The Chesapeake Scholars Program: Improving retention and enabling student success in the physical sciences

Dr. Chandra Turpen, University of Maryland, College Park

Chandra Turpen is an Associate Research Professor in the Department of Physics at the University of Maryland in the Physics Education Research (PER) Group and Engineering Education Research (EER) Group. Turpen's work involves designing and researching contexts for learning within higher education (for STEM students and faculty).

Dr. Gili Marbach-Ad, University of Maryland College Park

Dr. Marbach-Ad is a Research Professor in science education and the Director of the College of Computer, Mathematical, and Natural Sciences (CMNS) Teaching and Learning Center (TLC). In her role as Director, she promotes faculty adoption of evidence-based teaching approaches in science courses, advocates for teaching reforms, and develops innovative assessment tools for teaching and learning initiatives. She has served as the lead evaluator for three NSF Research Traineeship grants and evaluates several interdisciplinary STEM education initiatives. Additionally, she is a member of the steering committees for several national STEM initiatives.

Dr. Alexandra L Jones, University of Maryland, College Park

Dr. Alexandra Jones is an Assistant Clinical Professor in the Department of Atmospheric and Oceanic Science and the Director of the Undergraduate Program.

Dr. Katerina V Thompson, University of Maryland, College Park

Katerina Thompson is Assistant Dean for Science Education Initiatives and Instructor of Biological Sciences in the College of Computer, Mathematical, and Natural Sciences at the University of Maryland.

Donna Hammer, University of Maryland College Park

Donna Hammer is the Director of Education for the Department of Physics at the University of Maryland. She is Co-I on the Chesapeake Scholars in the Physical Sciences S-STEM Program.

Mrs. Ilcia Hernandez, University of Maryland College Park

Ilcia Hernandez is a doctoral candidate within the School Psychology program at the University of Maryland, College Park. She was the graduate assistant with the CMNS Teaching and Learning Center during the 2024-2025 academic year. As an early-career school psychologist, Ilcia is dedicated to supporting students' academic, mental, and emotional needs through evidence-based practices and approaches.

Dr. Jason Dreyfus Kahn, University of Maryland College Park

Dr. Kahn is an Associate Professor in the Department of Chemistry and Biochemistry. He teaches both undergraduate and graduate classes, both labs and lectures. His research interests are in protein-DNA looping and topology and also in biotechnology applications of modified nucleic acids. He co-mentors the UMaryland iGEM (international genetically engineered machines) synthetic biology team. In addition to advising students through his association with Chesapeake Scholars, he runs the departmental undergraduate honors and awards program.

Krandhasi Kodaiarasu, University of Maryland, College Park

Krandhasi Kodaiarasu is a doctoral student in the School Psychology program, and a graduate assistant with the Teaching and Learning Center at University of Maryland, College Park. Passionate about the human condition and how we navigate learning and the world, she is committed in her work to exploring solutions regarding equity, inclusion, and accessibility in education and mental healthcare in order to promote change within, and beyond, the community – through advocacy and interventions. her research and clinical interests broadly include trauma-informed care for marginalized youth, transformative social-emotional learning practices, and multi-tiered systems of support (MTSS).

Eun-Suk Seo, University of Maryland College Park

Dr. Eun-Suk Seo is Professor of Physics at the University of Maryland. She is PI of the Chesapeake Scholars in the Physical Sciences S-STEM program.

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I. Introduction & Background

Complex social, political, and economic systems influence higher education and shape students' experiences in college. Socioeconomic inequities have grown in the US since the 1980s, while state funding for public colleges and universities has dropped substantially and tuition costs have risen. Additionally, there are substantial racial disparities in wealth accumulation (McKernan et al., 2013). These sociopolitical factors influence students' college experiences, students' ability to have their basic needs met while attending college, and the needs of students' families and communities. Other scholars have documented that "Rates of basic needs insecurity are higher for students attending two-year colleges compared to those attending four-year colleges. Rates of basic needs insecurity are higher for marginalized students, including African Americans, students identifying as LGBTQ, and students who are independent from their parents or guardians for financial aid purposes" (Goldrick-Rab, et al., 2019, pg. 2). The COVID-19 pandemic multiplied the suffering experienced by students and their families (Goldrick-Rab, et al., 2020; Laska, et al., 2020) and has marked how often higher education systems can fall short of orienting holistically to students' wellbeing.

The importance of financial constraints faced by low-income students who might otherwise have the academic talent and preparation to major in the physical sciences is well known. STEM degree programs in general, and physical science programs in particular, are accurately perceived to be demanding, with many challenging lower-level and upper-level courses required to earn the B.S. degree. For students who must work to support themselves during college, this can be prohibitive. Students from financially disadvantaged backgrounds may be unaware of the excellent employment and earnings prospects enjoyed by recipients of bachelor's degrees in physics (American Institute of Physics, April 2017) and other physical sciences.

The structural barriers experienced by African American students in undergraduate physics and astronomy programs were highlighted by the TEAM-UP report: "The briefest summary of the TEAM-UP report is this: the persistent underrepresentation of African Americans in physics and astronomy is due to (1) the lack of a supportive environment for these students in many departments, and (2) to the enormous financial challenges facing them and the programs that have consistently demonstrated the best practices in supporting their success" (TEAM-UP Task Force, 2020, p. 11). The important role that community building and sense of belonging plays in recruitment and retention efforts was emphasized in the TEAM-UP report and has been described by other authors in the broader science and engineering education literature (Fullilove & Treisman, 1990; Murphy, et al., 2007; Shehab et al., 2007; Treisman, 1988; Walden & Foor, 2008). Students interviewed by TEAM-UP most often brought up faculty interactions, finances, and belonging. These factors are tied to persistence. Students' sense of belonging and persistence increased with the number of faculty who know them personally and demonstrate support for their success, as well as by having peers and more advanced students of similar social identity in the department.

There is a growing body of evidence that sense of belonging, the degree to which a person feels that they fit in a particular place, environment, or community, strongly influences academic outcomes (Master and Meltzoff, 2020; Trujillo and Tanner, 2017). A student's sense of belonging to their university and their department has a positive relationship with their motivation and likelihood of earning a college degree (Pedler et al., 2022). Within STEM fields, sense of belonging influences a student's choice of major (Good et al., 2012), their success in STEM courses (Fink et al., 2020; Seyranian et al., 2018), and their persistence in STEM majors (Fink et al., 2020; Good et al, 2012; Rainey et al., 2018). Sense of belonging is closely linked to science self-efficacy and identity as a scientist (Trujillo and Tanner, 2017). Collectively, these form a positive feedback loop that enhances student persistence in science (Graham et al., 2013; Robnett et al., 2015). Key practices that are known to boost sense of belonging for STEM students include undergraduate research, collaborative learning environments, peer support, and active pedagogies (Findley-Van Nostrand and Pollenz, 2017).

To incentivize our scientific community to address these barriers to student success, the National Science Foundation established the solicitation: Scholarships in Science, Technology, Engineering, and Mathematics Program (S-STEM). The goals of the S-STEM program are to "enable academically talented, low-income students to pursue successful careers in promising STEM fields. Ultimately, the S-STEM program seeks to increase the number of academically promising low-income students who graduate with an S-STEM eligible degree and contribute to the American innovation economy with their STEM knowledge" (NSF, 2026). To be eligible for these programs, scholars must be domestic low-income students with academic ability, talent, or potential and demonstrated unmet financial need who are enrolled in a degree program in an eligible STEM discipline. This program recognizes that financial aid alone cannot increase retention and graduation in STEM (NSF, 2026). Therefore, the program provides awards to institutions not only to fund scholarships, but also some resources to adapt, implement, and study evidence-based curricular and co-curricular activities that have been shown to be effective in supporting recruitment, retention, transfer, student success, and graduation in STEM.

This paper seeks to introduce the Chesapeake Scholars program at University of Maryland, College Park. This program was developed with support from NSF Award #2221369, seeks to enable undergraduate student success within the physical sciences. Specifically, we seek to: (a) increase retention among academically talented bachelor's degree candidates with unmet financial need who enter a physical science major through a range of pathways and (b) increase students' self-reported sense of belonging to their disciplines and their Scholars cohort through scholarships, academic support, mentoring, and community building (Walden & Foor, 2008; Zaniewski & Reinholz, 2016). Through the programming we lead and the relationships we build, our team provides personalized financial, academic and professional support to newly admitted physical sciences students and transfer students throughout their journeys at UMD.

II. Study Context and Program Design

A. Institutional Context: Undergraduate Physical Science programs at UMD

The University of Maryland, College Park (UMD) is the flagship campus of the University System of Maryland, a Carnegie Research Intensive University, a member of the Association of American Universities, and the State's Land Grant College. UMD enrolls 31,000 undergraduate and 10,600 graduate students in 107 undergraduate programs and more than 200 graduate programs. Science education is centered in the College of Computer, Mathematical, and Natural Sciences (CMNS), which is made up of 10 departments: Astronomy (ASTR), Atmospheric and Oceanic Science (AOSC), Biology (BIOL), Cell Biology and Molecular Genetics (CBMG), Chemistry and Biochemistry (CHEM), Computer Science (CMSC), Entomology (ENTM), Geology (GEOL), Mathematics (MATH), and Physics (PHYS). As a large R1 university, our campus and regional partnerships offer many opportunities for undergraduate research experiences. Undergraduate students that complete our physical science programs are in-demand by the regional and national economy, and they are met with excellent job prospects.

Our institution has successfully implemented programming associated with two previous (smaller) S-STEM awards, one serving undergraduate physics students (Focus on Physics) and one serving engineering students (EES). Our current Chesapeake Scholars program design leans heavily on lessons-learned from these local programs.

B. Introducing the Chesapeake Scholar's Program

Our Chesapeake Scholars program is a collaboration across various undergraduate physical science majors at UMD including Astronomy (ASTR), Atmospheric and Oceanic Sciences (AOSC), Biochemistry (BIOCHEM), Chemistry (CHEM), Geology (GEOL), and Physics (PHYS). The Chesapeake Scholars program is led by nine UMD faculty and staff members: Physics' Eun-Suk Seo, Thomas Gleason, Carter Hall, Donna Hammer and Chandra Turpen; Astronomy's Melissa Hayes-Gehrke; Atmospheric and Oceanic Sciences' Alexandra Jones; Chemistry and Biochemistry's Jason Kahn; and Geology's John Merck.

We documented that our students take three to four years to graduate, depending on when they declare their major, whether they change majors, and whether they transfer into our institution often from a community college. By collaborating with our financial aid office, we also learned that our physical science students with unmet financial need and a GPA > 3.0 have an average unmet need of $13,531.

As part of developing our 2022 S-STEM proposal, we engaged in a self-study of our in-discipline retention rates. First, we considered the sample of all traditional four-year students with unmet financial need who declared a physical science major in their freshmen year. The percentage of these students retained within the *same major* in the second year was 58% (64/110). Looking at matriculation cohorts from Fall 2011 to Fall 2015, the six-year in-discipline graduation rate for four-year physical science students with unmet need is 33% (47/143). The remaining 67% (96 students) departed their original physical science major. This illustrated that our in-discipline retention rates had substantial room for improvement. We sought to improve these retention rates through our proposed program. Next, we examined where these "leavers" ended up by looking at all students regardless of financial need. We considered four-year

students who started in the physical sciences as freshmen in the Fall of 2015 and completed any degree at the University of Maryland within six years. Among such students, 104 out of 168 left their original physical science discipline for another degree program. Among the 104 'leavers', 57 (55%) left for a non-STEM degree, 39 (38%) changed to another STEM field outside of physical science (such as engineering, computer science, or biological sciences), and seven (7%) changed to another physical science discipline. This analysis showed that we have substantial room for improvement in retaining students in our physical science majors, more than half of whom leave STEM entirely.

Our Chesapeake Scholars program was designed to serve a heterogeneous mix of traditional four-year students who enter with a declared physical science major (~50%), traditional four-year students who change majors (~25%), and transfer students (~25%). We sought to serve a diversity of physical science majors.

Lastly, our program partnered with Dr. Chandra Turpen as our internal evaluator and two external evaluators, Dr. Gili Marbach-Ad and Dr. Kaci Thompson, to gather formative feedback on our program and to help us monitor the impacts of our programming. Two Graduate Assistants in the CMNS Teaching and Learning Center, Ilcia Hernandez and Krandhasi Kodaiarasu, have also supported this evaluation work. These collaborations between the project team and the evaluation team helped us to adjust the design of our program and monitor the extent to which we were meeting our goals.

C. Who does the Chesapeake Scholars Program serve?

Since we started, our Chesapeake Scholars program has supported 31 students across three cohorts. Our first cohort of students joined the program in the Fall of 2023. Cohort 2 and Cohort 3 were launched in Fall of 2024 and Fall of 2025 respectively. Our Chesapeake Scholars program seeks to support undergraduate students that started their college trajectories at UMD and those that transferred to UMD from another institution. Similarly, we are interested in reaching students that started as physical science (PS) majors and those that change course and enter a physical science (PS) major at a later point in time.

Table 1: The student populations reached by our program across different cohorts of Chesapeake Scholars.

	Num. of UMD first-years that started within a PS major	Num. of UMD first-years that switched into PS majors	Num. of UMD external transfers	Total
Cohort 1	9	0	0	9
Cohort 2	6	2	7	15
Cohort 3	0	1	6	7

Our first cohort reached nine first-year students at UMD that had all entered with physical science majors. Our second cohort reached six first-year students at UMD that had all entered with physical science majors, two students that started their college careers at UMD and switched into a physical science major, and seven transfer students. Our third cohort reached one student that started their college careers at UMD and switched into a physical science major and six transfer students. Table 1 highlights how our program has gradually shifted from primarily serving first-year UMD students, to serving a mixture of first-year UMD students and "switchers" and transfer students, to primarily serving transfer students.

Our program serves students from a range of physical science majors. Table 2 below describes the distribution of physical science majors participating in our program as the beginning of the Fall 2025 semester. We note that some of our students are double majoring, particularly across physics and astronomy, therefore the totals will be greater than the total number of scholars in our program.

*Table 2: Composition of Scholars' majors (as of Fall 2025) *Note: Many of our Astronomy majors are double majors with Physics.*

	Undergraduate Major (in-progress)	Undergraduate Major (graduated)
AOSC	2	0
ASTR*	6	0
BIOCHEM	11	0
CHEM-BA	0	1
CHEM-BS	3	0
GEOL	1	0
PHYS*	7	0

D. What kinds of social and academic support are offered?

The Chesapeake Scholars Program provides more than financial assistance for fall and spring semester cost of attendance. Although that is a key component of addressing retention, we provide a variety of other benefits that impact retention, professional development, and activities to promote a sense of belonging to the program and the disciplines. This includes field trips to national laboratories, optional support for summer tuition, running cohort specific courses and discussion sections, assisting students with finding and securing undergraduate research opportunities, and an innovative mentoring model, described in the next section.

Students entering the program as freshmen are required to take a one-credit course introducing them to the university and strategies for success in college. Significant class topics include time

management, learning strategies, academic rules & regulations, academic integrity, bystander intervention, and career planning. Additionally, they visit useful resources on campus such as makerspaces and tour a biophysics research lab. Students have completed multiple reflection assignments relating to these topics and their progress in their academic careers. In addition to helping them start their journey at the university on solid footing, this cohort specific class provides opportunities to get to know one another and form a connection to each other and the program. Due to our location in the National Capital Region, we are able to take advantage of the numerous opportunities to visit national laboratories. Past trips have been to NOAA's National Center for Environmental Prediction, NASA Goddard, and the NIST Center for Neutron Research.

We partnered with our university's Office of Undergraduate Research (OUR) to reserve seats for our scholars, who were at the sophomore level and above, in their half-semester one-credit course, OURS100 Entering Research. Designed for students who are interested in getting involved with undergraduate research, OURS100 provides a structured, step-by-step approach to developing a path to undergraduate research experiences. From identifying research interests to confidently contacting faculty members, this course helps students develop essential skills for engaging in research and building transferable skills in professionalism and communication. During the course, students are immersed in an online community of peers seeking research opportunities while receiving direct support and peer mentorship from experienced undergraduate researchers. In addition to the formal instruction of this course, we hosted an informal discussion section just for Chesapeake Scholars. We engage the scholars in conversations and activities designed to increase camaraderie and assist participants in their pursuit of research opportunities. Students brainstorm where to find opportunities and peer review each other's resumes and cover letters. Our discussion topics cover previous research experience, professional networking, soliciting recommendation letters, and writing cold emails to approach faculty about working in their research groups.

We also created a process for students to apply for funding of a summer research opportunity on campus. The application process had three stages. First, the student indicates interest and provides the name of the faculty member on campus who agreed to mentor them and a very brief description of the intended project. Second, we follow up with mentors to confirm their willingness to participate and share mentoring resources with them. Third, the mentor and student work together on a very brief proposal, which includes a 250-word abstract, a detailed outline of the project timeline including specific objectives, methods, training requirements, and expected products/outcomes. They are also asked to describe the expected impacts on the student's professional development and complete a mutual expectations agreement that outlined frequency and patterns for communication, meetings, and work hours.

Throughout a student's time in the Chesapeake Scholars Program, they are provided with a variety of mentoring experiences, which are described in detail in the next section. Some of the program team members are academic advisors for many of the scholars. Having this expertise on the team allows us to respond to the student's academic needs by pointing them to on campus resources, and in some cases launching new initiatives within the program such as

summer tuition support and tutoring support during the semester. When a student needs to retake a class due to an unsatisfactory grade or can benefit from getting ahead on course work to lighten the upcoming load, we have a process for students to apply for summer tuition support. Students identify a course being offered in the summer and provide a justification for how it will positively impact their academic progress toward degree completion or career goals. We then verify whether financial support for that student had already been maxed out for the year according to NSF limits, and if funds are available, we apply funds to the student's account for summer tuition.

E. Introducing our innovative mentoring model

We established mentoring as a key component of our program. Students in the Chesapeake Scholars Program are assigned an academic advisor within their major as well as an additional mentor from the Chesapeake Scholars Program team, often from a discipline outside their major. Finally, students have the option of engaging in mentoring and cohort building with both peers and other members of the Chesapeake Scholars Program Team.

Upon entry to the University of Maryland, students are assigned an academic advisor. In the physical sciences majors within our program, students are required to meet with that advisor at least once per semester, prior to registering for the next semester's courses. Several members of the Chesapeake Scholars Program Team are academic advisors within their home departments. Almost every Chesapeake Scholar student is assigned to an academic advisor who is also a program team member. The benefits are numerous and include direct knowledge of student academic progress and success, as well as familiarity with common student concerns and available resources on campus.

While having a discipline specific academic advisor is key to academic success, students also benefit from having a mentor impartial to academics. Each team member mentors 2-4 students when the program is at full capacity. Students are assigned to program team mentors so that there isn't duplication with their academic advisor. Often, mentors are from a different discipline within the physical sciences. This allows mentoring meetings to focus on topics beyond academic performance, such as professional development and challenges and accomplishments outside of the classroom. We aim for these mentoring meetings to take place once per month during the fall and spring semesters. One-on-one meetings between mentors and mentees can be particularly useful when a student is experiencing challenges and needs more dedicated support and attention. Some of our program team members have found success in holding joint mentoring meetings with all or some of their mentees as schedules permit and when students don't require individualized attention. In the group format, students can also mentor each other by sharing their common experiences and tips for success. This also helps students get to know other Chesapeake Scholar students and may contribute to their sense of belonging to the community.

While semesterly meetings with their academic advisor and monthly meetings with their program mentor are required, students have the option of participating in additional mentoring

and cohort-building activities. They can reach out to any member of the Chesapeake Scholars Program team at any time. They can also participate in activities organized and attended by the team, which include monthly game nights, on campus discipline-based activities such as community outreach events and undergraduate research presentations, and occasional field trips and professional development activities. For example, we host an ice cream social at the beginning of each academic year. Additionally, students are invited to attend the Physics is Phun Show and a pre-show dinner just for Chesapeake Scholar students. Students have the opportunity to visit a working astronomy observatory and explore the wonders of the night sky. Students can attend field trips to federal labs and facilities due to our location in the national capital region (such as NIST or NASA). Over the summer we hosted a couple of brown-bag lunch time gatherings for any members of the community on campus taking courses, doing research, or those in commuting distance who just wanted to check in and socialize. We recently started a tradition of holding an annual research extravaganza in the fall, where students can present research that they completed the previous spring or summer. Finally, we have a dedicated study room for Chesapeake Scholars to utilize during the building's open hours. Each student has been granted access, and they can choose to drop in or coordinate with each other to study and socialize together.

F. Our Logic Model: Connecting Activities to Student Outcomes

As part of developing the activities and structures of the Chesapeake Scholars program, our team also sought to connect these designs to the short-term and long-term outcomes that we hoped to achieve in a logic model (Reinholz & Andrews, 2020). Figure 1 below visually represents the core activities of the Chesapeake Scholars Program and hypothesizes connections between those to the short-term and long-term outcomes that we predict will result from these activities. The sun icon indicates the primary outcomes that we seek to evaluate.

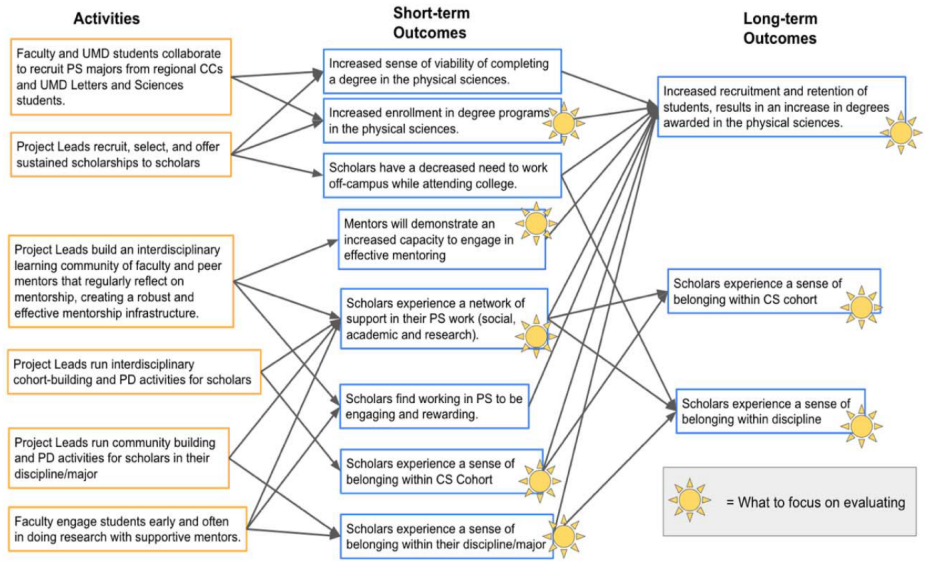

Figure 1: Logic Model of the Chesapeake Scholars Program. Abbreviations are ID = Interdisciplinary, CS = Chesapeake Scholars, PD = Professional Development, PS = Physical Sciences, CC = Community College.

III. Methods

A. Overview

This paper reports on our efforts to formatively assess and monitor the short-term and long-term outcomes of the Chesapeake Scholars Program. The evaluation team includes five team members. One internal evaluator, who is also a PI on the project, and four external evaluators, including two faculty members who are specialized in science education research and two doctoral research assistants from the School of Psychology. We utilized a mixed-method evaluation, including a mid-academic year survey in students' first year in the Chesapeake Scholar program, several focus groups with students and project team members, and artifact analysis from project team meeting notes.

As an evaluation team, we begin by monitoring the activities that are implemented and students' participation in these activities. Secondly, we focus on measuring the impacts of these activities on our Chesapeake Scholars by documenting: (i) how they experience their major programs and the Chesapeake Scholars program as supportive (with respect to effective mentoring, and social academic integration) and (ii) how these experiences result in learning, such as cultivating a sense of belonging and community, and a strong commitment to degree completion within the physical sciences. Our evaluation team also focuses on gathering formative feedback about the strengths of our program and areas for improvement, largely through small focus group interviews. These focus group interviews with students also help us to posit connections between the activities we run and the impacts we are documenting. Feedback from participants is used to evaluate the program's impact and iteratively improve our program from year-to-year.

B. Mid-academic year survey in first year as a Chesapeake Scholar

At the beginning of our project, we developed a mid-academic year survey for our Scholars to: (a) document their satisfaction with and perceptions of the program overall and its specific components (e.g., seminars, mentorship network), (b) gather students' formative feedback on program components, (c) understand their beliefs in their ability to earn a degree in the physical sciences, and (d) monitor their sense of belonging (in their disciplinary programs and within Chesapeake Scholars). To design this survey instrument, we built from existing validated instruments including the Aspects of Student Experience Scale (ASES) (Sachmpazidi & Henderson, 2021), Sense of Belonging in Math Scale (Good, Rattan, and Dweck, 2012), Scales on social and academic integration and goal commitment (Pascarella & Terenzini, 1980), and STEM degree completion intentions (Perez, Cromley, & Kaplan, 2014). Clusters of items adapted from these instruments were used to document how Scholars experience their major programs and the Chesapeake Scholars program as supportive (with respect to effective mentoring, and social academic integration), and how these experiences result in learning, such as cultivating a sense of belonging and community, and commitment to degree completion within the physical sciences.

In this paper, we focus specifically on the "membership" construct drawing on a subset of items from the Sense of Belonging in Math Scale (Good, Rattan, and Dweck, 2012). These three items included the statements: (1) I feel that I belong to the community; (3) I feel like I am part of the community; and (4) I feel a connection with the community. We adapted these items to include two distinct community framings: (a) When I am in a setting related to my physical sciences major… and (b) When I am in a Chesapeake Scholars setting… So, our respondents responded to these items twice with respect to each community setting. This allows us to track students' sense of membership (as a component of sense of belonging) within both communities.

Students responded to this survey in late December or early January in between their first and second semester as a Chesapeake Scholar. We have administered this survey to cohort 1 and cohort 2 (which we report on here). In January 2026, we are also administering this survey to cohort 3 students. In the future, we intend to survey our Scholars again in their last semester at UMD prior to graduation to monitor long-term outcomes of our program.

C. Focus groups with Chesapeake Scholars

To complement the data from the survey, the evaluation team convened focus groups with Chesapeake Scholars in their second semester and following one year in the program. The focus group protocol included questions to gauge feedback about program components (e.g., the UNIV/CMNS 100 course, monthly mentoring meetings with project team members within Chesapeake Scholars (CS), and advising support from their programs), as well as sense of belonging to the students' discipline, and sense of belonging to the CS program community.

Overall, the evaluation team conducted focus groups on four occasions (since we couldn't gather all students at the same time, on most occasions we divided the fellows into two focus groups, each lasting around one hour). In Spring 2024, following one semester in the program, we interviewed eight of the nine cohort 1 fellows, all of whom started as freshman at UMD and enrolled in the UNIV100 course. In Fall 2024, after completing three semesters, we interviewed six out of the seven fellows who remained in the program and were in physical science majors. In Spring 2025, we interviewed 12 fellows out of the 15 fellows of cohort 2. These focus groups included all six fellows who started as freshman at UMD, and six of the nine transfer fellows. Focus group interviews were audio-recorded and transcribed. Examples of responses are included to contextualize the data, and quotes are edited slightly for clarity.

D. Artifacts from project team meetings and monitoring of students' academic progress

Our project team meets twice monthly to share updates from our mentoring meetings and collectively plan activities. We keep agendas and meeting minutes in a shared document which helps us distribute tasks and responsibilities and monitor our project implementation. We also keep spreadsheets that help us monitor students' participation in Chesapeake Scholar programming. We revisited project team meeting notes and mentoring records to inform our

interpretations of survey results and focus group findings, as well as monitor students' progress toward degree completion.

E. Limitations

Each cohort of Chesapeake Scholars is limited to between 7-15 students. Therefore, our evaluation activities face the challenge of having a small number of participants. We note that this is an unavoidable fact in assessing small programs. Our small sample does however prevent us from making strong claims and from generalizing our results.

We also note that not all students have participated in the focus group interviews and responded to our survey. Our focus group interviews have reached a large proportion of our Scholars (89% in Spring 2024, 86% in Fall 2024, and 80% in Spring 2025). We note that in the Spring of 2025, we had a slightly lower rate of participation for our transfer students (67%), than our first-year students (100%). Similarly, our response rates to the mid-academic year survey were high but did not capture all student perspectives. For cohort 1, 8 of the 9 UMD first-year Scholars took our Winter Survey (for an 89% response rate). For cohort 2, 5 of the 6 UMD first-year Scholars took our Winter Survey (for an 83% response rate). For cohort 2, 6 of the 9 transfer Scholars took our Winter Survey (for an 67% response rate). We are unable to report on a response rate for Cohort 3 at this time, because the survey has not yet closed. Across these administrations, we do not have a clear understanding of how our sample of respondents may be biased. Although we know that students that leave UMD or leave the Chesapeake Scholars program are no longer participating in these assessment activities.

IV. Results

A. Result #1: An Initial Look at Student Retention

Here we take an initial look at our program's success in retaining students at UMD and within physical science majors at UMD. In this analysis, we do not examine cohort 3, since they have only participated in our program for one semester.

One of our program goals is to retain and support students in finishing undergraduate degrees at UMD and specifically degree programs within the physical sciences. At this point, we can only report on "semester-to-semester" retention within the physical science majors, as very few of our scholars have graduated yet. Table 3 below displays whether a Chesapeake Scholar student has: (a) left UMD entirely, (b) shifted to pursuing a non-physical science major at UMD, (c) continued to pursue a physical science degree at UMD, or (d) graduated from UMD with a physical science degree. As shown in Table 3, Cohort 1 has a 78% retention rate in the physical sciences at UMD and Cohort 2 has a 100% retention rate in physical sciences at UMD, as of December 2025 (after 3 semesters in the program).

Table 3: This table presents the percent of each Scholar cohort that has (a) left UMD entirely, (b) shifted to pursuing a non-physical science major at UMD, (c) continued to pursue a physical science degree at UMD, or (d) graduated from UMD with a physical science degree. We also give the number of students to contextualize these results within a small program.

	Left UMD	Pursuing a non-PS degree at UMD	Pursuing a PS degree at UMD	Graduated with a PS degree	Total
Cohort 1	11% (N=1)	11% (N=1)	78% (N=7)	0% (N=0)	9
Cohort 2	0% (N=0)	0% (N=0)	93% (N=14)	7% (N=1)	15
All Scholars	4% (N=1)	4% (N=1)	88% (N=21)	4% (N=1)	24

Overall, we are succeeding at retaining our Scholars in our program and in their physical science majors though many of them have yet to graduate. Cohort 1 has a 78% retention rate in the physical sciences at UMD (with one of the nine leaving UMD entirely and one switching to elementary education at UMD). Currently, Cohort 2 has a 100% retention rate in physical sciences at UMD. These are promising year-1 to year-2 retention rates, particularly compared to our previously documented baseline in-discipline retention rate of 58% (for first-year students with a declared major in the physical sciences and unmet financial need). We do note that some of our Scholars in Cohort 2 are encountering some struggles with their coursework. We have needed to send some warning letters to Scholars to bring their GPAs up and we have built additional support structures to enable their success. In our future work, we intend to report on our program's long-term impacts on students' degree completion in the physical sciences.

B. Result #2: Monitoring students' Sense of Belonging in their physical science programs and within Chesapeake Scholars

In this results section, we begin to analyze and monitor Chesapeake Scholar students' sense of belonging across settings. We begin by analyzing three survey items from the "membership" factor of the sense of belonging survey instrument. We examine mid-academic year survey responses from cohort 1 & cohort 2 (for a total of 19 responses), which includes: UMD "first-years" (N=13 respondents) and UMD "transfers" (N=6 respondents). First, we illustrate that our students' report a greater sense of belonging in the Chesapeake Scholars community, when compared to the community that they encounter in their physical science majors more broadly. Unfortunately, we do not have campus-wide measures available for comparisons. Drawing on evidence from focus group interviews, we claim that elements of the Chesapeake Scholars program may be responsible for fostering this sense of belonging within the program.

B1. Students report a higher sense of membership within Chesapeake Scholars than in their disciplinary programs.

Figure 2 below displays relative frequencies of scholars' overall sense of belonging across their communities, within their physical sciences majors and the Chesapeake Scholars Program. Nineteen scholars total (inclusive of those who started their first years at UMD and transfer students) responded to three items twice, once in reference to the Chesapeake Scholar setting, and once with regards to their major in physical sciences. The three items were*:* (1) I feel that I belong to the community, (3) I feel like I am part of the community, and (4) I feel a connection with the community.

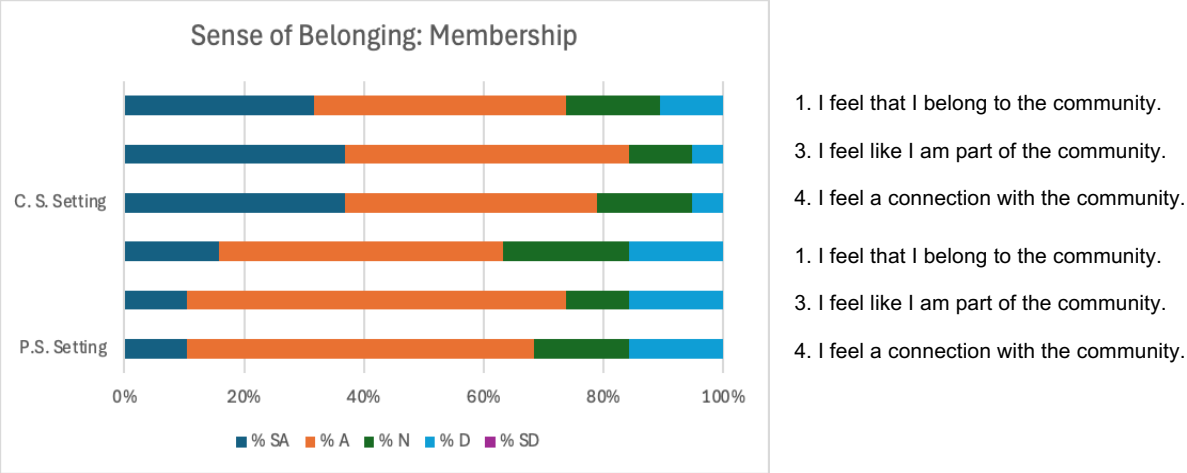

Figure 2: Overall Comparison of Students' Sense of Belonging Across Communities (C.S.: Chesapeake Scholars Setting and P.S.: Physical Sciences Setting) with first-years and transfers combined. Key Abbreviations: SA = Strongly Agree; A = Agree, N = Neutral, D = Disagree, SD = Strongly Disagree.

Fellows largely appeared to agree that they felt a higher sense of belonging in the Chesapeake Scholar setting overall across the three items, with 74-85% of students stating that they "agree" or "strongly agree" that they belong in the Chesapeake Scholars program, in comparison to the 63-74% of students stating that they "agree" or "strongly agree" that they belong in their major. Of note, more students (32-37%) stated that they "strongly agreed" on their sense of belonging within the Chesapeake Scholars community, almost three times as many students that "strongly agreed" that they belonged in their physical sciences major (11-16%).

B2. Students report that elements of the Chesapeake Scholars program may foster this sense of belonging within the program.

When asked what exactly promoted this stronger sense of belonging within the Chesapeake Scholars community as compared to their majors, students discussed specific program benefits that were supportive to their learning. Within focus groups, students from the first cohort within their first year, highlighted that the CMNS/UNIV100 course was particularly helpful. One student mentioned the reflection activities that were incorporated through the course's curriculum:

> *"[We] look[ed] at these journal entries [that we wrote] for at least the first few weeks that were about just various topics that were relevant to us. Like, I think maybe 'why he chooses college, why he chooses major', like career goals and stuff…And then provide your own feedback. And so it was pretty nice to see what other people were up to and how they thought about things."*

Another student described how 'shared struggles' brought scholars together:

> *"So, I mean, that sounds weird to say, but it's nice to see that everybody was struggling like we all had, like our complaints or like problems. So like, that's that sense of community that you're not just the only one that's having a hard time…"*

Some students also mentioned that monthly check-ins with their faculty mentors provided them with opportunities they would not have otherwise known about.

> *"I think the monthly check ins, we have to be in advisory because…we don't know our teachers… So it's nice to have at least, like another door on campus, that we can talk to….she [the faculty mentor] gets you…"*

One student in particular mentioned the benefits of having a mentor who was also in the same department as them:

> *"...especially since she's… in the physics department, you know, she comes to me with a lot of opportunities, such as, like the conference that's being held for… the underrepresented minority in physics... I would never have gotten [it] if, like, I wasn't in this program…"*

Cohort 1 students further along in the program, at the beginning of their second year at UMD, described finding friends in peers within the Chesapeake Scholars program, making shared classes and major programs feel less daunting.

> *"My first impression was how tight knit the community was. Being a freshman, you don't really know anybody on campus really. And already, like, from the first days, we already*

had the [Chesapeake Scholars program]. And a lot of us are also taking the same major. So it was like, Oh, we're going to see these faces again and again. It's like, Oh, I know that person from Chesapeake Scholars. I thought that was pretty cool."

"For me, it was like because we were all new to the campus and because, like you said… a lot of us have the same major [and take] organic chemistry. So like, especially in the chem lab, which can be a little bit confusing, it was nice to have someone that you could reach out to, to ask questions to. And now I have Orgo with [peer scholar] and we're like bouncing ideas back off of each other all the time. So it's really helpful to have a friend from [the Chesapeake Scholars program] that carries over to classes."

Scholars across both cohorts, both first-years and transfers, appreciated the social activities planned within the Chesapeake Scholar program, such as field trips or ice cream socials, as well as peer support and networking across cohorts, lending itself to a stronger sense of community overall amongst students.

"Kind of like with the NASA trip, it helped set us up for finding internships, for finding people to discuss their research and how to put yourself out there. I think that's very helpful."

"Just a couple of days ago, I was messaging someone in another cohort asking them a question, and they were very helpful, too. I think it just helps me feel more involved on campus. It gives me another reason to come to school and be present."

B3. Differences in First Year and Transfer Scholars Students' Sense of Membership

Figures 3 and 4 depict the levels of sense of belonging as experienced by fellows in the Chesapeake Scholars program across Cohort 1 and 2, analyzing results from the mid-academic year survey. We specifically report a subset of three items adapted from the Sense of Belonging in Math Scale which speak to students' sense of membership.

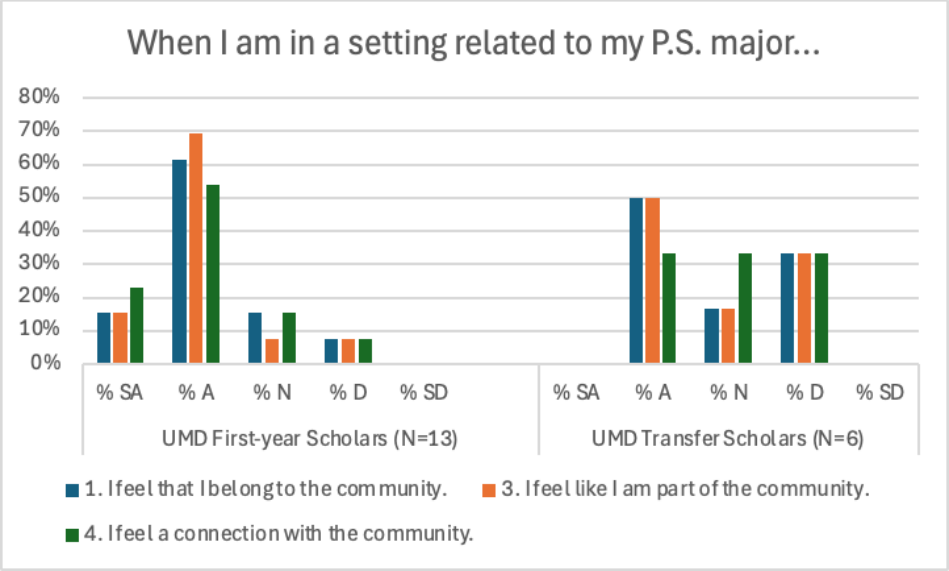

Figure 3: Students' Sense of Membership Within Physical Science Major Settings

Students of the Chesapeake Scholars Program that had started their first-year at UMD tended to agree more that they felt a sense of membership to their major, with 77-84% of students stating that they "agreed" or "strongly agreed," while only 33-50% of transfer scholars stated as such, when asked if they felt that they were members of their major's community.

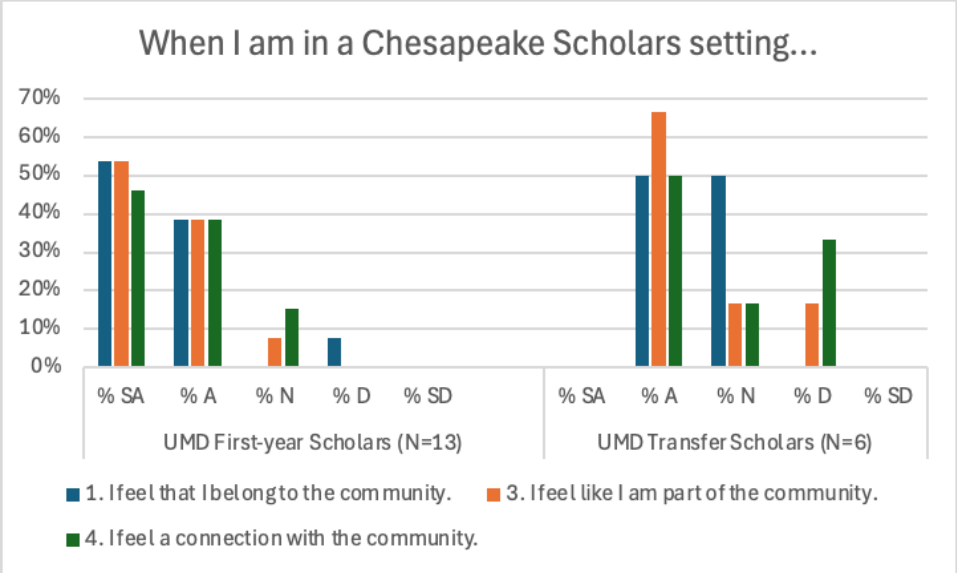

Figure 4: Students' Sense of Membership Within the Chesapeake Scholars Program Settings

Similarly, students that had started their first-year at UMD tended to agree that they felt a sense of membership within the Chesapeake Scholar community, with 84-92% of students stating that they “agreed” or “strongly agreed,” while 50-67% of transfer scholars felt they were members of the Chesapeake Scholar community, more so than previously described with comparison to their major.

We speculate that this tangible difference in sense of membership between transfer scholars and first-year scholars can be attributed in part to the CMNS100 course that first-years are expected to enroll in. One student in Cohort 2, a continuing first-year, particularly described how being in the CS program helps ease the transition to college, particularly by bringing together students with shared interests in STEM and similar academic goals.

> *“It was nice, because I think we're all in the same situation. We obviously have an interest in STEM, and also the majority of us are freshmen as well. So it was nice being in a space where everyone had the same interests, we're all after the same thing, right? Because not a lot of people–like I have friends that are in a different major, and they find it hard finding people within the same major as them.”*

However, when asked about peer mentoring, some Cohort 1 scholars, at the beginning of their second year at UMD, anticipated unique challenges. Students found the program’s intent to build a community of scientists valuable, but noted that the upcoming year's cohort includes many transfer students, and the mixes of majors and years across cohorts would complicate this goal. They also noted that transfer students may feel isolated due to their shorter time in the program, leading to a lack of connection with others.

Our evaluation team prompted our cohort transfer students to react to the idea of building a peer mentoring program. One transfer student commented on the challenges of designing such a peer mentoring program that served all students’ needs.

> *I'm not sure necessarily if I would be mentored as easily by cohort one, I think because they are... about at our level or younger, I think a lot of them were freshmen. And they're also very different, like they're mostly chemistry, biochemistry, I think. So it might not fit as well for me, but, um, I would definitely be …open to mentoring, just sort of in general. Like if someone's coming into the college for the first time or something like that, just like in general. I would definitely… I would be down for that because I feel like it's a very smart idea to just help people integrate better into the college because it's very… it's hard [getting used to] college. So having someone to help you integrate better into the community will definitely be good.*

We can see in this quotation that transfer scholars report that it could be difficult to find common ground with first-year scholars, especially if they are in different majors or are in less advanced courses.

V. Discussion

Major insights from all focus groups on their thoughts and feedback about the Chesapeake Scholars program are summarized below.

A. Strengths of the Chesapeake Scholars Program

Students highly valued their approachable mentors, who provided both academic advice and personal guidance, enhancing their college experience. Regular, monthly, one-on-one meetings fostered strong, supportive relationships that helped students navigate challenges in pursuing their academic and career paths. Transfer students especially found value in mentorship as it assisted them in their transition into UMD, providing genuine, informal conversations and offering advice on future opportunities like internships.

Students also stated that they had built strong friendships and a sense of community through shared classes, goals, and activities. Approachable professors and supportive peers across cohorts encouraged campus involvement and deeper engagement with their studies. The program's welcoming events and networking opportunities, such as orientations, ice cream socials, conferences, and internships, further strengthened connections and future prospects. The UNIV100/CMNS100 courses served as an anchor for students who took it, providing structure when talking to professors or participating in lab tours.

Scholars enjoyed educational experiences, like field trips to MakerSpace, NASA, NIST, and physics labs, which facilitated networking and exposure to topics beyond their coursework. A dedicated study space provided for Scholars exclusively, was said to be a reliable and comfortable environment for students, especially commuters, to focus on their work.

Tuition assistance was emphasized as a significant factor in allowing students to focus on academics with reduced stress of financial burden.

B. Opportunities for improvement

Students offered suggestions to strengthen academic support by pairing mentors with similar academic backgrounds to provide more program-specific guidance. They also identified the range of mentorship approaches—some more structured and goal-oriented, others more flexible and encouraging—that impacted each student differently. Cohort 1 students recommended enhancing communication and establishing clearer pathways for accessing tutoring and academic assistance. Transfer students especially expressed a desire for more proactive mentor check-ins, as well as clearer communication about the mentorship program, to ensure all students benefit from available guidance. They also suggested a liaison (i.e., student board) between students and faculty as a way to enhance communication and incorporate student feedback.

Across cohorts, students emphasized the importance of clear communication and accessible academic resources. Cohort 2 suggested creating a centralized platform (such as ELMS) to streamline access to tutoring hours and academic support. Cohort 1 highlighted the need for improved communication about field trips, events, and financial assistance, preferring consistent email updates and greater transparency. They also expressed strong interest in accessing research opportunities.

Students across cohorts emphasized the need for stronger community-building and more intentional opportunities to connect, though they also acknowledged their own challenges with making and protecting time for such activities. Cohort 2 participants suggested structured social events, better-planned field trips, and more cross-cohort engagement. Cohort 1 students valued being among like-minded peers but sought more organized events and communication to foster deeper connections across cohorts. Many expressed interest in becoming peer mentors to support new students and develop leadership skills.

Students highlighted a need for additional support during academic transitions. Transfer students appreciated faculty guidance but found course planning somewhat challenging and requested greater flexibility in course offerings. Cohort 1 students discussed balancing research responsibilities with other commitments and encouraged future cohorts to be proactive in building connections and utilizing available resources.

From the perspectives of our project team members, we have recognized that our university's policies around freshman forgiveness and course retake seem to serve our Scholars well and positively contribute to their capacity for bringing up with GPA within the grace period (pending their continued interest in re-taking that course). Additionally, our project team thinks that supporting our Scholars over the summer term has served them well, and we envision continuing this practice as needed going forward. We have developed a more transparent process for students to use to request summer tuition support. We remain optimistic that our seven continuing Cohort 1 Scholars and our fifteen continuing Cohort 2 Scholars will succeed in their chosen physical science programs.

VI. Conclusions

We have documented initial signs of success for our Chesapeake Scholars Program. The vast majority of our Scholars are continuing their pursuit of a physical science degree. Most of our scholars have developed a sense of belonging within the Chesapeake Scholar program and some are developing a sense of belonging within their physical science programs. We will continue to implement our innovative mentoring model and associated academic and social support programming. We will continue to adapt this programming to meet the needs of students, particularly as they get closer to graduating. Now that our program has grown to span multiple majors and various years in college, we are launching a peer mentoring program to better connect students across cohorts.

Student feedback indicated that transfer students reported a lower initial sense of belonging (at the end of their first semester in the program), consistent with known challenges associated with entering large research universities through non-traditional pathways. In response, our program is implementing transfer-specific onboarding, enhanced peer mentoring by advanced Scholars, and earlier faculty engagement focused on research and academic planning. These targeted interventions are designed to accelerate social and disciplinary integration and strengthen transfer students' sense of belonging within both their majors and the Scholars cohort.

In our evaluation activities, we will continue to monitor short-term and long-term impacts on our Scholars. We look forward to reporting on their retention through to graduation in the coming years. In the coming months, we hope to learn from other successful S-STEM programs across the country to iterate on the design of our program. We intend to take our local formative feedback and lessons learned from others to secure a second S-STEM grant to continue to support students' success, particularly for those students with unmet financial need.

We conclude by letting some of our Chesapeake Scholar students speak for themselves. In a recent news piece from our college one of our Chesapeake Scholar students, Jamil "Jam" Yacoubou Adam shared that "One of the biggest challenges I've overcome as a result of this program has been making STEM friends. It was difficult for me, as someone who looks and sometimes acts like a stereotypical athlete, to feel like I belonged in the lab or at a conference" (CMNS, 2025). Jam continued to reflect, saying: "This program has let me build bridges with people I probably never would have met or gotten to know because I just assumed the only things we had in common are our classes. It's made me more confident in what I can do in the future after graduation" (CMNS, 2025). Our project team hopes to continue to support students like Jam in seeing a place for themselves in the physical sciences.

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