

Comprehensive Program Review Report



Program Review - Physics

Program Summary

2023-2024

Prepared by: Quinn MacPherson and Marc Royster

What are the strengths of your area?: The Physics Department offers two physics course sequences to meet the needs of various science and mathematics-based majors. The calculus-based sequence (PHYS 55, 56, 57) is designed for engineering, physics, mathematics, computer science, and other majors requiring a more advanced level of physics. The algebra/trigonometry-based sequence (PHYS 20, 21) typically meets the needs of biology, health science, and some computer science majors, among others.

Additionally, the physics department aids in promoting transfer by teaching classes that satisfy the UC and CSU group 5A and group B1 requirements respectively. Astronomy ASTR 10 and physical science PSCI 20 satisfy both these requirements, the latter also fulfilling a lab requirement. These courses are typically taken by a diverse set of student majors and are usually highly popular. See corresponding program reviews for details.

Because each physics course is a prerequisite for the following courses in the series and not all students need to complete the entire series each course in the series typically has less enrollment than the previous course. For example, at the census date of spring 2023 enrollments in the 55, 56, 57 series were 43, 27, and 16 respectively.

All PHYS courses include a lab component taught in JM 208. Due to equipment, instructor, and seating limitations labs are traditionally capped at 24 students, though we sometimes stretch resources to accommodate up to 32. Because of this limitation, Physics 55 in the spring and fall as well as PHYS 20 in the fall are offered as a stacked lecture with two lab sections.

Because of the laboratory enrollment caps and low enrollment in PHYS 57 the FTES/FTEF ratio for PHYS has traditionally been rather low. However, this ratio has been increasing due to increasing enrollment. The FTES/FTEF ratio in the 2022-23 school year is higher than in 2021-22 for all five of the Physics courses. Our FTES/FTEF ratio for physics as a whole is 14.98, which is the highest it has been (at least in the past 6 years). This significantly exceeds the master plan's 2025 target for Physics which is 11.67 but is still short of the college-wide goal of 17.5.

Success rates in physics courses tend to be lower in the first course in the series (55 and 20) and higher in subsequent courses (56, 57, and 21). This is presumably either because the ability to pass the first course selects for students likely to succeed in subsequent courses, or because the first course prepares students for success in the following courses. The success rates in physics courses as a whole increased to 74.3% in the spring of 2023, the highest value since the fall of 2019. The success rates were buoyed by a relatively high success rate in PHYS 55 (69.8% compared to a 5-year average of 61.1%) and a 100% success rate in PHYS 21 with a class size of 25. However, we caution that success rates can be quite variable so this may not be part of any longer-term trend.

The physics laboratory is fairly well equipped and new equipment has been acquired using the physical science budget, Above-Base, supplies obtained with COVID-related funds, assistance from biology and chemistry in years when they have remaining funds, and grant funding. We continue to upgrade old equipment, replenish consumables, acquire more equipment to accommodate increased class sizes, and improve old and add new experiments. We do not anticipate any particularly large-budget items this year.

What improvements are needed?: Most students in PHYS courses are not physics majors (the physics 55-56-57 series is mostly

populated by engineering, biology, and computer science majors). In the past several years we have not any events or programming specifically for physics majors. This is particularly problematic because many physics majors are taking math prerequisites so have not yet had an opportunity to meet a physics professor. We hope to organize a few events a semester - for physics majors and those interested in potentially being physics majors.

Enrollment in physics courses has both bright spots and points of concern. Enrollment is highest in the first course in each sequence (i.e. PHYS 20 and 55) and drops off in subsequent courses. In the 20-21 series this difference is accommodated by having three sections per year of PHYS 20 (two fall and one spring) with only one section of PHYS 21 in the spring. This arrangement is currently functioning well with reasonable enrollment levels. We typically raise the enrollment caps in PHYS 20 from 24 to 32 but sufficient drops during the first few weeks typically brings enrollment back to a more optimal level. There is currently insufficient demand for a fall section of PHYS 21, though this may change in the future.

We offer two sections of PHYS 55 each semester and a single section of PHYS 56 and PHYS 57. The two lab sections of PHYS 55 are offered back-to-back Tuesday afternoon. There is consistently more demand for the 1pm start time than the 4pm start time. This is likely due to a time conflict between the second lab and CSCI 5, 6 and 20 as well as students not wanting to be on campus late. To encourage students to sign up for the later lab we set both caps to 24 and process enrollments in the first lab beyond 24 via add codes. Though the second section does not completely fill, it has a healthy enrollment level.

The enrollment demand PHYS 56 is in an awkward place where it stretches resources for the single lab section currently offered each semester but is currently insufficient to justify two sections. We have raised the enrollment cap on PHYS 56 from the traditional 24 to 32. There are 32 student chairs in JM 208, but with all of them filled the lab equipment and instructor time are stretched a bit thin. We are unable to accommodate additional students, should demand for enrollment at the beginning of the semester grow any further. However, if we were to start a second lab section and reduce the cap back to 24 the second section would likely only garner an enrollment of 8-10 at the beginning of the semester. After a few inevitable drops, the enrollment in the second section would be insufficient to justify its existence.

The census enrollment in the single section of PHYS 57 offered each semester has averaged 12 over the past four semesters. While this enrollment is lower than would be preferred it is important to offer the final course in the series and those students who enroll in PHYS 57 have a high success rate. It should be noted that due to a relatively low census enrollment in PHYS 55 this fall (40 compared to a 46 average over the previous four semesters), there may be a smaller PHYS 57 class in fall 2024.

To increase enrollment in physics courses we plan to take the following actions: 1) Increase outreach to highschools in the area about the STEM opportunities at COS. 2) Work to better inform students about the transfer advantages of completing the full PHYS 55-56-57 series. 3) Improve pedagogical techniques to increase success rates in PHYS 55 and 56 as well as preparedness and enthusiasm for subsequent courses.

Both physics professors use Gradescope to manage their homework and exam grading. A budget augmentation was approved last semester to cover this. However, Gradescope has changed its pricing scheme and starting in fall 2024 will only offer Gradescope via an institutional license. We therefore will see if there is interest among the other science and math faculty for this product, and if so, request it for funding. See the associated action item.

Another issue facing this physics program is room availability for supplemental instructors. With John Muir rooms having high occupancy rates - particularly during popular hours for students - it has become difficult for SI to find rooms for their sessions. Teaching an occasional class in another location (such as Yokut) could free up a few rooms in John Muir. However, we are generally limited to addressing this issue by the available space.

The hallway outside the physics lab is popular among students studying physics and other science courses. There are insufficient chairs and writing surfaces for these students, who sometimes borrow desks from classrooms. To better facilitate student studying we have added the action item of obtaining extra chairs and a few small tables for the hallway. The parameters of this furniture have already been discussed with a vendor. The quote is pending.

Describe any external opportunities or challenges.: None.

Overall SLO Achievement: Most SLO's in physics courses were assessed by Dr. MacPherson during the past few years. Students fell short of the desired performance on the majority of the SLOs. Most of these SLOs were assessed by Dr. MacPherson for the first time. There are very few recorded details on how these SLO's were assessed in the past (particularly the difficulty level of the problems), so the aforementioned results should not be compared to prior results.

Changes Based on SLO Achievement: Two major improvements that have been implemented to address this: 1) Dr. MacPherson has moved to shorter and more frequent (twice weekly) homework. 2) Both Dr. MacPherson and Dr. Royster have implemented

weekly in-person quizzes based on content from recent homework. This change, originally suggested and piloted by Dr. Royster, is expected to significantly improve student accountability and engagement in homework and thereby improve performance.

We have also recently updated the SLO's in the 55-56-57 courses as part of our 5-year curriculum review.

Overall PLO Achievement: The last time PLOs were assessed was by Dr. MacPherson in Fall of 2021. There was significant room for improvement on all three PLO identified based on the assessment at the time. This was Dr MacPherson's first time doing PLOs, so he didn't have much context for how PLO assessment was done in the past.

Changes Based on PLO Achievement: Dr. MacPherson noted that shorter and more frequent homework would be an improvement, which has been implemented. With the addition of Dr. Royster to the department and significant changes to Dr. MacPherson's teaching methods, the next assessment this year may show significant changes.

Outcome cycle evaluation: We are scheduled to assess all three program level outcomes during the 2023-24 school year. We are also scheduled to assess PHYS 20's three SLO's in spring 2024. Other SLO are not scheduled for assessment until at least next year, though we sometimes assess them early to record additional information.

Action: More equitable student grading and feedback with Gradescope institutional license

We will assess interest among science and math faculty in using the Gradescope software application. If there is sufficient interest, we will pitch this to the administration for funding an institutional license.

See the attached email from Howard Fooksman from Turnitin, Gradescope's parent company. He quoted \$6/student/semester with a minimum of 500 students.

Leave Blank:

Implementation Timeline: 2023 - 2024

Leave Blank:

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Identify related course/program outcomes: Because Gradescope saves scores and analytics for common errors on each problem on each exam/homework, it streamlines and enhances the process for assessing and evaluating SLO's. More granular data on SLO achievement has assisted us in targeting improvements for course SLO's in physics. By showing exams/homework one problem at a time rather than one student at a time Gradescope increases grading consistency thereby reducing any grading biases. This will help address any equity gaps (District objective 3.1) caused by grading inconsistency.

Person(s) Responsible (Name and Position): Quinn MacPherson, professor of physics, is spearheading this proposal. Josh Puhl, who is on the technology committee, is helping with the technology committee aspect of this action.

Rationale (With supporting data): The most important benefits of having an institutional license to Gradescope are:

- > Gradescope's question-at-a-time setup, anonymous grading system, and improved rubric interface will increase grading consistency and reduce and equity issues resulting from inconsistent grading.
- > Gradescope has a better and faster interface for leaving feedback on student work as compared to Canvas. This is expected to improve student achievement.
- > Gradescope will reduce faculty labor time required to grade exams/quizzes/homework more instructor time will be available to interact directly with students.
- > Gradescope seamlessly allows the mixing of question types (e.g. multiple choice and short answer) on exams and reduces grading time. This will facilitate the equitable assessment of higher-level reasoning skills.
- > We can use printed bubble sheets, eliminating the need for scantrons and scantron readers.

Priority: Medium

Safety Issue: No

External Mandate: No

Safety/Mandate Explanation:

Resources Description

Technology - Institutional license to Gradescope from Turnitin. Priced at \$6/student/semester. (Active)

Why is this resource required for this action?: The software facilitates faster and more equitable grading with more useful feedback for students.

Notes (optional):

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Cost of Request (Nothing will be funded over the amount listed.): 7000

Related Documents:

[GradescopeQuote.pdf](#)

Link Actions to District Objectives

District Objectives: 2021-2025

District Objective 3.1 - Reduce equity gaps in course success rates across all departments by 40% from 2021-2025.

Action: Increase degree complete by conforming to standard meeting times. (Student worker)

We are requesting a budget augmentation for a student worker to help set up (and possibly tare down) labs.

Leave Blank:

Implementation Timeline: 2022 - 2023

Leave Blank:

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Identify related course/program outcomes:

Person(s) Responsible (Name and Position): Quinn MacPherson (Associate Physics Professor)

Rationale (With supporting data):

Priority: High

Safety Issue: No

External Mandate: No

Safety/Mandate Explanation:

Update on Action

Updates

Update Year: 2022 - 2023

08/11/2023

Status: Action Completed

Lab times were moved to 1:10 pm and 4:10 pm to align with the college-wide template.

Lecture days for PHYS 56 was updated to MWF to align with the college-wide template.

Impact on District Objectives/Unit Outcomes (Not Required):

Resources Description

Personnel - Classified/Confidential - Hire student worker (Active)

Why is this resource required for this action?: In order to conform with COS's newly circulated standard meeting times, we will be moving our labs 20 minutes earlier. Labs that used to start at 1:30 pm and end at 4:20 pm will start at 1:10 pm and end at 4 pm. However, because we teach lectures during the 12:10-1:00pm hour we will need a student to set up lab so it can be ready at 1:10pm. Even with the current 30-minute spacing, there is often insufficient time for us to set up labs; lab setup in 10 minutes will not be possible. Having a student worker to set up labs between 12:10 and 1:00 pm would alleviate this problem. Having a student set up, and possibly help tare down, labs would also free up time for professors to spend more time on student interaction. The hours for this student could be 3-6hr per week.

Notes (optional):

Cost of Request (Nothing will be funded over the amount listed.): 4000

Link Actions to District Objectives

District Objectives: 2018-2021

District Objective 1.1 - The District will increase FTES by 1.75% over the three years

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District Objective 2.1 - Increase the percentage of students who earn an associate degree or certificate (CTE and Non-CTE) by 5 percentage points over three years

District Objective 2.2 - Increase the number of students who transfer to a four-year institution by 10 percent over three years

District Objectives: 2021-2025

District Objective 1.1 - The District will increase FTES 2% from 2021 to 2025.

District Objective 2.1 - Increase the number of students who earn an associate degree or certificate (CTE and non-CTE) by 5% from 2021-2025.

District Objective 2.2 - Increase the number of students who are transfer-ready by 15% and students who transfer to four-year institutions by 10% from 2021-2025.

Action: (2022-2023) Software to accelerate student grade feedback and format assignments.

We plan to apply for budget augmentation for software.

Leave Blank:

Implementation Timeline: 2022 - 2023

Leave Blank:

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Identify related course/program outcomes: All SLOs. In fact, I use Gradescope when compiling the SLOs.

Person(s) Responsible (Name and Position): Quinn MacPherson & Marc Royster

Rationale (With supporting data): As the number of students in physics grows, we need a way to maintain equitable grading practices. Gradescope software will help us accomplish this.

There are two different software packages we are requesting funds for. The primary one is Gradescope for accelerating student grade feedback.

Gradescope has a number of advantages over the alternative methods: canvas or paper grading:

- Compared to paper submission, Gradescope allows for the remote submission of homework by students and the turn of homework to students. This reduces the time between when a student does a problem and receives feedback.
- The Gradescope grading interface is user-friendly for the grader making grading faster than with either canvas or paper.
- Gradescope allows for the grader to grade all students' problem 1, then all students' problem 2, etc rather than grading each student's assignment as a whole. Grouping problems this way helps the grader be more consistent on how they grade each problem, making grades more equitable.
- Gradescope incorporates full LaTeX support, including comments tagged to locations on the students' work. Since answers and feedback in physics courses are often in the form of equations this feature is essential.

Gradescope costs \$3/student/semester. For physics, this amounts to under \$900/year at current enrolment rates. Covering physical science will be an additional \$75/year. Some of this cost would be recovered because Gradescope refunds us for students who drop before the end of the semester.

The other software license we would like included in the budget augmentation is Overleaf which is used for formatting, organizing, sharing, assignments, homeworks, lab handouts, and exams.

Currently, one physics professor has access to Overleaf through his previous institution's general license. Giving both professors access to this platform would allow them to share and write documents with this software. This would cost approximately \$120/year. See the "Personal" license.

See attached documentation.

Priority: Medium

Safety Issue: No

External Mandate: No

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Safety/Mandate Explanation:

Update on Action

Updates

Update Year: 2022 - 2023

08/11/2023

Status: Continue Action Next Year

We received funding approval for these software applications. However, Gradescope, just announced a change in their billing design to move to institution licenses rather than per-class purchases. We will be working with the technology committee to see if Gradescope is something the college would like to purchase a site-wide license to.

Impact on District Objectives/Unit Outcomes (Not Required):

Resources Description

Adjustment to Base Budget - Budget augmentation for software (Active)

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See attached documentation.

Notes (optional):

Cost of Request (Nothing will be funded over the amount listed.): 1120

Related Documents:

[Gradescope.png](#)

[overleaf.png](#)

Link Actions to District Objectives

District Objectives: 2018-2021

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District Objectives: 2021-2025

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District Objective 2.2 - Increase the number of students who are transfer-ready by 15% and students who transfer to four-year institutions by 10% from 2021-2025.

Action: (2022-2023) Address inequitable textbook access in PHYS 20/21

Purchase Textbooks for PHYS 20/21

Leave Blank:

Implementation Timeline: 2022 - 2023

Leave Blank:

Leave Blank:

Identify related course/program outcomes: All outcomes for PHYS 20 and PHYS 21 will be benefited by these texts.

Person(s) Responsible (Name and Position): Quinn MacPherson

Rationale (With supporting data): Last year received funds to purchase textbooks for the PHYS 55/56/57 series. This has allowed us to ensure that all students - independent of financial status - have access to quality texts from the first day of class. We use a different text, "College Physics: a strategic approach, 4ed" by Knight, Jones, and Field for the PHYS 20/21 sequence. The MESA center was able to obtain 10 copies of the textbook with their funds. However, in fall 2022 the MESA center loaned out all of their copies and there were remaining students who were unable to borrow a copy. Funds permitting - we would like to purchase additional copies of this text.

The price of used texts varies with time and orders are often limited resulting in texts not all costing the same amount. Currently, Knight is being sold used on Amazon for \$120/copy. We would like an additional 15 copies. At a total cost of about \$1800+tax/shipping.

Priority: Medium

Safety Issue: No

External Mandate: No

Safety/Mandate Explanation:

Update on Action

Updates

Update Year: 2022 - 2023

08/11/2023

Status: Action Completed

Funds were acquired and some textbooks were purchased for PHYS 20/21. Ready for loan out to students in fall 2023.

Impact on District Objectives/Unit Outcomes (Not Required):

Resources Description

Equipment - Instructional - Textbooks to loan out to students. (Active)

Why is this resource required for this action?: Last year we received funds to purchase textbooks for the PHYS 55/56/57 series. This has allowed us to ensure that all students - independent of financial status - have access to quality texts from the first day of class. We use a different text, "College Physics: a strategic approach, 4ed" by Knight, Jones, and Field for the PHYS 20/21 sequence. The MESA center was able to obtain 10 copies of the textbook with their funds. However, in fall 2022 the MESA center loaned out all of their copies and there were remaining students who were unable to borrow a copy. Funds permitting - we would like to purchase additional copies of this text.

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about \$1800+tax/shipping.

These texts will be loaned out many times so should serve the college for many years.

Notes (optional):

Cost of Request (Nothing will be funded over the amount listed.):

Related Documents:

[CollegePhysicsKnight.PNG](#)

Link Actions to District Objectives

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Action: 2022-2023 Improve Lab Environment

Replace broken lab chairs (35)

Leave Blank:

Implementation Timeline: 2022 - 2023

Leave Blank:

Leave Blank:

Identify related course/program outcomes:

Person(s) Responsible (Name and Position): Quinn MacPherson and Francisco Banuelos

Rationale (With supporting data): Many of the lab chairs are broken or have missing/loose bolts

Priority: High

Safety Issue: Yes

External Mandate: No

Safety/Mandate Explanation:

Update on Action

Updates

Update Year: 2022 - 2023

08/11/2023

Status: Action Completed

The chairs have been replaced in room 208!

Impact on District Objectives/Unit Outcomes (Not Required):

Resources Description

Equipment - Instructional - 35 armless lab chairs (Active)

Why is this resource required for this action?: safety and maximizing learning

Notes (optional):

Cost of Request (Nothing will be funded over the amount listed.): 30000

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Link Actions to District Objectives

District Objectives: 2021-2025

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