



THE BOSTEM INITIATIVE

Creating Pathways to the STEM Workforce

“Go forth and ponder”

Jen Bodde, Education Director at Courageous Sailing (a BoSTEM partner), yells these words out to a Russell Elementary School fifth grade class, prompting a chorus of scraping chairs. Students rush to bins in the corner of the classroom housing various materials—pencils, tape, markers, pipe cleaners, glue, straws, paper cups, pins, construction paper. They rifle through the supplies, grabbing what they can and returning to their desks to get working. The charge? To build their own anemometers, or instruments that can measure wind. Some students work individually while others work in pairs and groups, all trying to assemble something that can stand up to the gust from the big classroom fans. Jen walks around the room asking prompting questions and offering hints. She checks in with students desk by desk, listening to their rationale and encouraging their progress. Students create colorful iterations of pinwheels, flags, and wind socks. As class is wrapping up, Jen urges students to clean up, write their names on their creations, and stash them away to finish construction. They will test their designs next week.

Activities like this, where students are able to explore real-world science and engineering challenges through hands-on, peer-to-peer, creative activities, can have a lasting impact on students' academic and career aspirations. High-quality programming in the STEM fields (science, technology, engineering, and math) during the middle grades can spark lifelong interest in these subjects, encourage students to deepen their knowledge through advanced coursework, and set them on a pathway to a future career in Massachusetts' growing STEM ecosystem.



Massachusetts has developed a reputation for being a hub of innovation in science, technology, engineering, and math. Fields such as health care and technology are booming here. Yet compared with the general population, the people who fill these roles are disproportionately White. As the number of high-paying careers in STEM increases in the Commonwealth—the Bureau of Labor Statistics estimates that between 2018 and 2028, one out of every three jobs created in Massachusetts will be in STEM fields¹— people of color remain underrepresented in STEM. Statewide data from 2020 estimates that “27% of STEM workers are non-white” with those who identify as Black making up 5% of the Massachusetts STEM workforce and those who identify as Hispanic or Latino making up 6% of the STEM workforce,² compared with the overall state population of 9% and 12.4%, respectively.³ There are increasing opportunities to work in this growing, lucrative industry. But for whom?

The disproportional underrepresentation of Black and Latino individuals in the STEM workforce is not due to a lack of capability or an inherent lack of interest in these fields. For example, The Education Trust analyzed the results of a survey completed by students in 80 school districts across 24 states, finding that “[o]n average, roughly 2 in 5 (or 40%) of the Black and Latino students in our sample...aspire to go to college and name STEM subjects as their favorites.” But when it comes to feeling as though they belong in STEM studies, a study of 184 schools reported that only 24% of Latino students and 13% of Black students felt as though they belonged in AP STEM classes while 45% of White counterparts reported the same sense of belonging.⁴ The underrepresentation of individuals with marginalized identities in STEM fields feeds into students’ individual perceptions, making them feel like they don’t belong on that path and reducing the appeal of STEM careers. Overall, even though many students with marginalized identities have an intrinsic interest in and capacity for STEM coursework, there is a

systemic shortage of support, representation, and resources to help cultivate that interest so it doesn’t wane over time. Researchers have noted that such students need a “particular emphasis on the development of agency through visibility, representation, and identity scaffolding, to help them envision academic success.”⁵

Diversifying STEM pathways is also imperative for employers, as “[r]esearch shows that workplace diversity drives innovation, workplace culture, and productivity and that the companies with more racial and gender diversity outperform companies with less diversity.”⁶ Massachusetts needs a diverse STEM workforce to continue expanding in the STEM sphere and to maintain its position as a hub for STEM industries. Ensuring greater access to high-paying STEM jobs for individuals of color will also help close gaping racial wealth gaps and sustain a strong economy within the Commonwealth. To realize these benefits, industry partners must develop trusting relationships with the communities in which they are located and invest in diverse, homegrown talent early and often.

The critical work necessary to undo the exclusion of Black and Latino people from the STEM space starts well before individuals enter the workforce. High school is a period where students can lean in and access higher-level STEM content through advanced and enrichment courses, but even high school is too late to build a foundation for rigorous STEM engagement. It is through sparking and cultivating a STEM interest in the elementary and middle grades that students, particularly marginalized students, build the knowledge base, confidence, and desire to explore a STEM-based path in high school and beyond.

Research shows that “early interest in math and science is a key indicator of whether students pursue STEM pathways later,”⁷ so providing young students with access to engaging STEM content increases the likelihood that they will seek out advanced STEM courses in high school



and continue those studies into college. Furthermore, “[o]ne study of graduate students found that 65% of those asked said their interest in STEM began before middle school,”⁸ making the middle grades an ideal time to support student exploration of STEM.

The out-of-school-time (OST) space is in a unique position to provide creative and enriching STEM educational experiences for middle school students, connecting school-day learning with students’ lives outside of school. OST programs reach a substantial number of young people each year—for example, in 2014, it was estimated that more than 10 million youth nationwide participated in afterschool programs.⁹ Out-of-school-time STEM programming also has the benefit of incorporating a flexible curriculum that introduces students to concepts they may not learn in school. In OST learning, students frequently engage in hands-on learning that can “inspire inquiry, reasoning, hypothesizing, experimenting, problem-solving, and reflecting on the value or importance of STEM in everyday life.”¹⁰ They can also experience positive social and emotional development through trusted relationships with friends and role models, ensuring that programs are safe spaces for cultivating new interests.

Research shows that “[c]onsistent engagement in afterschool STEM programming has...been shown to positively affect STEM career interest and participation in informal STEM activities.”¹¹ In one study, middle school students who participated in science clubs were “more likely to endorse an interest in STEM-related careers in college than peers who did not participate in STEM.”¹² Evidence supports the theory that when OST organizations offer programs that incorporate STEM and social-emotional skill-building, positive youth development, and STEM career exposure to middle school students, students will feel more secure in their STEM educational pursuits throughout their academic career and will be more likely to explore STEM careers. A 12-year-old participating in an after-school program may seem poles apart from a 22-year-old seeking a full-time job, but research shows that middle school activities are in fact deeply interconnected with the career choices of adults.



THE BOSTEM INITIATIVE

The BoSTEM initiative, which originated in 2015 from a partnership between United Way of Massachusetts Bay and Merrimack Valley (UW) and Boston After School & Beyond (BASB), is doing this exact work in Boston. Recognizing the need for skilled STEM workers (both locally and nationally) and the urgency of helping marginalized (i.e., first-generation, low-income, minority, and high-need) students thrive in post-secondary education and careers, the two organizations responded by seeking to establish an ecosystem that supports high-quality STEM education and college/career readiness in grades 6-8. Through collaboration with various OST programs, Boston Public Schools (BPS) educators, and STEM industry partners in the area, BoSTEM aims “to encourage innovative, customized site-based strategies and supports within a framework for quality implementation,” promoting the use of “culturally responsive STEM programming” to encourage students’ STEM aspirations.¹³

Among its wide array of measurement and improvement activities, BoSTEM offers quality professional development and communities of practice to enhance collaboration across the OST STEM field, externship learning experiences for BPS teachers looking to bring lessons from local STEM partners back to the classroom, and access for STEM industry partners to the local, homegrown talent that the initiative is developing. BoSTEM’s intricate ecosystem supports programming and connections between school-day, out-of-school, and post-secondary stakeholders, resulting in positive outcomes for all involved, but most importantly for students—BoSTEM reports “increased student interest in STEM and STEM-related careers, increased student attendance and social-emotional skills, improved student STEM achievement, [and] improved STEM learning opportunities” from their model.¹⁴

This case study examines BoSTEM’s approach and results in greater detail, highlighting how the initiative has impacted stakeholders such as students, BPS educators, OST staff, and the broader OST field. By examining data on BoSTEM’s outcomes from existing sources and through conversations with multiple stakeholders, this report tells the story of BoSTEM’s progress over the past few years—and its potential for continued impact.

The BoSTEM Program Model: Building a STEM Ecosystem in Boston

The BoSTEM model is based on the two pillars of data-informed improvement (by way of professional development and coaching for OST programs) and career exposure for middle school-aged students. These pillars undergird BoSTEM's specific components, all of which are meant to build a supportive ecosystem that connects Boston students to STEM knowledge and careers. Because BoSTEM includes such a range of opportunities, it is helpful to think of them in two buckets: first, assistance for out-of-school time programs, and second, connections with local employers (and individual employees) in STEM fields. Within the first bucket, BoSTEM works closely with 12 OST partner organizations, providing professional development and coaching for OST program staff and guidance on career connections, social-emotional learning (SEL), and STEM project-based learning for students. In the second bucket, BoSTEM calls upon various STEM industry partners to collaborate and develop externships for teachers and learning opportunities for students, while helping partners build connections among themselves and with BPS. By working with participating OST programs and industry partners to meet their professional, financial, and social needs, BoSTEM builds a more supportive environment for Boston students seeking to enter STEM career pathways.

METHODOLOGY

The Rennie Center for Education Research & Policy partnered with UW and BASB to examine and document the out-of-school-time programs and practices that support transformative STEM interest in middle-school age students in Boston Public Schools. The Rennie Center began with a review of scholarly research on STEM interest and pathways for students of color as well as existing literature about the initiative provided by UW. These sources supported the development of a research protocol that guided virtual interviews.

Interviews took place with staff from UW, BASB, BPS, and BoSTEM industry partner Autodesk. (A representative from another industry partner, Schrödinger, shared responses to the interview questions by email.) UW staff also identified and connected Rennie Center researchers with three BoSTEM partner programs (CitySprouts, Courageous Sailing, and Sociedad Latina) to engage in additional data collection, with the aim of capturing their experiences with BoSTEM and to assess their alignment with the goals of the overall initiative. Working with these programs, the Rennie Center completed two site visits and hosted two focus groups, one with students from the Russell School in Dorchester participating in the Courageous Sailing program and the other with students from the Timilty School in Roxbury participating in the Sociedad Latina STEAM Team program.

Information presented in this case study reflects findings from the Rennie Center's literature review, interviews, site visits, student observations, student focus groups, and data review.



SUPPORTING HIGH-QUALITY OUT-OF-SCHOOL-TIME STEM PROGRAMMING

The consensus among BoSTEM programs is that they would not be able to operate at their current capacity without the support of the initiative. The most valuable contributions BoSTEM provides to participating programs are a network of peers, professional development, resources to support program expansion, and assistance with data collection and analysis.

Participating programs have found it extremely helpful to connect and share experiences with other programs in the out-of-school-time space. In meetings of a BoSTEM community of practice facilitated by BASB, programs can share best practices, help each other address common challenges, learn more about other programs' work through conversations and site visits, and create deeper connections with one another and their local communities. This setting has been particularly important for front-line program staff. For example, Karl Koch, a CitySprouts garden educator, reflected that on-the-ground staff don't often have opportunities to meet with their counterparts from other organizations, and being able to come together in this way in a community of peers has been instrumental to his growth as an educator. Beyond the benefits for individual participants, having a cohort of similar organizations to bounce ideas off and provide new perspectives supports programs' ongoing improvement efforts. As a collaborative network, the group of participating programs celebrate one another's successes and support each other through their challenges. Building and fostering community among youth-serving organizations has been one of the biggest impacts the initiative has had on the out-of-school-time space in the Boston area. As Courageous Sailing educator Jen Bodde puts it, "Bringing us in touch with each other to share best practices has been fantastic."

Participating programs also come together for professional development (PD) trainings and workshops facilitated by BoSTEM and other organizations in order to explore common concepts in the out-of-school time space. The initiative enables access to a wide range of no-cost PD opportunities, facilitating some sessions directly, promoting relevant content from other sources, and helping cover the costs of opportunities that charge a participation fee. These offerings are curated based on a review of BoSTEM program data to determine where additional support would be most useful, and programs have the freedom to explore whatever topics align with their work while also being encouraged to sample additional content. Professional development opportunities include sessions on cultural responsiveness, race and equity, SEL and mental health, and family engagement, with particular courses focusing on topics like “How to Use Brain Science to Boost Student Motivation,” “Latinx History is Black History,” and “Social Justice in the Science Classroom.”

Providing trainings and resources for frontline staff at no cost is critical, considering how tight a budget small nonprofits and out-of-school-time organizations often have for supporting staff PD. Without financial constraints, trainings can be accessed by all staff rather than a select few, enhancing the programs’ work by helping build a shared vision and plan for the future and allowing every educator to bring back new strategies and best practices to their work with students. Additionally, given that there tends to be a fair amount of turnover among OST staff, these PD opportunities help new hires get up to speed more quickly in order to succeed in their roles. Overall, bringing OST staff together in these workshop settings has been instrumental in

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helping programs break down silos and improve the craft they are dedicated to.

BoSTEM not only acts as a program convener, it also works with individual programs to help them access their full potential. This includes providing support with recruitment and building awareness of programs, advocating on behalf of OST programs, and offering financial support and material resources. BoSTEM funding has helped program staff focus on training and professional development to enhance their programming. Using BoSTEM funding, some programs have also been able to expand into areas where they otherwise could not; for instance, Courageous Sailing used BoSTEM resources to launch an after-school middle school STEM program, STEMsail.

Alongside a community of peers, targeted professional development, and resources to aid program expansion, the fourth main benefit that BoSTEM provides to programs is assistance with data collection and use. Programs have access to a suite of assessment tools that help them measure the efficacy of their offerings. More specifically, BoSTEM

programs use the Dimensions of Success (DoS) and the Common Instrument Suite (CIS)—developed by Partnerships in Education and Resilience (PEAR) and its partners—as well as the Survey for Academic and Youth Outcomes for Youth (SAYO-Y), Teachers (SAYO-T), and Staff (SAYO-S), developed by the National Institute on Out-of-School Time. Collectively, these assessments help illuminate strong practices and areas for growth for program staff, so they can keep tabs on how they have progressed.

Program staff report that these assessments, and the data they provide, are critical to understanding the impact of their programming



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and how invested students are in it. In particular, the Dimensions of Success metric (an observation-based rubric that looks for evidence of effective STEM practices across 12 areas, such as “Purposeful Activities,” “Inquiry,” and “Relevance”) has been helpful to track how programs center youth voice in their programming and connect science with social-emotional learning. Gathering data and feedback from BoSTEM observations allows programs to effectively course-correct their curriculum and approach for working with students. At the same time, not all data collection tools are viewed by program staff as equally useful. For instance, the SAYO-T, which is intended to get reflections from school-day teachers on how frequently students demonstrate behaviors associated with certain social-emotional skills, is not always seen as a helpful way to measure student growth, considering how it can be hard for those teachers to identify the outcomes of OST programming they are not a part of. Overall, though, programs value the breadth of assessments BoSTEM provides. See page 14 for more on data.

Beyond providing access to data tools, programs also appreciate how BoSTEM assists with analyzing the data collected, delivering action plans and data-based coaching on how to improve their programming, and loading all survey data onto a single dashboard so they can look for trends in the impact of their work. Staff particularly called out the importance of having access to data experts from BASB who can help them evaluate their progress. Additionally, a CitySprouts staff member notes that without BoSTEM they would have to rebuild a data dashboard from scratch, which would be a costly and time-intensive undertaking. BoSTEM’s facilitation of data collection, analysis, and coaching takes a great deal of stress off of individual programs while allowing them to monitor and improve their practice in a number of ways.

One thing that BoSTEM purposely does not do is contribute to each program’s approach and curriculum. Rather than dictating what should be taught, BoSTEM leaders appreciate each program for the unique perspective and insights they bring to the OST STEM space. The initiative instead serves as a thought partner in helping programs develop high-

quality STEM learning experiences for their particular community of students and chooses to focus on “uniting around a common framework, language, and data, so no matter what you’re doing we can have a conversation about it and support and improve your work,” BoSTEM Director Joe Rosenbaum explains. Overall, programs are satisfied with the resources, assistance, and opportunities BoSTEM has provided them. This assistance has allowed them to enhance the quality of their programs and opportunities for the youth they serve, while supporting their sustainability over time.



CONNECTING STUDENTS AND EDUCATORS WITH STEM INDUSTRY PARTNERS

By working with OST partners, BoSTEM aims to not only improve student learning experiences but also better prepare students for future careers. In these efforts, BoSTEM staff can call upon a network of STEM industry partners to provide real-world perspectives on their training and day-to-day work. Business owners, entrepreneurs, and STEM professionals across industries have volunteered to speak to students and facilitate workshops, site visits, and internship opportunities. Prior to the pandemic, BoSTEM helped coordinate field trips to STEM companies in order to facilitate two-way awareness and communication between these companies and Boston students. Some of these conversations included opportunities to reflect on how identity intersects with working in STEM—for example, students participating in OST programming through Sociedad Latina were able to take a field trip to a company with a Latino affinity group and speak with members about their experiences.

When they were unable to offer in-person experiences due to the pandemic, BoSTEM pivoted to the virtual world, designing programs that allowed students to connect with individuals in the STEM

workforce. The BoSTEM staff named these opportunities STEM Chats and STEM Bites, a series of usually asynchronous virtual experiences that allowed students continued access to the career exposure aspects of the initiative. STEM Chats were BoSTEM-facilitated, informal conversations with industry partners and STEM professionals about careers in the field, while STEM Bites were mini STEM lessons from professionals, supported by BoSTEM staff to ensure high-quality and age-appropriate content. BoSTEM also hosted Critical Conversations, which examined career pathways through the lens of identity, capturing personal stories about navigating the pathway to becoming a STEM professional.

Along with helping students explore various careers, BoSTEM aims to help employers build pathways into STEM fields that support a diverse, well-prepared workforce. BoSTEM staff seek out industry partners that are interested in not only sharing about their work, but also developing a reciprocal, long-term connection where they can be a host for future site visits and field trips as well as a trusted neighbor and resource. In short, they look for industry partners that want to get as much out of the experience as they are putting into it for educators and students. As Karissa Goff, Director of Partnerships for Boston Public Schools, puts it, “This is a two-way process, not a sales pitch.”

From the industry perspective, participating in BoSTEM programming has the benefit of enhancing connections with the community. Wade Miller of Schrödinger (a pharmaceutical company) lamented “how far removed teachers and students feel from the life sciences industry in the region.” Kellyanne Mahoney, Youth Program Specialist for software firm Autodesk, reflected that as the company moved into Boston’s Seaport neighborhood, they wanted to be good neighbors and make their space visible and approachable for local residents. BoSTEM helps industry partners bridge these gaps and engage with the teachers and students in the communities where they work in order to develop longer-term connections and opportunities.

A primary method by which BoSTEM aims to build connections between STEM education and local employers is to offer educators the opportunity to participate in STEM-focused externships. Participating teachers can learn from and collaborate with STEM industry partners and bring that learning back to the classroom. Held during school vacation weeks or over the summer, externships are one- to two-week-long programs in which teachers engage with hands-on, project-based programming designed by industry partners. In this way, teachers are put in the position of learners, building content knowledge and a deeper understanding of how to prepare their students for the demands of the STEM workforce. There are industry-specific externship tracks, so educators can focus on specific areas of interest, such as life sciences or construction. Among other topics, past externships have explored drug discovery, cybersecurity, green jobs, TinkerCAD software, and construction. The externships are open to anyone who works directly with students, regardless of grade level or subject matter. Being open to any school staff means that this learning experience brings together school teams and staff that don’t normally work together in collaboration and allows for a variety of perspectives.

To inspire teachers to apply their new knowledge and skills to their classroom work, externships require participants to produce some sort of final deliverable, such as developing lesson plans or

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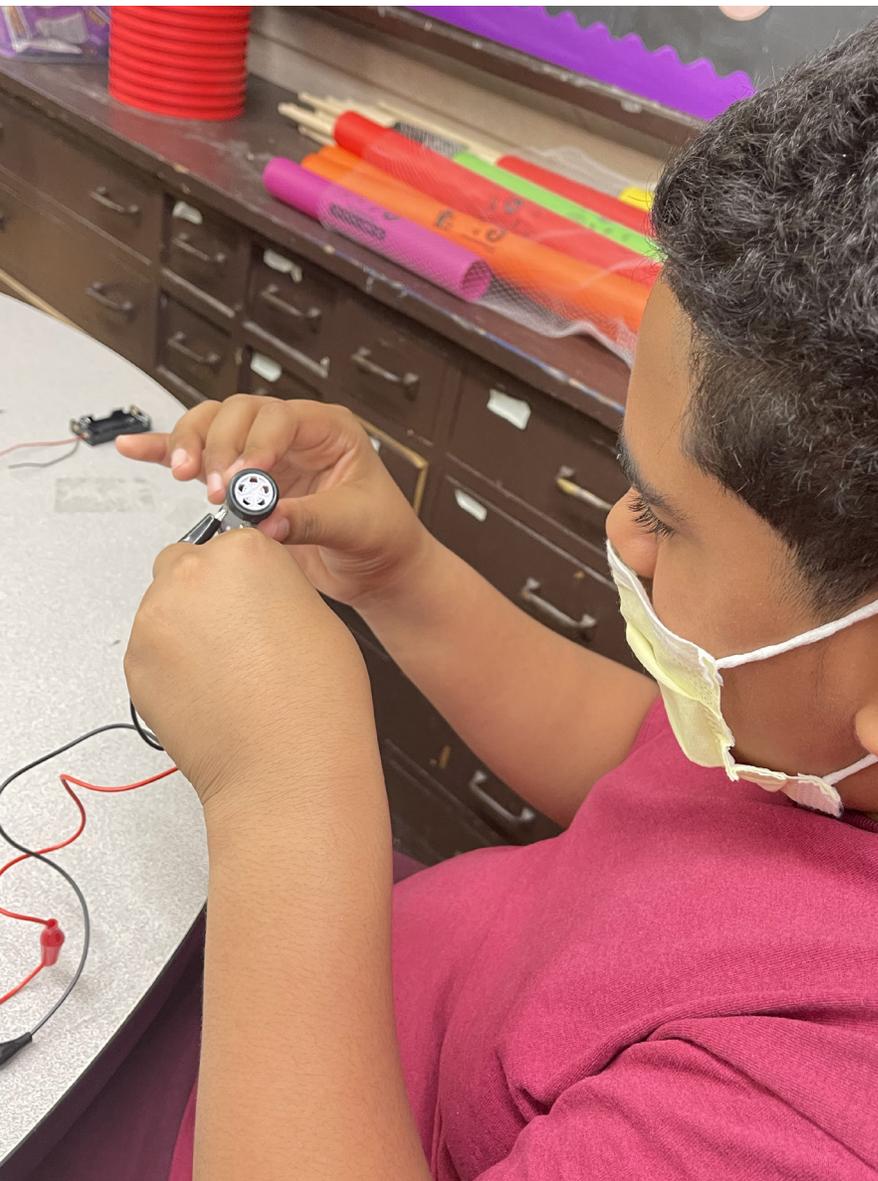
- KARISSA GOFF,
DIRECTOR OF
PARTNERSHIPS FOR
BOSTON PUBLIC
SCHOOLS

presenting their findings and ways to implement solutions in their own schools. For instance, Autodesk, a company that makes software products for architecture, construction, and engineering industries, hosts an externship that culminates in a project that teachers present as part of a final showcase. Through this experience, teachers deepen their content knowledge and technical skills, practice using a design thinking approach, and grow their own social capital by expanding their networks among corporate partners (who can act as future field trip hosts and guest speakers for students).

The externship focus is on teachers, rather than students, because one teacher can influence the experiences and aspirations of many students based on the knowledge they gain in the externship, creating a ripple effect that produces a long-term impact. In particular, educators can use their experience to inform how they prepare students for the demands of the STEM workforce, since gaining a real-world understanding can shift teachers' perceptions of STEM competencies and careers. As Louis Baptista of UW puts it, STEM skills are evolving, and success in a STEM field can require skills ranging from "creating a hypothesis to being an active problem-solver and understanding what it's like to work in a team." Similarly, Karissa Goff of Boston Public Schools finds the collaboration between industry partners and teachers in externship experiences critical to expanding the idea of what STEM careers look like, showing them that these go beyond lab coats and test tubes to encompass a wide range of positions. For instance, STEM companies also need employees with skills in communications, graphic design, finance, and human resources. By seeing STEM skills in action during an externship,

teachers can bring this knowledge back to how they teach STEM (and other) subjects in school.

Teachers can also bring two other valuable conversations back to their students: information about the specific career paths they explored, and conversations about how students with identities that are underrepresented in STEM fields can navigate the workforce. Connecting to STEM careers can be challenging for students because of the perceived disconnect between their interests and paid work in the STEM sphere. Externships help bridge that gap, as educators are able to take what they've learned about a particular industry and the skill sets necessary to succeed in it to show students that there are more connections than they may have originally thought. Having gotten a glimpse into STEM workplaces, teachers can also prepare students for future careers where they may be the only individual in the room with a particular identity. At the same time, educators can serve as a voice for their students within the offices of industry partners, pushing STEM professionals to



think about their company's representation and how it relates to their students back at school.

For many industry partners, participating in BoSTEM programming dovetails with their goal of building a more diverse workforce. As Autodesk's Youth Program Specialist Kellyanne Mahoney puts it, "The construction industry faces a lot of challenges, from environmental sustainability to housing affordability, and dealing with those requires a diversity of perspectives that we don't have right now." Through the connections that BoSTEM facilitates, industry partners seeking to recruit and retain a diverse talent pool have the opportunity to learn from teachers how to make their workplaces more welcoming and inclusive for students of color. Questions from teachers about how affirming and representative an industry will be, particularly for their most marginalized students, have pushed participating STEM companies to think critically about the recruitment, diversity, and inclusion practices they have in place and how to develop them further for future generations of STEM leaders.

“Through the connections that BoSTEM facilitates, industry partners seeking to recruit and retain a diverse talent pool have the opportunity to learn from teachers how to make their workplaces more welcoming and inclusive for students of color.”

Another benefit of participating in BoSTEM programming is that industry partners can change common (mis)perceptions of their work among teachers (and by extension, students). For instance, Kellyanne Mahoney of Autodesk hopes externship participants will communicate to students how interesting a potential career in construction could be. Partnering companies also have the opportunity to engage in peer-to-peer collaboration as they meet with and plan learning experiences alongside other industry partners, thereby expanding their networks within their geographical or content areas. And as they work with local teachers and students, industry partners can gain insight into the state of science education in Boston, as well as the current pathways that exist for local students to pursue jobs within their field.

Finally, the STEM industry partners that work with BoSTEM recognize that this collaboration allows them to connect with students as well as educators. Several partners hope to capitalize upon this connection moving forward. For example, Schrödinger hopes to increase its touchpoints with teachers and students beyond the externship program, and Autodesk is planning to expand its outreach to students this year through an internship program for high school students. This opportunity will provide compensation for students as they explore the fields of architecture, construction, and engineering and offer recommendations about how to address workforce shortages within the industry.

A photograph of two students in a classroom. One student is pointing at a whiteboard with drawings of a hamburger and a hot dog. The other student is looking at the board. The whiteboard has handwritten text including 'rice', 'meat', and 'beans'. The title 'A LOOK AT THE DATA' is overlaid in large white letters.

A LOOK AT THE DATA

The Rennie Center reviewed quantitative data from two BoSTEM-provided assessments to examine how OST programming affects student perceptions of STEM and to seek evidence of the impact that the BoSTEM initiative has on partner programs. The two assessments were:

- 1**] The Common Instrument for Students (CI), a pre/post assessment that asks students to respond to questions in four categories: STEM career interest, STEM career knowledge, STEM engagement, and STEM interest outside of school. Students respond to questions to indicate their degree of agreement or disagreement with various statements (using a scale from 1, for “strongly disagree,” to 4, for “strongly agree”), and the results are calculated across the four categories.
- 2**] The Dimensions of Success (DoS), an observation tool that asks an observer to examine and rate a program on twelve dimensions that correlate with high-quality practices in STEM learning. Some of these dimensions are specific to STEM (e.g., inquiry, engagement with STEM), while others are more general, such as relevance, reflection, and youth voice. DoS scores are rated on a scale from 1 (meaning evidence of the practice is absent) to 4 (meaning there is compelling evidence of the practice).

Raw, de-identified data from both instruments was provided to the Rennie Center by staff from Boston After School & Beyond. BASB had replaced program names with site-specific ID numbers, so Rennie researchers looked for general trends in place of the results of specific programs. The time period of the data collection (e.g., 2018 summer, 2019-20 school year) was also provided to allow for analysis over time. The following graphs highlight a few key takeaways from the data.

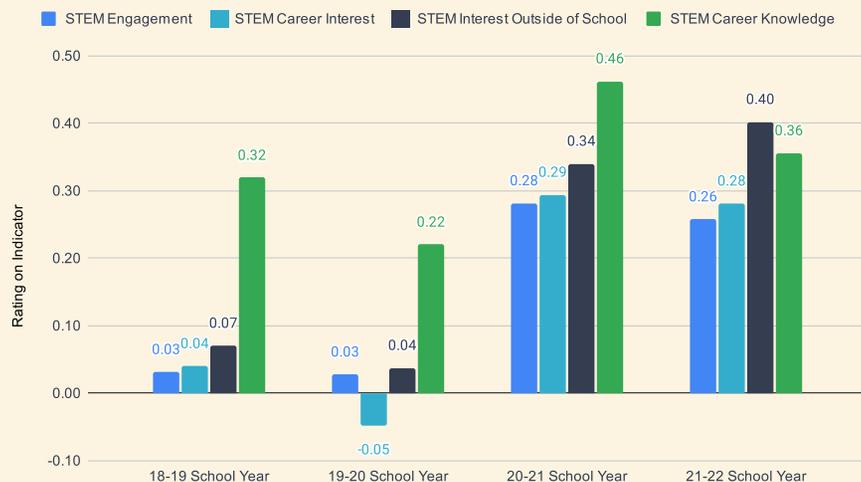
GROWTH IN STEM INTEREST, ENGAGEMENT, AND CAREER KNOWLEDGE

The graph below uses data from the CI to examine the average growth in STEM interest, engagement, and career knowledge over the course of a single school year. It looks at the change in pre to post data on each of the four categories included in the CI. The chart includes data from all programs with available pre and post data within the same school year, whether for school year 2018-19, 2019-20, 2020-21, or 2021-22.

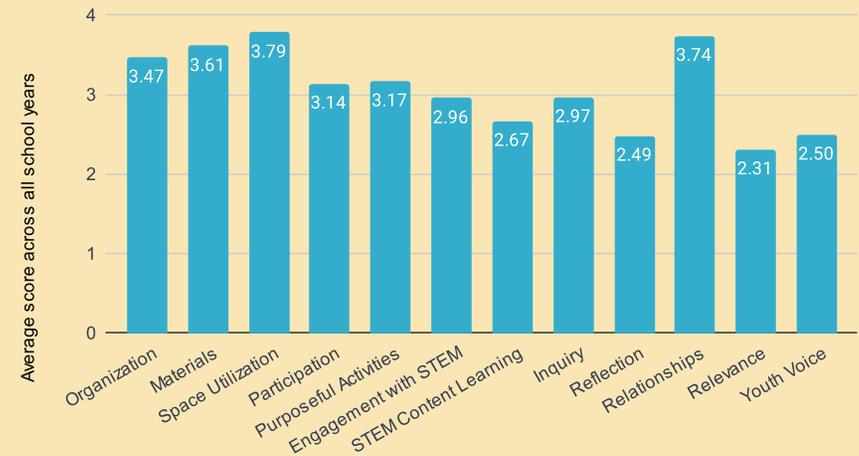
While the 2019-20 school year saw a leveling-off in STEM engagement and interest outside of school, and a dip in STEM career interest, the end of this school year also coincided with a period of interrupted learning due to the COVID-19 pandemic. Therefore, it may be hard to draw general conclusions from that year's data. In contrast, the 2020-21 school year saw strong increases in all four categories from the beginning to the end of the school year. This trend continued in 2021-22, with substantial increases in all areas from the beginning to the end of the year. This indicates that BoSTEM partner programs are having a positive impact on students' interest in and knowledge of STEM. Career knowledge, in particular, has demonstrated strong growth throughout the year, perhaps because it tends to start from a lower overall base than the other three areas.

BoSTEM Common Instrument Data

Average growth from pre to post assessment across programs within each school year (on scale of 1-4)



Dimensions of Success: Average score across all school years



EVIDENCE OF HIGH-QUALITY STEM LEARNING PRACTICES

The above below uses data from the DoS to examine the areas where programs tend to have high-quality STEM learning practices in place and areas where they would benefit from additional support to improve their programming. These scores reflect the average score in each category from all school-year data collected between the 2017-18 school year and the 2021-22 school year. Lower scores indicate that evidence of the element is more limited, while higher scores indicate that evidence of the element is more consistent.

Six areas received an average score below 3, which indicates "reasonable evidence" of the practice: relevance, reflection, youth voice, STEM content learning, engagement with STEM, and inquiry (although the last two received average scores of 2.96 and 2.97, respectively, putting them very close to the 3-point threshold). Programs would benefit from additional training to strengthen their work these areas, particularly on making content relevant, where the score was closer to 2 ("inconsistent evidence") than to 3. On the positive side, most programs demonstrate strong evidence of relationship-building.

IMPROVEMENT IN PROGRAM PRACTICES

The graphs to the right also use data from the DoS. In this case, Rennie Center researchers looked at all programs with at least two sets of DoS observational data and calculated the average percentage increase in each dimension from the first to the second administration of the data collection instrument. In most cases, the data collection took place in consecutive school years; however, for three programs, the first administration took place in the fall of 2021 and the second administration took place in the spring of 2022 (so, during the same school year). Any elements that had received the highest score during both data collection periods were excluded from the average so as not to skew the data, since there was no opportunity for improvement in this case. This means that the categories in the chart represent data from different numbers of programs. The number (n) of programs included in the calculation of each data point is provided along with the name of the dimension. Note that three dimensions from the DoS (organization, materials, and space utilization) are excluded from these graphs because they are less relevant to a discussion of program content.

Dimensions of Success: Improvement Areas

Average percent increase in scores, first to second data collection



The "Improvement Areas" graph looks at areas where BoSTEM programs improved their programming following their initial DoS data collection, and the "Growth Areas" graph looks at areas where scores declined. Programs were able to make improvements across several areas, with particularly large increases in participation and engagement with STEM. Conversely, program scores declined in the areas of inquiry and STEM content learning. Though more evidence would be needed to confirm this trend, it is noteworthy that the most-improved areas are affective elements (looking at whether students are connected to each other and to the program), while the two areas with decreases are focused on STEM content. This data raises the question of whether programs seeking to build relationships may have prioritized that outcome over the presentation of STEM content upon receiving their observational data from the DoS. In any case, programs have strengthened many aspects of their programming after receiving DoS data, indicating the value of this observation tool for quality improvement.

Dimensions of Success: Growth Areas

Average percent decrease in scores, first to second data collection



Connecting Students with STEM Learning Opportunities: A Closer Look at Three BoSTEM Partner Programs

While BoSTEM carries out a range of activities to build a stronger STEM ecosystem in Boston, most of the direct connections with students take place through the work of its partner programs. Each of these organizations has its own mission and approach to help build STEM skills and support positive youth development, but all are united by the desire to provide meaningful learning experiences in the out-of-school-time (OST) space. This section dives deeper into three programs within the BoSTEM network—CitySprouts, Courageous Sailing, and Sociedad Latina—in order to explore how OST programs can cultivate STEM interest, set students on a pathway toward careers in STEM fields, and build strong relationships to sustain their connections with students over time.

CULTIVATING STEM INTEREST

The BoSTEM initiative and its participating programs expose students to a wide breadth of content within the four STEM subjects in order to both build their skills and deepen their desire to pursue further opportunities in these fields. The middle grades are a particularly important time to generate STEM interest and enthusiasm. Evidence shows that when marginalized students are able to get access to “rigorous, culturally relevant, and identity-affirming curricula” in middle school, this gives students the prerequisites needed to succeed in upper-level STEM courses, making them more likely to choose careers in STEM fields as they move beyond high school. OST educators are in a unique position to generate interest in STEM by showing students that there is more to these subjects than what they learn in classes. Program staff can introduce students to STEM in multiple ways and build inclusive spaces where students feel welcomed and supported as STEM learners and practitioners.

Ultimately, regardless of where each student is coming from in their relationship to STEM subjects, BoSTEM programs recognize that they have to meet each student where they are to spark or deepen that interest. To do so, programs know that they have to make their STEM content *relevant, robust, and recreational*.

Three R's

- When we describe how BoSTEM programs make content **relevant**, this includes the use of methods that create connections between 1) lessons and students' cultures, as well as 2) lessons and real-world issues and solutions.
- When we describe the **robust** programming of BoSTEM OST partners, this means the various methods BoSTEM educators use to teach students a conceptual understanding of STEM topics.
- When we describe how BoSTEM programs work to cultivate STEM interest by making it **recreational**, this describes the fun, multimodal, and exploratory activities that students are able to engage in.

MAKING

STEM

RELEVANT

In the development of the BoSTEM initiative, one driving principle was the use of culturally grounded STEM experiences to teach content that is both relevant to student life and connected to STEM learning. For this reason, BoSTEM has offered numerous trainings to participating programs on infusing cultural responsiveness into their STEM programming for students. Karley Ausiello, United Way Senior Vice President of Community Impact, stresses that students feel safer exploring STEM topics in culturally relevant spaces, while they may not feel the same sense of safety in a classroom setting. Furthermore, she notes that culturally grounded STEM can look different in different settings, based on the individual program's model and the population served—for instance, Sociedad Latina is particularly aware of creating a welcoming environment for English Learners, conducting their programming bilingually and supporting students' language skills while simultaneously promoting STEM exploration. Culturally responsive and relevant STEM, she says, is about starting with the students' culture and "then wrapping STEM around it, rather than starting with a skill or topic."

Each of the three featured BoSTEM programs infuses culturally relevant content within their approach, though their content and focus areas differ. As noted above, Sociedad Latina STEAM Team programming is fully bilingual. Whether in classroom decorations, slide decks, worksheets, or conversations, the after-school program bounces between English and Spanish effortlessly, helping students feel a sense of community while also supporting their language development.

Additionally, in all three programs, students engage with real-world scenarios, because staff believe that students should be aware of the world around them and how it connects with their learning. While students dig in the garden, CitySprouts educators teach about the importance of vertical gardens in communities like Dorchester, where many of the students live and where there is less access to healthy food and green space than in many other neighborhoods of Boston. Courageous Sailing encourages students to get outside the classroom and explore their communities through concepts like navigation and weather. From testing handmade model boats all the way to sailing in full-size boats out on the water, students are able to make connections with their classroom learning while experiencing new ways of seeing and understanding their own communities.



SPOTLIGHT: CITYSPROUTS

CitySprouts works to spark wonder and curiosity about natural science through hands-on learning in urban gardens. At their garden sites across the greater Boston area, elementary and middle school students can simultaneously get their hands dirty, develop STEM skills, and practice building wellness habits. Along with offering school-day programming in nine Boston schools and district-wide in Cambridge, CitySprouts hosts year-round out-of-school-time programming for middle school students. During the school year, this includes weekly after-school club meetings in three locations, while in the summer, CitySprouts' Young Leaders Program allows middle schoolers from Boston and Cambridge to earn a stipend in exchange for working in gardens five days a week. Past examples of projects include:

- Helping maintain school gardens
- Growing food and flowers
- Managing their own take-home garden kits
- Cooking the produce grown in the garden

MAKING STEM ROBUST

Each program has a different approach to teaching new content, but they all aim to provide an educational experience where students can develop STEM competencies. Through engaging activities and community building, programs facilitate sessions that teach students about and let them explore STEM concepts such as inquiry, design thinking, the scientific method, and reflection. Courageous Sailing instructors lay out learning objectives, refer back to past sessions, and use prompting questions to determine students' retention and understanding of previous lessons (and scientific terms) before expanding on that week's learning. On any given Thursday, the Sociedad Latina STEAM Team engages students in a lesson with specific learning objectives and goals, incorporating explorations of language, culture, job opportunities and career fields, all brought together by a centering STEM activity. For example, in one lesson, students dove into the world of ecologists by way of an owl pellet dissection, identifying the rodent that an owl consumed by sorting and classifying the bones they found. Program staff introduced the lesson by sharing objectives and building background knowledge on ecology, and the lesson included a component where the instructors and students explored the experience of ecologists (e.g., salary, educational background). And while CitySprouts does not ask students to demonstrate understanding of scientific terms as in a classroom environment, they have intentionally developed their curriculum to introduce various phenomena to students, such as photosynthesis and decomposition.

Once the objectives and concepts are introduced, the programs support student learning through a variety of hands-on, project-based activities. CitySprouts takes students out of the classroom and into the fresh air to get their hands dirty growing their own food and flowers, exposing them to scientific concepts while they perform everyday, real-world science. Garden educators frequently prompt student thinking and exploration with open-ended questions and by modeling the use of scientific inquiry, sharing thoughts like, "I wonder, where do plants get their energy and how do we get energy from eating the radish?" In a similar way, after a lesson about why wind blows, Courageous Sailing students were encouraged to reflect on what they learned while they played outside at recess. Courageous Sailing students also carry out a number of experiments and feats of engineering during their sessions that are kept in the classroom from week to week until they can be taken home to share with families.

Past projects have included building boats, assembling compasses, and designing devices to measure wind speed. For Sociedad Latina—where the after-school program is named the “STEAM Team” because it encourages students to explore the connection between STEM fields and the arts—the use of hands-on, interactive lessons is aptly demonstrated by the presence of dozens of student projects, posters, and plants, as well as by the artwork hung around the room. In one upcoming project combining STEM and the arts, students will be developing a commercial on cybersecurity, calling upon creative skills such as costume design and filmmaking as well as STEM skills like an understanding of computer technology.

“Some BoSTEM partner programs are explicitly focused on providing academic support that helps students build STEM skills inside as well as outside the classroom.”

Students participating in these programs benefit from exposure to topics and instructional methods they may not encounter in school. Students across multiple programs expressed that they enjoyed learning more about STEM subjects through their participation in OST activities. In some cases, they shared that they preferred the programs’ approach to learning over the structure of school lessons. (For example, one Courageous Sailing participant at the Russell School in Dorchester lamented, “I wish we had Courageous Sailing instead of science class!”) In other cases, students appreciated being exposed to entirely new concepts they had not learned about in school. This is not to say that all OST programming is completely separate from in-school lessons, however. In the Courageous Sailing program, for instance, Courageous Sailing instructors collaborate with teachers at the Russell School to stay updated on what their students are learning in the classroom, using this to help plan lessons in order to create throughlines for students who participate in the program. Courageous Sailing lessons also help lay the groundwork for concepts, like fluid dynamics, that students will cover in more detail in high school.

Additionally, some BoSTEM partner programs are explicitly focused on providing academic support that helps students build STEM skills inside as well as outside the classroom. Sociedad Latina in particular works to identify specific students who would benefit from leaning into STEM instruction outside of the classroom, as well as those who would benefit from additional academic support. To do this, Sociedad establishes relationships with stakeholders such as school-day faculty, caretakers, and family members, collaborating with them to recruit and enroll students. Along with providing hands-on STEAM instruction, Sociedad also reaches out to school-day staff and faculty to identify gaps in student performance and builds in an hour of after-school tutoring where students have additional time to develop their academic skills and address growth areas.



SPOTLIGHT: COURAGEOUS SAILING

Courageous Sailing offers a variety of youth and adult programs to expand access to sailing within the Boston community. As part of their educational programming, they engage students to deepen their understanding of STEM through creative explorations of sailing and related subjects. Along with their long-running summer programs, including Swim Sail Science, Courageous Sailing has more recently expanded to offer school-day and after-school programming in several sites across Boston. During the school-day program, instructors come into classrooms in Charlestown and Dorchester to present lessons on the science of sailing and engage students in interactive projects to design and build sailing-related tools. Meanwhile, their after-school STEMSail program (launched in 2018 through the BoSTEM partnership) exposes middle school students to various engineering challenges and takes them out on the water for sailing lessons. Across all programming, Courageous Sailing links sailing principles like buoyancy and aerodynamics to everyday science and engineering and supports students as they develop social-emotional skills. Past examples of projects include:

- Designing, building, and racing model sailboats
- Making and flying kites
- Creating magnetic compasses
- Comparing the buoyancy of different types of hulls
- Learning how to tie various kinds of knots

MAKING STEM RECREATIONAL

Students digging in gardens and wondering how boats stay afloat are, in fact, learning about STEM. However, because of the disconnect between what students do in these programs and how STEM subjects are often taught in school, students do not always consider fun, creative activities as ways to engage in STEM learning. This can lead students to internalize the feeling that STEM is not for them, cutting them off from gaining critical skills and foreclosing a world of future possibilities. Programs have seen this effect on students in real-time—for instance, Sociedad Latina staff report that they have faced recruitment challenges because when middle school students hear “STEM,” all they are reminded of is classes in school. With this in mind, each program seeks to develop curriculum and activities that change students’ feelings toward STEM. Staff have found that making learning recreational for the students and emphasizing how embedded STEM learning is within daily life helps improve students’ perception of STEM subjects.

Without having to focus on giving students grades or administering assessments, OST providers have more freedom to make learning stress-free and fun for students. When asked how they feel about STEM subjects through the lens of their out-of-school time programs, students excitedly recounted activities and field trips, and they made connections about how lessons showed up in video games and classroom learning. In some cases, students were vocal about how much they enjoy engaging in STEM outside of the classroom, getting to build upon what they cover in science class and zero in on specific concepts that may not make it into the school day. As one fifth grader shared, “We get to focus more [in the Courageous Sailing program], and this teaches us way more things than what we’re taught in science.”

OST programs also have the unique ability to work with students to expand their definition of what STEM means and how their skills and passions fit into it. Garden educators strive to connect the excitement that CitySprouts participants feel while working in the garden to the fact that they are learning STEM skills and engaging in scientific processes. They also point out that students use those same skills every day as they exercise their natural curiosity and wonder about the world.

Participating in OST programs help students see STEM in a more favorable and relatable light, and it helps them expand their ideas of what STEM is, allowing them to feel that their authentic selves, capabilities, and interests are welcome in that space. As one Courageous Sailing participant excitedly put it, when students are able to experience STEM learning through an intentional, culturally relevant, hands-on, and creative lens, their “brains explode with creativity.”



SPOTLIGHT: SOCIEDAD LATINA

Sociedad Latina, a youth development organization that aims to build the next generation of Latino leaders, created the STEAM Team program to offer year-round, high-quality, bilingual academic support and arts-infused STEM enrichment for 6th to 8th grade students in Boston Public Schools. During the school year, the program takes place immediately after the school day within two BPS buildings, Dearborn STEM Academy and James P. Timilty Middle School. STEM coaches (all of whom are Sociedad Latina program alumni) welcome students with snacks and conversation. They then provide an hour of academic tutoring and homework help, followed by another hour-long lesson on a STEM content area that includes an overview of relevant careers. The second hour of programming also incorporates hands-on activities to further explore the concept of the day. The STEAM Team works primarily with low-income families and English Learners, seeking to boost academic achievement and English Language development while sparking and sustaining STEM engagement for middle school students in Boston. Past examples of STEAM Team projects include:

- Gathering DNA from a strawberry to learn about genetics
- Exploring electricity and circuits by making a battery-powered fan
- Growing plants from seedlings to learn about natural science and plant life
- Pumping “blood” (water dyed red) through a bottle to learn about the cardiovascular system

SUMMARY OF PROGRAM CONTENT



CITYSPROUTS

Students build wellness habits by cooking and eating the food they grow, and they investigate topics like access to healthy food within urban communities.

**MAKING
STEM
RELEVANT**

Garden educators expose students to scientific concepts like photosynthesis and pollination.

**MAKING
STEM
ROBUST**

Students roll up their sleeves and get their hands dirty down in the garden with their peers.

**MAKING
STEM
RECREATIONAL**



COURAGEOUS SAILING

Students explore their communities and consider physics concepts they encounter in their daily lives as they apply sailing concepts like navigation, weather, and buoyancy.

Instructors support students with creative problem-solving as they investigate sailing-related questions through experiments.

Students work to develop creative solutions to engineering challenges.

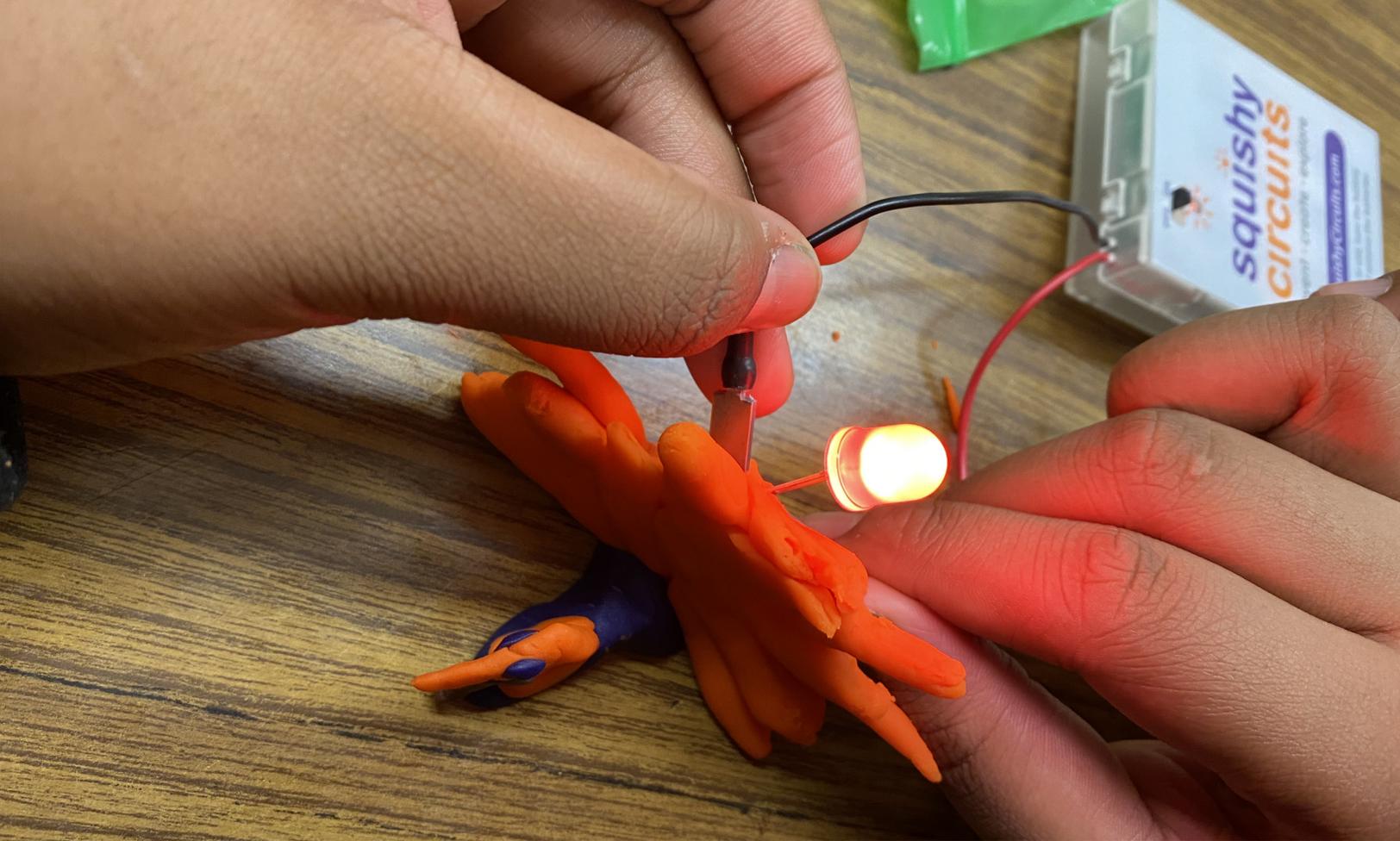


SOCIEDAD LATINA

Students engage in fully bilingual lessons and sessions that link STEM practices (and careers) with students' interests.

Instructors lay out clear objectives for the day, build students' background knowledge, and provide targeted STEM career exposure.

Students engage in creative, often arts-based, small-group activities, putting themselves in the shoes of STEM professionals.



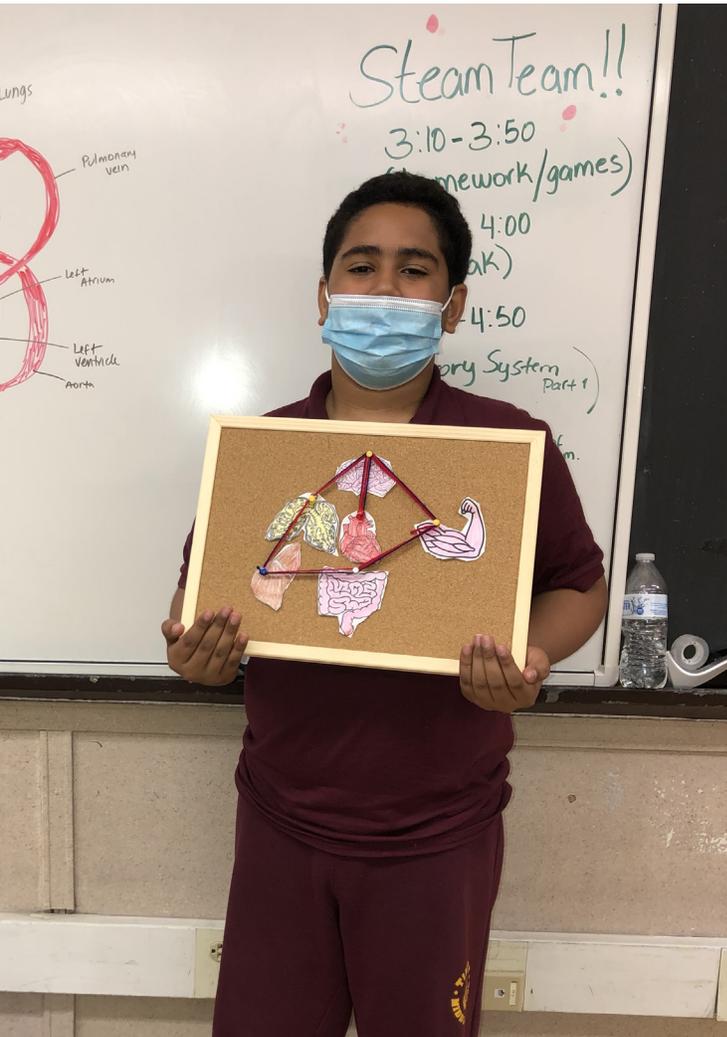
HELPING STUDENTS EXPLORE STEM CAREERS

As Boston boasts a growing landscape of STEM industries and companies, there remains a disconnect between the STEM companies based within the city and the people who inhabit its neighborhoods. While BoSTEM aims to address this challenge by bridging the gaps between industry partners and educators, OST programs within the BoSTEM network play the critical role of helping students explore their interests and connect these to potential STEM careers.

A primary goal of BoSTEM—as well as the programs in its network—is to support students in building STEM skills and knowledge not only for the present moment, but also for their futures. While middle schoolers don't necessarily need to know what field of work they want to enter, learning about potential career paths while concurrently discovering more about who they are and what they like to do will prepare them well for future decisions (in particular, decisions about the topics they would like to study and pursue once in high school). Engaging in OST STEM enrichment also teaches students critical career-ready “skills such as critical thinking, collaboration, creativity and communication,” which Partnerships in Education and Resilience (PEAR) identifies as beneficial “even for those who ultimately choose not to pursue STEM careers.”¹⁵ And as BoSTEM works hard to contradict the misconception that all STEM careers involve hard science (like lab work and coding), programs can introduce students to careers that draw upon a wide variety of skills and interests, including communications and the arts.

Each program within the BoSTEM ecosystem has a different approach to career exposure. Courageous Sailing recognizes the importance of introducing students to potential STEM careers. Prior to the pandemic, staff took students on field trips to an engineering firm and to the Boston Society of Architects; more recently, BoSTEM connected program staff to an engineer who spoke to students virtually. At the same

time, Education Director Jen Bodde notes that the smaller-scale context in which students operate can be difficult to connect with the work that STEM professionals are doing: “When we’re in a school or in the yoga room at the YMCA building a boat with cardboard and tape, students don’t automatically envision a career as an engineer, wind power technician, or naval architect.” Despite facing some challenges in connecting program activities with the work of STEM professionals, Courageous Sailing staff are still able to find avenues to promote career exposure.



CitySprouts sees their regular programming as a way to help students explore their identities rather than look into specific careers. However, they do offer a summer leadership program for middle schoolers that helps students develop critical skills they will need in future careers. This summer program requires students to show up daily to help take care of the CitySprouts gardens. In exchange for their efforts, they receive a stipend at the end of the summer. All the while, students are developing a skill set that includes working on a team, committing to a project, public speaking, planning, caring for something for a period of time, and exercising leadership. Particularly for the leadership component, CitySprouts is flexible in how they ask students to demonstrate these skills, allowing participants to build on their strengths.

Sociedad Latina is more explicit in helping students connect their skills and interests to potential career paths in the STEM world. During STEAM Team after-school sessions, educators show students the career platform O*NET Online and look at STEM careers connected to the lesson of the day. For example, during a lesson that involved dissecting owl pellets, the group examined what it takes to be an ecologist, discussing the projected salary, required education levels, and what skills and passions are needed for the work. The instructors shared parts of their own career journey where applicable and asked students

prompting questions to get them to imagine themselves in that career. This approach can help make career opportunities more tangible to students by connecting their work in the classroom with the job they are exploring; for example, by the end of a lesson, students engaged in building solar cars can better describe how that activity relates to working for an institution like NASA.

Furthermore, due to an ongoing history of exclusion from education, employment, and socioeconomic opportunities for Latino individuals and other people of color, the Sociedad program staff understand how critical representation is for their students. They are very intentional about the speakers they bring in to talk to students about their career pathways. Program Manager Angelica Rodriguez emphasizes that “role modeling is very important, and it is important to show them someone who looks like them succeeding in that role, path, or career.”

BUILDING STRONG RELATIONSHIPS

Student engagement is the lifeblood of OST programs. Unlike school, attendance in OST programming is not mandatory, so while it is critical for programs to expose students to STEM fields, teach them STEM skills, and prepare them for their academic and career journeys, program staff also have to meaningfully respond to students' needs to keep them coming back voluntarily. When out-of-school-time programs respond to students' personal needs and interests intentionally and thoughtfully, students are more likely to respond positively to these efforts and continue returning day after day—while encouraging others to join as well.

There is a common misconception that the “hard science” skills that fall under STEM learning and the “softer skills” of social and emotional learning (SEL) are on opposite ends of the education spectrum, but programs in the BoSTEM network want to change that narrative. Down in the garden, CitySprouts educators see social and emotional learning as a core tenet of their scientific experience, and they argue that science can be a powerful vehicle for SEL. According to Executive Director Jane Hirschi, program staff work to develop a “supportive, social-emotionally healthy environment for kids to figure out who they are, what they like, [and] what they're good at,” stressing that the program is just as much about SEL and wellness as it is about STEM learning. They encourage students to build connections with both the natural world and one another. Students listen to and share with one another, engaging in critical thinking as they work together to keep the garden alive and flourishing. Another SEL skill the program reinforces is growth mindset, as shown by how one garden educator discussed a set of recently transplanted strawberry plants: some of the plants thrived while others died, but the takeaway for students was to learn from the experience without seeing it as a failure.



The relationships that students build and maintain while they are participating in OST programs are critical to keeping students engaged and returning to the space each week. Employing small group work (and play) helps deepen relationships concurrently with developing STEM skills. This is where students can collaborate, connect on an academic and personal level, support one another in pursuit of a successful project, model positive youth support, and learn about their own personalities and how they may change in different settings.

Sometimes positive peer relationships predate students' participation in OST opportunities—one student participating in the Sociedad Latina STEAM Team admitted that he started attending the after-school program because of his friend on his left, who responded with a smile. But programs also work intentionally to create a welcoming, team-oriented environment. It is clear from watching them interact that the students in the STEAM Team program have become friends and forged relationships in and out of the program. The students are quick to work in teams and happy to choose their own groups. They huddle together on bean bag chairs as they participate in a lesson on ecology, they make jokes together, they keep each other focused, and they remark on the "chill vibe" present in this after-school space as opposed to in a school-day science class. The focus on peer-to-peer relationships and creating a comfortable environment for learning is critical for students to invest in and take away insights from the program.

When cultivating space for positive peer-to-peer relationship building is done well, the results are abundantly clear. When asked about their

skill sets and what they have learned about themselves throughout the course of the program, the students in the Sociedad Latina STEAM Team jumped at the chance to answer for one another. Choruses of praise—"You're a leader," "You're a good friend," "You're very helpful and smart"—rang out. These types of supportive statements serve as evidence of an environment where all students feel included as important members of the group.

The program staff facilitating OST opportunities also have a great influence on how students view these learning experiences. Program leaders and front-line staff can serve as role models and advisors for students, particularly where they're able to cultivate strong personal relationships

with each young person. They can build a strong sense of community among families and learners by prioritizing consistent communication. And they can support student learning by knowing when to let students explore new phenomena and

when to step in with guidance and direction. Staff from the three profiled BoSTEM programs carry out these functions (and more) as part of their efforts to build strong relationships and enhance students' STEM journeys.

For the out-of-school time programs in the BoSTEM network, program staff know they must build trust and goodwill to keep students coming back. The Sociedad Latina STEAM Team leaders at the Timilty Middle School, Paola and Avigail, have distinct rapports and relationships with each of the six students present. With conversation flowing between academic and personal topics, they ask students how they enjoyed that day's field trip, then check to see

“One student participating in the Sociedad Latina STEAM Team admitted that he started attending the after-school program because of his friend on his left, who responded with a smile.”

if they have homework and if they need help doing it. The afternoon's STEM lesson starts with a fun question about whether students would rather be at a waterpark or an amusement park, prompting an exchange of personal anecdotes and sparking connections that bring everyone to the conversation. These check-ins, discussions, and bonding moments bounce between English and Spanish, demonstrating the value of culturally responsive programming for setting students at ease and helping them build relationships with staff and one another. Additionally, though they don't join every STEAM Team session, Sociedad Latina also employs alumni of the program who are now in high school to serve as youth leaders, STEM coaches, and mentors for the middle school students, providing near-peer role models they can turn to for support.

CitySprouts staff, meanwhile, see their program as a trusted community of peers and adults. One garden educator calls out the language the program uses to make the experience feel like a community rather than a classroom. In particular, he consciously refers to daily programming as "activities" rather than "lessons," and he calls the participants "youth" rather than "students."

CitySprouts staff are also eagerly working to bring caretakers and families into this community, using multiple means of communication in order to build and deepen those relationships and connect students' learning with their home lives. Jane Hirschi, Executive Director of CitySprouts, points out that this work has taken on renewed urgency in light of the pandemic, when front-line staff had to make stronger connections with families at home in order to keep programming going. Since last fall, CitySprouts has been implementing a series of targeted family engagement practices in order to deepen the bonds between staff and caretakers; as Jane puts it, "It's not just about putting out a newsletter, it's about building relationships."

Jen Bodde of Courageous Sailing has put in ample work to build a trusting, respectful learning environment alongside her students at the Russell Elementary School. Jen provides support when needed, but she intentionally tries not to lead students in any particular direction, encouraging whatever path they take in an experiment. As students work on building tools to measure wind speed, Jen bounces from desk to desk to observe their process while letting them problem-solve, think critically, and get creative about their objective. She gives students time to work with the materials, popping in occasionally with helpful hints for the class (such as how to fold a paper to help it catch the wind and spin like a pinwheel). Students appreciate her input and guidance, but her approach to cultivating supportive relationships also allows for a deep sense of individual accomplishment among students—when one group of students blew on a pinwheel they had created, they quickly let out triumphant cries of "It spins!" and "We did it!"



All three programs use the relationships educators and staff have built with students to “make sure that young people are the ones owning this space, and that the program is really driven by the interests of the youth,” in the words of Sociedad Latina Associate Director Juan Maldonado. Educators can look at the data collected through the DoS and SAYO-Y observations (assessment tools that BoSTEM has provided) to see where they stand on prioritizing youth voice and centering relevance for students in their programming. As they develop positive relationships with students, they can also learn what participants are or are not getting out of the program. Staff take student input very seriously and use it to develop a curriculum that incorporates student interests and is grounded in a culturally responsive approach.

With trusted adults and educators, students eagerly share when they are having fun, and they give honest and critical feedback when they are not. Program participants are not shy about detailing their favorite and least favorite projects—for instance, Courageous Sailing students lit up while talking about launching their own boats, while they were visibly disappointed reflecting on a compass-making experiment that didn’t work as intended. Where peer and adult relationships are strong, students are also unashamed to admit when they are struggling, and they are unafraid to ask for help. Developing a sense of community among peers and program staff creates a space where students can show up to programming and engage in new experiences as their authentic selves. The result is an enriching, student-driven experience that students will want to come back to, week after week and year after year.



SUMMARY OF PROGRAM CONTENT



CITYSPROUTS

Staff provide students with hands-on gardening experience and space to work together to grow and maintain their own flowers and food.

During summer programming, middle school students earn a stipend for maintaining community gardens while developing key leadership and career-ready skills.

Students work alongside peers and garden educators to keep gardens growing, cultivating social-emotional skills as they tend to their plants.



COURAGEOUS SAILING

Staff introduce students to sailing-related STEM content and help them practice everyday STEM skills.

Instructors take students on field trips to STEM companies, invite STEM professionals to speak to students directly, and seek to link activities with STEM careers.

Instructors build a trusting environment, providing support and guidance while also allowing students to achieve individual and creative accomplishments through program activities.



SOCIEDAD LATINA

Staff provide students with a safe, culturally relevant space to gather with friends and explore STEM concepts through interactive lessons.

Instructors navigate the O*NET Online career platform with students to look into various STEM careers, exploring their salaries, education requirements, and critical skill sets.

Program staff create a space for friendships to bloom and build positive relationships with students, becoming trusted mentors who encourage students to keep coming back to the program.

**CULTIVATING
STEM
INTEREST**

**HELPING
STUDENTS
EXPLORE
STEM
CAREERS**

**BUILDING
STRONG
RELATIONSHIPS**

Recommendations and Conclusion

Overall, BoSTEM has contributed in many ways to building a more comprehensive and interconnected ecosystem in order to link historically marginalized students in Boston with STEM career pathways. OST programs are generally very satisfied with the support and resources that BoSTEM provides, not only to ensure the continuing viability of programming but also to improve program quality and bolster links with other organizations. Meanwhile, industry partners benefit from the connections to the local community that come through BoSTEM, particularly the network of educators and students they can introduce to their work.

Alongside these strengths, stakeholders also pointed to a few areas for growth the initiative can address to enhance its impact in the future:

- 1] Clarifying the purpose and goals of the BoSTEM model.** BoSTEM is a multifaceted project with many components, from externships for teachers to career exposure for students to data support for OST programs. Communicating the goals and approach of the initiative could help participants in each of these fields understand the full breadth and scope of the work. Additionally, UW has expressed interest in getting more involved in policy conversations regarding the out-of-school-time space as a vehicle for building career pathways, but in order to do so, it would benefit from providing clearer messaging on its various components and how they intersect. The BoSTEM advisory committee (composed of leading STEM stakeholders) can play a particular role in clarifying the approach and goals of the BoSTEM model, both among existing partners and with the general public.
- 2] Maximizing the utility of data collection tools and processes in partnership with programs.** While data collection resources from BoSTEM are generally very well-received, not all of the data that programs gather and report on is seen as equally applicable or useful. Instead, some measures can feel like “jumping through hoops” for the sake of fulfilling BoSTEM requirements—in particular, the SAYO-T (which asks for staff input on student social-emotional growth) is not universally seen as a helpful way for programs to measure their effectiveness, at least in comparison with other measurement tools. Going forward, United Way and Boston After School & Beyond staff can continue to engage programs in discussions about the types of data collection that are most high-impact and how to support professional development around data use and related topics.
- 3] Supporting real-world career connections within programming.** In order to accomplish the goal of building career pathways in STEM fields, the BoSTEM initiative can also support programs’ capacity to establish stronger career connections in their programming, as some programs have struggled to contextualize and incorporate career exposure in their work with middle schoolers. Data corroborates this challenge, showing that programs have produced strong results in terms of building STEM interest among students, but they have had a more limited impact on supporting STEM career interest. The situation has been exacerbated by the pandemic, which shut down crucial points of connection like field trips, job shadows, and other in-person career exposure activities. Moving forward, BoSTEM can leverage its network of industry partners and the community of practice it has created among OST programs to identify successful strategies for enhancing students’ STEM career knowledge.

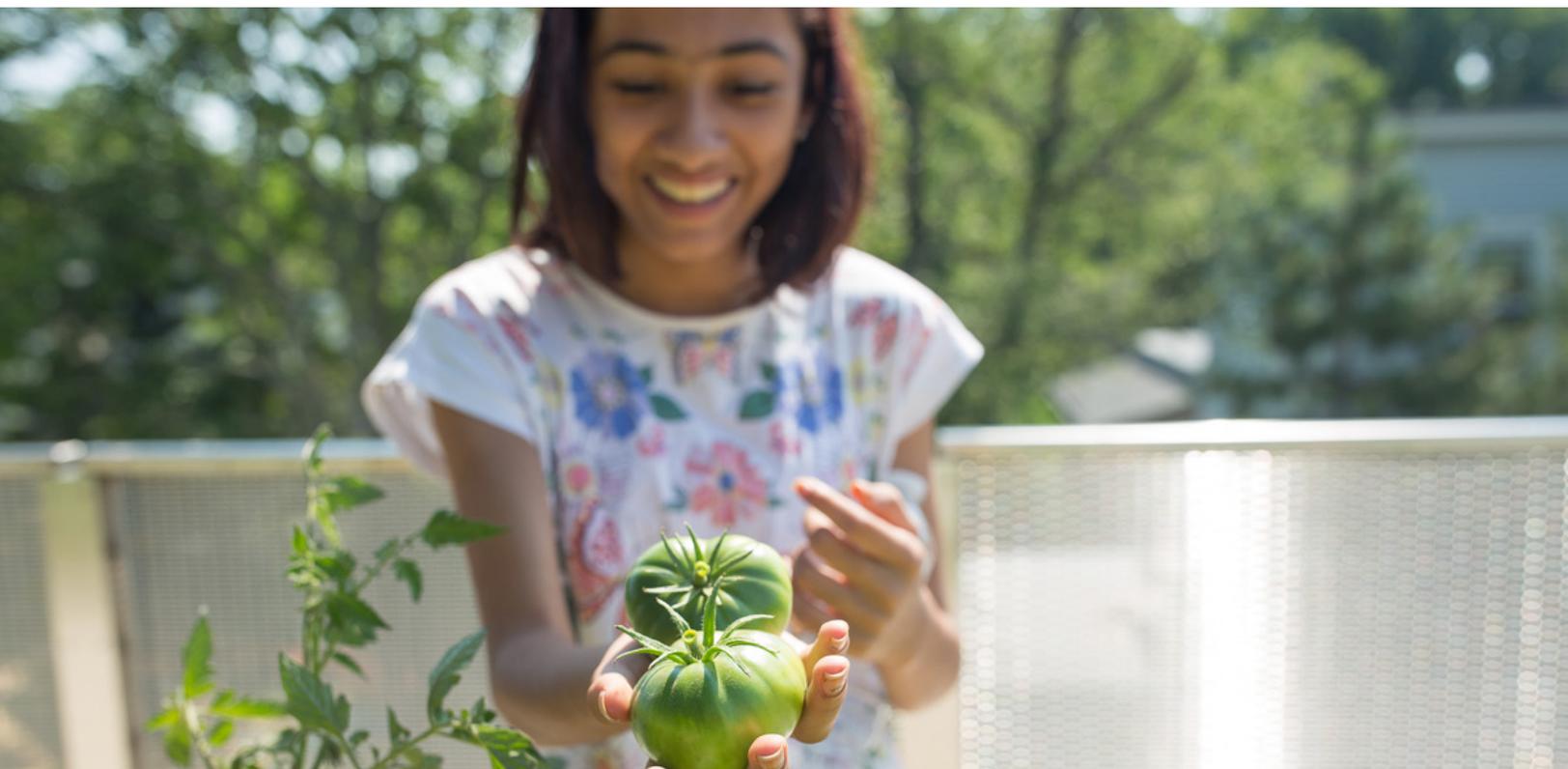
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Enhancing participation in the teacher externship program. The externship model can be extremely valuable for both industry partners and classroom teachers, but the program could be strengthened in a few ways. For one, stakeholders mention that it has been difficult to recruit as many teachers as there are slots available in externship programs. It has also been a struggle to get district and school leaders from Boston Public Schools to buy into the externship program and its benefits, or even to attend events with industry partners where teacher participants present their externship projects. Another takeaway has been that the lessons learned in externships have sometimes been challenging to bring back into classrooms and infuse into pre-existing curriculum.

All in all, despite its many successes, the initiative has room to grow in these areas. With continued funding and ongoing involvement and support from across the STEM landscape, it can build on the lessons learned from the program thus far and maintain its reach and impact.

The BoSTEM ecosystem is one-of-a-kind. In this space, companies can work alongside educators to teach and push one another on how to create diverse and affirming spaces for underrepresented young people in STEM fields. Out-of-school-time programs can come together to break down silos and address some of the most pressing challenges they face in supporting marginalized students during a formative period in their lives. Students can learn more about STEM concepts, skills, and careers, diversifying future pipelines into the field. They can build relationships with one another and with trusted adults, tap into their potential and creativity, recognize new capabilities, and learn more about who they are and who they want to be.

The promising practices at the core of BoSTEM's model warrant further evaluation to ensure that they are having sustained positive effects for students and the community. As BoSTEM continues to apply (and expand) its equity-based STEM initiative regionally, it can also be used as a replicable model and uniting framework for stakeholders in other regions. When stakeholders invest in young people's out-of-school education as a necessary complement to their school-day learning, students will be able to more fully form the identities, skills, and interests that help them succeed in their academic journey and beyond.



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About the Rennie Center

The mission of the Rennie Center for Education Research & Policy is to improve public education through well-informed decision making based on deep knowledge and evidence of effective policy making and practice. As Massachusetts' preeminent voice in public education reform, we create open spaces for educators and policymakers to consider evidence, discuss cutting-edge issues, and develop new approaches to advance student learning and achievement. Through our staunch commitment to independent, non-partisan research and constructive conversations, we work to promote an education system that provides every child with the opportunity to be successful in school and in life.

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