills students that we can no longer disaggregate. Even still, the "no math at SMC" demographic has a lower success rate than those that have taken math at SMC (67.5%) suggesting the importance of having strong math skills for completing chemistry courses.

Course success rate in Chem 10 by Basic Skills designation, Fall 2016 - Spring 2019

Designated "Basic Skills"			Designated "non-Basic Skills"		
Success	Total Enrolled	% Success	Success	Total Enrolled	% Success
2101	4776	44.0%	4532	7081	64.0%

*Success grades include A, B, C, and P

Course success rate in Chem 10 by Math Completion x Race/Ethnicity, Fall 2019 - Winter 2023, "Post-AB705/1705"

	Did not complete math at SMC			Completed math at SMC prior to enrolling		
Fall 2019 - Winter 2023	Success	Total Enrolled	% Success	Success	Total Enrolled	% Success
Total	1500	2516	59.6%	930	1378	67.5%
Asian	213	283	75.3%	144	182	79.1%
Black	62	162	38.3%	34	69	49.3%
Latine/x	440	985	44.7%	337	592	56.9%
White	545	728	74.9%	260	331	78.5%

*Success grades include A, B, C, and P

**Excludes EW grades

Interestingly, when examining Chem 10 success by math completion and race/ethnicity, both Latine/x and Black students have much lower success rates in Chem 10 if they do not complete a Math class at SMC first. In fact, the Latine/x post-AB705/1705 success percentages more

closely align with the “basic skills” data from Fall 2016 – Spring 2019 and the Black students experience even lower success rates than the “basic skills” data. This would suggest that Latine/x and Black students are less math ready and would probably place in the “basic skills” category if basic skills were still being assessed. Also of interest, in the post-AB705/1705 data, we see that even after completing a math course at SMC, Black and Latine/x students experience success in Chem 10 at a lower rate than their White and Asian counterparts, suggesting there are issues beyond math skills that need to be addressed for these students to succeed.

Given the data presented, one area that creates equity gaps is math readiness. With the AB 705/1705 policy preventing our math department from offering basic skills math classes and soon precalculus, the responsibility of addressing math readiness has become a core issue in gateway STEM classes, like Chem 10 and Chem 19. Additionally, we can see from the data that even with completion of a math class, Black and Latine/x success is lower than Asian and White success suggesting that there are issues beyond math skills that need to be addressed. These additional factors likely include understanding how to study for a STEM course, adequately allotting time to practice the skills being taught in the STEM course, and engaging in help seeking behavior.

The study skills needed for STEM classes are rarely taught in college level STEM classrooms, as it is assumed students have learned these skills along the way in K-12. Unfortunately, these skills are rarely taught in the K-12 system either; they are often taught by parents, older siblings, friends, or just picked up along the way by trial and error. Understandably, first generation college students, like many Latine/x and Black students, do not have access to someone that will explain this “hidden” curriculum. Further, students that come from households that can afford to support the student financially should have more time built into their schedule to practice the skills taught in STEM classes. In contrast, low-income students, often Black and Latine/x, need to work to support themselves and their family, leaving much less time to study. As a result, they find themselves wondering how to maximize their study time with the little time they have, usually with mixed results. Often the result is poor performance on exams and no idea what to do next. Ideally, after receiving a poor test score, students will seek help from their instructor, however, it is incredibly common for students, especially those identifying as Black or Latine/x, to avoid seeking help or stop attending class altogether. This scenario highlights the need to normalize and teach help seeking skills.

Collectively, it is incredibly common as instructors, to look at our course outlines of record and maximize the time spent on each topic to the point that we spend very little time talking about study skills, time required to succeed, and normalizing help seeking behavior. However, without these three factors at play, students will continue to fall through the cracks because they do not know what is needed to succeed in the course. Perhaps the most valuable change we can make as a department is to prioritize teaching: (1) math skills; (2) study skills; (3) help seeking behavior; and (4) carving out time to study.

14d. What else does your program need to know to better understand how to address equity gaps in your program’s course success and retention rates?

Our department would benefit from understanding students’ course-taking patterns for several reasons:

1. To determine the best times and modalities to offer classes while avoiding scheduling two classes that they need at the same time or at completely different times of day, making it impossible to be employed while taking these classes.
2. To understand the level of preparation students bring with them to class. While we do not have data for it, we suspect that students have higher success rates in Physics 21, the gateway calculus based physics course, in part because they have already taken several other STEM classes first. Through trial and error, students may have learned the study skills, time management, and help seeking behaviors from other classes before enrolling in Physics 21. Data to support this theory would be incredibly useful.
3. To identify which courses students take first: math, chemistry, physics, biology? Once we know the most common entry course into STEM, we can focus on building up students’ study skills, time management skills, and help seeking behavior in those courses and set them up for success in their subsequent STEM courses. This should also improve retention throughout the program.

Additionally, our department would benefit from engaging in regular conversations and training to learn how to incorporate the skills highlighted in section 14c. We have all had many years to learn and refine our skill to teach our respective subjects, but most of us were never taught study skills, help seeking behavior, or time management associated with finding time to study. We learned these skills along the way, so it can be difficult to conceptualize what a curriculum in study skills and time management might look like. In the long term, professional development will be key to providing students greater support in these areas.

Currently, the STEM program focuses on these life/study skills, but they are only able to serve a limited number of students that self-select to take advantage of the resources available. As a college, we need to focus on how to connect all our STEM students to these resources and how to bring these resources into the classroom. This type of equity work will take more than just a single instructor making a few changes to their classroom instruction. It will take a whole team including instructors, counselors, peer mentors, tutors, and therapists to support students studying STEM.

SLO Mastery Rates:

15a. Description of process: Describe your program’s processes and practices for defining, assessing, and analyzing learning outcomes. Include a discussion of how your program uses the results of SLO data to inform course and program improvement efforts.

Each course in our department will assess, on average, three SLOs every Fall/Spring semester. As a guiding principle, faculty will meet at least once a year to discuss assessment results and possible adjustments to pedagogy or curriculum. During the pandemic, it was difficult to adequately assess some SLO’s, as they are centered on lab skills that students were not able to demonstrate via remote learning and others relied on a standardized exam that cannot be given online, unproctored. As such, SLO results were not discussed as thoroughly during the remote learning period of the pandemic.

Since returning to in-person instruction in Fall 2022, faculty have begun to engage in careful discussions about pedagogy and curriculum focused on improving the results of SLO assessments. For example, in Chem 19, a question about the melting points of fats and oils was used as the SLO assessment and the student answers were examined and reported back to the group. Faculty discussed how the topic was taught and the difficulties encountered by students based on how students responded to the SLO question. From this discussion faculty

engaged in a review of pedagogical approaches that worked well and made plans to improve student comprehension and critical thinking skills.

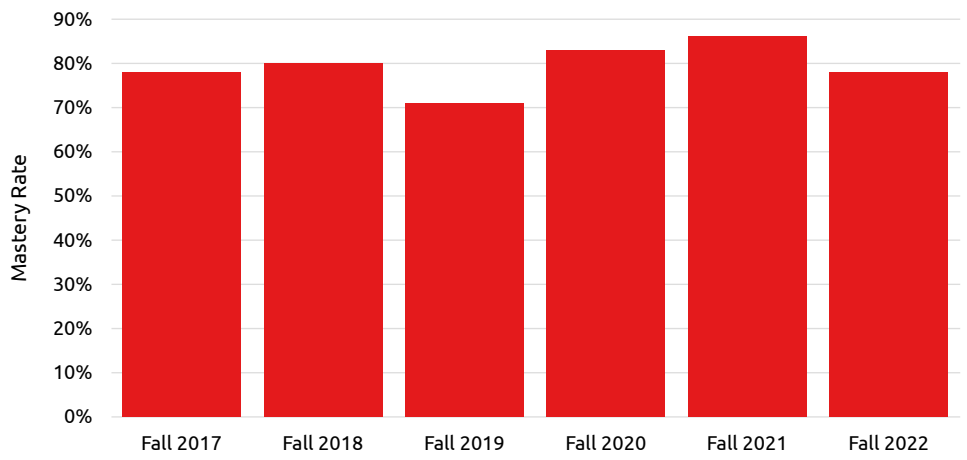
In the physics program group, faculty recently discussed making a concerted effort to assess SLO's using a common question or assessment. In previous years, the process has been less unified where some instructors will base SLO mastery on a graded lab report and others may extract information from the final exam. Going into the next review cycle, the physics faculty have made plans to discuss and implement a more unified approach to assessing SLO's.

15b. Most salient findings: Describe the most salient results of course or program SLO mastery rates data over the last review period, including results of disaggregated data. Include a discussion of how the results will be used to improve student learning.

As a department, we found that pandemic was incredibly disruptive to collecting SLO's. In part, this is because some of our SLO's center on lab skills that can only be demonstrated in person. As a result, many of us used lab report scores as a proxy for measuring skills mastery. Prior to the pandemic, Chemistry 10, 11, and 12 used standardized final exams to assess one of the SLO's, however, during the pandemic these nationally normalized exams were not available to be used in an un-proctored, zoom setting. As a result, each instructor wrote their own final exams making comparisons between pre-pandemic SLO results and during pandemic SLO results less meaningful. We look forward to resuming detailed analysis of SLO during our Fall 2024 Departmental Flex meetings.

Course SLO

Physical Sci



Measures: Mastery Rate and Successes and Attempts

	Fall 2017			Fall 2018			Fall 2019			Fall 2020			Fall 2021			
	Mastery Rate	Successes	Attempts	Mastery Rate	Successes	Attempts	Mastery Rate	Successes	Attempts	Mastery Rate	Successes	Attempts	Mastery Rate	Successes	Attempts	Mastery Rate
Measures	78%	3,338	4,254	80%	2,942	3,682	71%	2,518	3,549	83%	2,356	2,846	86%	1,578	1,826	78%

Degrees and Certificates:

16a. Analyze your program's degree and certificate award trends against your department's institution-set standards (minimum threshold) and improvement goals. Document any significant changes or trends over the last review period.

Within the department, the only discipline awarding degrees or certificates is Engineering. As such, the questions under topic 16 will focus on the Engineering program.

The first degrees awarded for engineering were in the 2019-2020 school year. In 2019-2020, two A.S. degrees were awarded; in 2020-2021, seven A.S. degrees were awarded; and in 2021-22, six A.S. degrees and six certificates were awarded.

Notably, engineering coursework is not required for transfer into an engineering major. As such, many students do not opt to complete coursework to achieve an A.S. degree in engineering at SMC. The degree itself is, however, was designed to include coursework that articulates to CSU and UC schools, so that students who choose to stay longer at SMC may earn the degree while continuing to make progress on their bachelor's degree.

Degrees and Certificates

Physical Sci

Measures: Degrees and Certificates

Award Type Detailed	Program Title	2019-2020	2020-2021	2021-2022	2022-2023
A.S.	**Engineering**	2	7	6	2
	Total	2	7	6	2
Cert 16 to 29 Units	**Introduction to Engineering**	1	1	11	10
	Total	1	1	11	10
Cert 30+ Units	**Engineering**	0	0	6	1
	Total	0	0	6	1
Total		3	8	23	13

16b. Which student racial/ethnic groups disproportionately earn more awards in your program? Which racial/ethnic groups earn disproportionately fewer degrees and certificates?

Of the 15 A.S. degrees awarded in the last three academic years, five were awarded to students identifying as Latine/x, four were awarded to students identifying as White, while one was awarded to a student identifying as African American/Black.

16c. Based on your analyses, what changes is your program exploring, including addressing any equity gaps?

At the moment, the program is not exploring any changes to address low degree attainment, as students seeking to transfer to a university to study engineering have little incentive to complete an A.S. degree at SMC.

If applicable:

17a. Labor Market Data: Discuss the labor market demand for your program. What is the gap between demand and supply? How does labor market data inform your overall program planning?

n/a

17b. Additional Assessment: Describe the results of any additional assessment or evaluation your program conducts and how the findings inform program planning and improvement.

n/a

F. Your Program's Past and Future

Past Action Plan:

18. Discuss the progress made on the action plan and objectives from your program's last review.

Program Review 2012-202 Action Plan Objective #1: Work with Risk Management to implement next steps of the safety plan:

1. Review & update Chemical Hygiene Plan
    1. Reviewed by Daniel Phillips, Jennifer Hsieh (Chair of Physical Sciences), and Garen Bagdasarian (Chair of Life Sciences) in January 2024.
2. Provide safety and chemical hazard training to faculty through Keenan online training.
    1. Postponed/discontinued as training cannot be mandated as it is not part of the faculty contract. Discussions are ongoing about addressing training during Flex days and department meetings.
    2. All new faculty will have onboarding training via Keenan online training.
3. Provide safety and chemical hazard training to chemistry stockroom staff.
    1. Stockroom staff were assigned to attend Keenan in-person HAZCOM training, February 2024. More trainings will be assigned as they become available.
4. Review existing chemicals in storage to determine their applicability in our courses and dispose of unused ones.
    1. The inventory has been reviewed and most, if not all, unneeded chemicals have been discarded. This is an ongoing process that is revisited regularly.
5. Create a process to maintain cleanliness in chemistry laboratories.
    1. Instructions are posted in each classroom, upon return from the pandemic reminders were needed, but overall the labs are well kept.
    2. The stockroom staff are now checking the chemistry labs monthly for cleanliness, leaks, and safety concerns to help address this issue.
6. Properly labeling chemical reagents that are stored in secondary containers.
    1. Initial task completed in early 2024. Staff will need to maintain labeling on all new secondary containers going forward.

Overall, the bullet points in this objective were adequately completed.

Program Review 2012-202 Action Plan Objective #2: Update and organize physics manuals through the following steps:

1. Review, rewrite, and reformat existing Physics laboratory procedures.
    1. Some labs have been updated, but overall this is an ongoing project.
2. Move the updated Physics lab procedures to Canvas or some other source that is not the departmental webpage.
    1. A google sites pages has been created to make physics lab procedures available to students. While not all procedures are posted, good progress has been made. More work needs to be done.

Overall, the bullet points in this objective were addressed but not completed. This objective will be rolled over into the next planning cycle.

Future Action Plan:

19a. Considering your program's past plan and this review's findings, what challenges and concerns need to be addressed in the next review period?

Enrollment appears to be the greatest challenge and concern the department faces going into the next review period. As noted in previous sections, our department enrollment has dropped by 31.0% overall, with the most concerning drop in the Chemistry program. While Physics also experienced a 30.0% drop in enrollment, most of this loss can be attributed to non-major courses like Physics 12 and Physics 14. Both Physics 6 and Physics 21, two of our entry level "STEM majors" Physics classes are in growth mode, with Physics 6 increasing in headcount by 87.8% (41 enrolled in Fall 2017 and 77 in Fall 2023) and Physics 21 by 28.8% (163 enrolled in Fall 2017 and 197 in Fall 2023).

Beyond enrollment, equity gaps are still a concern between the highest succeeding groups (White and Asian) and less successful groups (Black and Latine/x). AB 705/1705 has eliminated the possibility of our Math department offering “basic skills” math classes like Math 31 or Math 20 and soon, in late 2025, the College will no longer be able to offer Math 2/3/4, which means that even fewer Chemistry and Physics students will be math ready upon enrollment in our courses. As noted earlier, students that had not taken a math course at SMC had notably lower success rates in Chemistry 10 than their peers. Additionally, both Black and Latine/x students experienced a disproportionate impact when taking Chem 10 before completing a math course at SMC. This holds true for Chem 11 and Chem 12 for Latine/x students as well.

With an interest in attracting students back to SMC and supporting greater success in our gateway courses so that our Chemistry, Engineering, and Physics pathways remain healthy, we look to create new classes to respond to student interest and need. These classes include training courses to respond to industry demands like courses in analytical instrumentation, water technology, environment, health and safety, and science education. These new courses would be developed in addition to supporting our growing Engineering program.

In collaboration with our colleagues in the Department of Life Sciences, we are interested in diversifying our Chemistry course offerings to meet the needs of students taking Chemistry in support of their Biology majors program. Biology majors often take more Chemistry courses than Biology courses in their first two years and would benefit from a chemistry track that is tailored to their program that will accelerate completion so that they can move onto classes in their major program of study. In collaboration with our colleagues in the Mathematics Department, we look to develop non-credit, basic skills math courses that would support greater success in our courses.

The list of possible new courses seems almost daunting. It will take time and significant effort to first, determine which courses will add the greatest value to our department and second, develop and move them along the Academic Senate approval process. This brings the discussion to our last challenge, staffing in the department. The level of exploration and development that the department is looking to undertake will require significant work by full-time faculty over the next review period. As noted earlier in this report, we recently lost one of our full-time faculty to an unexpected death and two other faculty are struggling with long-term health challenges preventing them from being able to teach and provide support to program development. Both faculty will likely retire within the next 1-2 years. While we started the 2023-2024 academic year with 22 full-time faculty, in reality, our department is currently being supported by 18 full-time faculty: one has passed away, two are ill, and one has full-time obligations with the Faculty Association.

19b. Identify 1 – 5 goals for your next review period’s Action Plan to address your program's challenges and concerns. Label the goals Ongoing, Revised, or New.

Goal 1 – New

Identify, research, and create new courses/certificates/degrees in response to student interest/need and/or industry need.

- Itemize a list of possible courses/certificates/degrees and identify faculty to research them.
- Research existing courses/certificates/degrees at other institutions, identify requirements for transfer (when appropriate), identify capital investments required.
- Move the courses that will bring the greatest value to our department forward to develop the Course Outline of Record.
- Develop the Course Outline of Record and move it through the Academic Senate approval process.
    - Move certificates/degrees through the appropriate review process to seek approval.
- Offer the classes and assess added value by tracking enrollment, retention, and success data.

Goal 2 – New

Identify, research, and create a support system for the Health and Wellness AoI similar to the STEM Program for the STEM AoI.

- Identify interested parties and form a work group.
- Identify what infrastructure would be needed to support the Health and Wellness AoI in a similar capacity to the STEM AoI via the STEM Program.
- Research and identify possible sources of funding, including grant funding.
- Collaborate with the administration to realize a functioning Health and Wellness Program that provides wrap-around services for Allied Health students, like those enrolled in Chem 19.

Goal 3 – Revised

Collaborate with Safety and Risk Management to build upon safety culture in Chemistry and develop safety programs in Engineering and Physics.

- Identify new or modify existing safety training materials to better support the Chemistry courses.
- Identify the safety hazards associated with each Physics course and develop training materials.
- Identify the safety hazards associated with the Engineering Fabrication Lab (Maker Space) and develop training materials.
- Implement routine safety inspections of all lab spaces, Chemistry, Physics, and Engineering.
- Develop a system for documenting and tracking safety trainings and inspections.
- Identify ways to provide ongoing safety training to faculty during Flex days and department meetings.

Goal 4 – Revised

Update the Physics labs to modernize them and create lab procedures that can be posted on the departmental Google site.

- Investigate new physics labs that modernize the hands-on experience.
- Review the new procedures against the Course Outline of Record to ensure that the course content does not change substantially while making the updates.

- Establish a standard format for writing all Physics laboratory procedures so that documents have a cohesive look.
- Write or rewrite laboratory procedures to reflect modernizing the labs.
- Move the updated Physics lab procedures onto the Google Sites page.

G. Resources and Budget

20. What are the most critical resources needed to implement your program's Action Plan in the next review period?

Focusing on growing enrollment back, the department needs to make efforts to attract students to our programs. To that end, we need support from the College in a variety of ways:

- Scheduling classes at optimal times to fit students' busy schedules. We need better data to support creating a student-centered schedule.
- Providing optimal instructor to student ratios in the classroom to improve success rates. We need more WTH to schedule more single section lecture meetings.
- Creating new courses/certificates/degrees that will prepare students to join the workforce or give them opportunities to upskill which will attract students to SMC rather than other community colleges.
- Create a Health & Wellness Program, similar to the STEM Program, to support Health & Wellness AoI students. We need faculty, staff, and administrators to collaborate on realizing this vision, including a community space for allied health students to meet, study, and get tutoring and peer mentorship. It's worth noting, the STEM program cannot provide tutoring for Allied Health classes like Chem 19 and Physiology 3.
- Maintaining the STEM Program at it's current level of staffing beyond the life of the grant. The current grant is set to expire in 2026 and without institutional or alternative funding, most of the program will go away. The counseling, tutoring, peer mentorship and community space have been instrumental to supporting STEM students including those in Chemistry, Engineering, and Physics.
- Maintaining full-time faculty staffing at or above 22 full-time faculty so that we have the human resources needed to develop above-mentioned courses/certificates/degrees/programs.
- Speaking aspirationally, providing release time to faculty to develop the above-mentioned courses/certificates/degrees/programs, to evaluate and develop safety training programs for Chemistry, Engineering, and Physics, and to support outreach efforts to attract historically underrepresented students to consider a career in a physical science. All of these projects take well more than the few hours a week allotted for service work.
- Hiring a second full-time Engineering/Physics (50/50 split) instructor to support the existing Engineering courses and to develop new courses as the program continues to grow. We made this request in our 2019-2020 Program Review and maintain that the position is needed more than ever.
- Hiring a full-time chemist to replace our long-time colleague who passed away unexpectedly. We need to keep the staffing at current levels so that we have the human capital to revitalize our chemistry program.
- Hiring a 100% administrative assistant for Life Sciences so that the current administrative assistant that we share can focus on supporting our department 100% of her time. The PBAR was approved in Fall 2023 and the College should honor our need, given the complexity of the courses we offer and the added support needed from our administrative assistant.
- Hiring a staff technician to prepare materials for the Engineering courses so that Engineering faculty do not have to and can focus on teaching and developing courses. The technician would also support the Engineering Fabrication Lab (Maker Space). If we have a technician staffing the Maker Space, students can access the Maker Space outside of class time to work on projects which will create added value for students attending SMC.
- Hiring additional staff technicians to support opening our new labs in the Math and Science Complex. While the new building will inherently attract new students because they want to take classes in state-of-the-art facilities, our labs are only functional if we have staff available to prepare the supplies students will use in their classes. Our current staff will find it incredibly difficult to support both the existing stockrooms and labs as well as the new spaces, given the physical distance between the labs and the demands of the number of sections currently running in a semester.
- Identifying a new location for the Engineering Fabrication Lab (Maker Space) that is slated to be demolished as early as Fall 2025 when Dresher is torn down. Our Physics and Engineering programs are growing because of Engineering. Once the Maker Space opens in Fall 2024, students will realize the Maker Spaces as an additional benefit to attending SMC. Opening the Maker Space will further solidify our role as a leading program in Engineering in the area and losing this resource to future construction will be detrimental to our program.
- Updating our current building and infrastructure. The current building opened in October 1999, twenty-five years ago. The same paint, carpet, flooring, and furniture remains in the building and it is showing its age. The carpet is ripped and buckling throughout the building. Walls are scuffed and dinged. The furniture in all the faculty offices is rusted to the extent that students ask why the furniture has brown spots all over it. The building leaks when it rains. During the last big rain in February, our administrative assistant reported 13+ unique leaks in the building. The leaks over the last 25 years have caused both major damage that gets repaired and minor damage that is often left unrepaired. This includes bubbling and peeling paint, vinyl baseboards peeling or outright removed and not replaced. As noted in the 2019-2020 Program Review, a large number of faucets have leaked in Sci 305 and have damaged the wood cabinets and lockers. While the leaks have been repaired, the cabinets are still damaged. Ceiling tiles in the East wing of the building often fall and have injured employees on more than one occasion. Even now, after most of the ceiling tiles have been clipped and replaced, we still find tiles hanging from the framing. All this to say, our building needs a rejuvenation. With the new Math and Science Complex opening, student may come to SMC to learn in our new facilities, but they will likely be disappointed when they have to take many of their STEM classes in the Science Complex because it is tired and run down.
- Just like the building, our programs use much of the same equipment that was purchased when the Science Complex opened 25 years ago. It was state of the art at the time, but a lot of it needs to be updated. In particular, the Physics labs need to be modernized, as they are still completing experiments from over 25 years ago using analog equipment when digital equipment is preferred in the professional world. The organic chemistry program, as well as a future classes in analytical instrumentation, rely heavily on our 400 MHz Nuclear Magnetic Resonance (NMR) instrument. The last time we updated our NMR was in 2012 after the College was awarded the first STEM program grant. In the next 4 -5 years, our NMR will approach it's end of life with the manufacturing company, Jeol, no longer supporting replacement parts. We will need to explore options to replace our NMR.
- Finally, with new programs on the horizon, we will likely need new instrumentation to support them. In particular, we are in the exploratory phase of developing a CTE program in applied chemical sciences that would require an analytical instrumentation course that will prioritize

using high-end analytical equipment like a GC-MS (gas chromatography – mass spectrometry) and an HPLC (high pressure liquid chromatography).

21. If additional resources are needed to implement your Action Plan, what new funding sources and/or budget reallocations is your program exploring?

Many of the new courses/certificates/degrees that we are exploring are in areas where there are opportunities for grant funding. The Applied Chemical Sciences program could be supported by an NSF-ATE grant (National Science Foundation – Advanced Tehcnological Education), like the one the Biotechnology program is supported with. The environment, health, and safety program could be supported by the NIH Occupational Safety and Health Training Project Grants (NIH = National Institutes of Health). There are many grant opportunities available to support training new STEM educators that will work in the public school system. To be successful in applying for these grants, we need the College to support and participate in the grant application process. When the College was awarded the first STEM grant back in 2011 it was through the efforts of STEM departments support AND the grant writing skills of Laurie McQuay Peninger, Associate Dean of Grants. At the time, she wrote the grant proposals and was quite good at her job. In our current structure, we have a Director of Grants that coordinates College approval for faculty seeking to submit proposals, but the expectation is that faculty should write their own grant proposals. Again, noting that faculty are allocated ~5 hours per week for service work, it is incredibly difficult to find time to write lengthy NSF or NIH grant proposals, let alone faculty often have little to no experience writing major grant proposals. Speaking apsirationally, if the College wants and supports seeking greater funding from granting agencies, the College should create the infrastructure to be competitive in seeking grant money. Please consider hiring grant writing expert(s) that will write grants with the input of program constituents.

In the recent presentations for the Facilities Master Plan, it was noted that there is a plan to update spaces in the Physical and Life Sciences Complex, including paint, flooring, roofing and modernizing aging building systems. We applaud and support this plan. We ask that once planning begins the Department Chairs from both Life and Physical Sciences are included in the discussions to determine the most high-priority needs. It seems that the College has allocated a future budget to this project; we urge you to keep that plan and do not delay it. The building is in need of these renovations.

Finally, we are asking for human resources to support our programs – chemistry, physics, and engineering. With a recent loss and upcoming retirements, maintaining our full-time instructor staffing at current levels will be critical. With new labs opening in the Math and Science Complex and the Maker Space opening in Fall of 2024, we need new staff to support these spaces. This should come through institutional support and we encourage the College to fund and support these hires. It makes very little sense to build the infrastructure for growth in STEM without funding the staffing (both faculty and technicians) to support facilities growth.

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