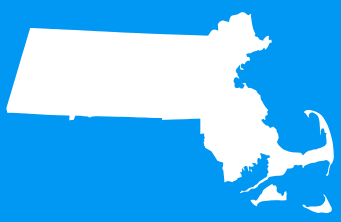
2020-21 Third Room Pilot Recap

Expanding Diversity and Access to Careers in the Life Sciences



Through remote industry partnerships with rural MA high schools

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1. Executive Summary

1.1 Problem

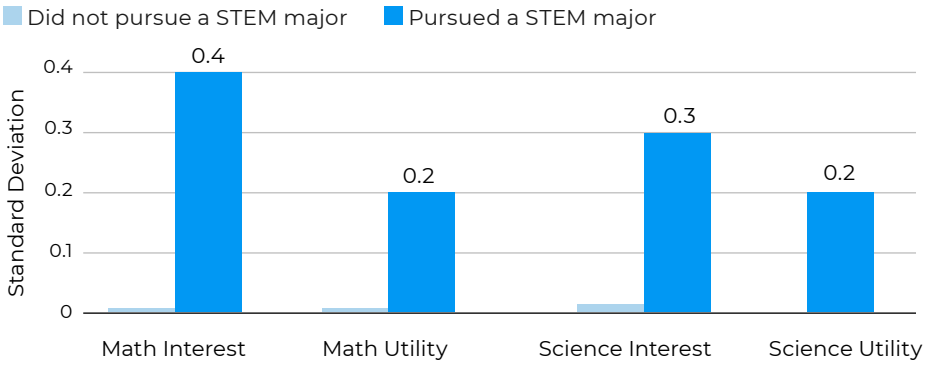
Economic projections point to approx. 3.5m unfilled STEM jobs by 2025 because of lack of skilled candidates. In a 2018 survey by Randstad, 76% of students 11-17 years old do not know what engineers do for work. 52% of students say they don't know anyone with a job in STEM.[1] In a 2019 survey conducted by the Center on American Progress, a leading indicator for students pursuing STEM majors is students' self-perceived interest and value in math and science.[2]

Specifically in the life sciences sector, MassBioEd estimated that in Massachusetts alone, an additional 20,000 jobs will be added to the life sciences ecosystem by 2024.[3] Due to broad demographic trends, the current pipeline of students will not be large enough to fill this demand. The lack of awareness of STEM in rural schools is even more severe. There are over 88,000 rural students in MA who attend a school in locales designated as fringe, distance, and remote.[4] Compared with students in urban/suburban areas, many of these students lack access to take advanced level STEM coursework and receive little exposure to STEM careers. In addition to access to coursework, many rural students do not have personal connections to STEM professionals. These factors can contribute to students' lower perceived interest and value in STEM subjects which decreases intention to pursue STEM related majors in college.[2]

We believe there is a huge opportunity to raise awareness and interest for students who might otherwise have enormous potential to succeed in STEM but don't know about the opportunities. How might we use online learning during COVID to build a sustainable model for rural students in MA to learn from career professionals in STEM? What impact would these experiences have on students' math and science mindsets?

9th grade math and science mindset correlate with pursuit of STEM majors in college

2020 study showed a big divide between math and science utility and interest rating among students who pursued STEM majors and those who did not. [2]



1 Employers Must Redefine Stem To Attract Future Talent, According To New Randstad US Data.https://rlc.randstadusa.com/press-room/press-releases/employers-must-redefine-stem-to-attract-future-talent-according-to-new-randstad-us-data

2 Quirk, Abby. Center for American Progress. (2019). Early High School STEM Perceptions Associated With Post-secondary Outcomes Center for American Progress

3 MassBioEd. (2021). 2021 Life Sciences Employment Outlook.

4 Higher Education Equality for Students in Rural MA PowerPoint, Fall 2019. Harvard Graduate School of Education

1.2 Solution

From Sept. 2020 to Feb. 2021, Third Room, MassBioEd, and the Massachusetts Rural Schools Coalition designed and piloted a virtual industry-school collaboration serving 7 rural districts in western MA reaching ~330 middle/high school students. This pilot connected rural STEM classrooms with local life science industry professionals serving as Career Ambassadors. **The format was 3 virtual sessions for each classroom between students and Career Ambassadors.** The objectives of this pilot were to:

1. Expose students to biotech/life science careers that they were not aware of.
2. Build rapport between students and STEM professionals.
3. Help students see real-world applications of what they learn in class.
4. Support teachers in making real-world connections for their content.
5. Provide relevant data to determine how this pilot can be expanded in the future and inform future virtual opportunities.

1.3 Key Stakeholders

Third Room

Third Room is an education technology company that develops platform solutions to connect students, educators, and industry together. Third Room designed, organized, and coordinated the pilot program. Among other tasks, Third Room recruited schools, coordinated between teachers and industry professionals, led instructional design process, provided logistical and technical support, and conducted data collection and analysis.

MA Rural Schools Coalition

MRSC is a 501c3 non-profit partnership of 31 rural MA districts and their leaders, including 16 “high need” districts. MRSC was a founding partner of this collaboration, supporting 2018 research to define “Rural in Massachusetts”, funding 2019 research on “Disparities in STEM and CS”, and recruiting districts for the 2020 pilot efforts. MRSC assisted in the school outreach and recruitment.

MassBioEd

MBE is the 501c3 representing the workforce interests of 1,400 life sciences firms in MA. MBE’s mission is to build a sustainable life sciences workforce in the region through eduational programs that engage and excite teachers and students. MBE recruited industry professionals for the pilot and offered feedback on instructional design and future improvement.

Impact Highlights

2020-21 Pilot Summary

333

STUDENTS IMPACTED

22

LIFE SCIENCE PROFESSIONALS

12

EMPLOYERS

11

MIDDLE/HIGH SCHOOL CLASSROOMS REACHED

7

RURAL DISTRICTS

These districts designated as rural priority by MA Rural Schools Coalition

25

HOURS

Total hours of workforce infused project based learning across entire pilot

1.4x

INCREASE PURSUING STEM CAREERS

Increase in students' self reported likelihood of pursuing STEM careers (n=224 in pre, n=134 in post, 23% pre to 33% post who report somewhat likely/ likely)

2.4x

INCREASED KNOWLEDGE OF STEM CAREERS

Increase in students' self reported knowledge of careers in STEM (n=224 in pre, n=141 in post, 19% pre to 46% post who report somewhat agree/ agree)

70%

STUDENT ENGAGEMENT

70% of students reported feeling engaged or strongly engaged throughout the pilot

82%

INTERESTED IN SIMILAR EVENTS IN FUTURE

82% of students are interested in future events and staying in touch with the industry professional (some aren't interested in STEM)

I was fascinated with hearing the process of developing a drug and the different types of people who must collaborate in order to make it happen. - Student

“I learned about how drugs are developed and all the different tests that are done. I also learned about all the different things that scientists need to keep in mind while developing drugs for the market. I also learned that there are big teams that work in different subjects [departments] which work together towards the common goal.”

-Student

Novartis presents Drug Design Challenge to students

2. Background

2.1 Why Life Sciences?

This pilot leveraged the strength of MA's bio-innovation economy. MA is a global hub of bio/life science and medical research, development, and entrepreneurship. COVID vaccine development press coverage has showcased the increasing role of computation, artificial intelligence, and machine learning within a "convergence" of biology and technology.[1] In the MA knowledge economy, Computer Science (CS) is already being applied across genetics, microbiology, physiology, molecular biology, plant biology, neuroscience, synthetic biology, systems biology, pathology, etc. "Advances in biological sciences, combined with the accelerating development of computing, data processing, and artificial intelligence, are fueling a new wave of innovation" and a broad "Bio-Revolution".[2] The MA Department of Elementary and Secondary Education (DESE) supports CS Education through statewide Digital Literacy and Computer Science (DLCS) standards, curriculum frameworks, professional development, classroom resources, curriculum plans, etc, including project-based learning support (PLTW) and new Computational Biology courses and resources (Science+C 2020). MA economic development agencies also provide financial support and resources to employers who offer work-based learning opportunities by hiring high school students as interns or apprentices in bio/life science and tech firms (Massachusetts Life Sciences Center, MassTechCollaborative, MassBioEd).

	MA Rural Schools 29 designated rural districts by MA Rural Schools Coalition	**Postsecondary Pathways** Programs & Support to Expand Access, Readiness & Support	**Regional Workforce** (MA Employers & Economic Development Skills Programs)
Assets	• Strong Bio/AP Bio enrollment • Strong HS graduation rates • Strong MCAS (achievement) • Strong PSAT/SAT scores • State STEM & DLCS support • Engaged teachers/families • Motivated Bio/AP Bio students • School role in community • 10% of MA students are in rural	• Strong Bio/Life Science paths • Strong CS+Bio Degree Programs • Strong HS-CC Connections • Early college pathways • State funded internships • Industry college programs • STEM Starter Academy • STEM regional hubs • MassTransfer Pathways	• Strong Bio/Life science/health hiring & CS+Bio skill needs • Exceptional support for skills Development (MassBioEd's BioTeach Program, MTC, & MA Life Sciences Center Initiatives) • Diversity of CS-infused career tracks in bio/life science/health • Vibrant industry volunteerism (e.g Life Science Cares, Individual Firms)
Barriers	• Low career/industry awareness • Low CS & CS AP Participation • Low AP offerings & success • Educators lack industry links • Educators feel isolated • Bus transportation • Broadband connectivity • High first generation to college • High economic disadvantaged • Lack of STEM+C Confidence	• Low CS college participation • Lack of career awareness in life sciences industry • Lack of STEM+C confidence • Low access to industry mentors at scale • Financial constraints/tuition costs • Transportation/distance • Geographic mobility issues	• In pre-COVID times, employers historically did not engage rural districts distant from the MA economic hub of Boston • 20,000 unfilled jobs in life sciences projected by 2024 • Logistics of connecting with rural districts challenged by lack of scale and staffing gaps • Physical distance for follow-on in-person internships
Implications for Pilot	• Workforce Infused Projects • Educator Led, In-Class Projects • Integrate career discusison of data science/computational thinking in high school Bio/AP Bio/CS • CS+Bio Industry Relationships • Apply student developmental theory • STEM stereotype considerations	• Connect student interests to careers • Connect careers to real pathways • Connect pathways to HS classes • Share findings with programs that support college internships in the life sciences • Transferrable practices that colleges can use to grow interest in the life sciences • Build upon research base addressing self-efficacy, identity & skills	• Engage MassBioEd, Life Science Cares, and partner corporations for follow-on programming and investment in tools to scale up impact • Champion "Permanent" virtual engagement strategy for rural districts in and diverse, underserved students in those districts • Strengthen MA Rural Schools Coalition's agenda for long term impact

1 Hockfield, S. (2019). The age of living machines: How biology will build the next technology revolution. W. W. Norton & Company.

2 McKinsey Global Institute (2020). The Bio Revolution - Innovations transforming economies, societies, and our lives.

2.2 Access Issues in Rural MA

This pilot program focused primarily on rural communities throughout MA, which have historically had little access to the many opportunities that the growing presence of biotechnology companies provides to much of the state's population. The pilot took place in seven towns across four counties—Berkshire, Franklin, Plymouth, and Worcester. Students in these communities face obstacles to engagement in extracurricular programming including long bus rides (up to 90 minutes) and limited or nonexistent after-school bussing, limiting the accessibility of after-school programming. In addition to the limitations on accessible programs, the logistic challenges of transportation and distance often preclude teachers and schools from offering visits to industry locations such as laboratory tours that would increase student exposure to STEM careers. Furthermore, students have limited access to internships or other prolonged engagement with the biotech industry. As a result, even those students who are most interested in and proactive in pursuing a career in STEM are placed at a disadvantage due to the limited opportunities to engage with STEM career professionals or pursue internship or other career-oriented experiences.

Participating School District	Middle/High School Pop.	Town, County	Town Pop.
Silver Lake Regional School District	1,175	Kingston, Plymouth County	12,629
Athol Royalston Regional School District	346	Athol, Worcester County	11,753
Quabbin Regional School District	632	Barre, Worcester County	5,398
Pioneer Valley Regional School District	280	Northfield, Franklin County	3,032
Mohawk Trail/Hawlemont Regional School District	284	Shelburne Falls, Franklin County	1,806
Berkshire Hills Regional School District	502	Great Barrington, Berkshire County	6,852
Quaboag Regional School District	361	Warren, Worcester County	5,135

2.3 The impact of COVID-19 on Participating Schools

This pilot program was designed, organized, and implemented throughout late 2020 during the ongoing public health crisis of the COVID-19 pandemic. During the pilot program period (Sept. 2020-Feb 2021), Massachusetts was experiencing a steady rise in COVID cases after a lull in the summer of 2020. Despite the rural location of the participating schools, all were located in regions where the risk of contracting COVID-19 was categorized as "High Risk" or "Very High Risk," according to the New York Times.[1] As the caseload risk increased throughout the fall, schools adjusted their policies accordingly, with many moving between distance learning, in-person learning, and a hybrid model where some students attended in-person and others online. For most participating schools, distance learning is a new experience and several participating STEM teachers mentioned their concerns about how to provide a "hands-on" experience for their students in subjects such as biology, given the challenges both distance learning and social distance guidelines present to activities such as using science equipment.

Throughout the pilot, Third Room encountered several challenges and adjusted operations to overcome them. One unexpected challenge faced in the initial phase of outreach was that many schools were in the midst of transitioning from online-only education to in-person education. As a result, the most effective strategy was conducting several rounds of email outreach and follow up with subsequent calls. However, the primary challenges encountered occurred during the implementation phase. Most challenges related to the difficulty of scheduling sessions in the context of rapidly changing school schedules, where in some cases teachers would only be given their class schedule one week in advance. As a result, it was occasionally difficult to find days sufficiently far in advance that would suit Career Ambassador schedules, and occasional rescheduling was necessary, resulting in an expanded timeline for session implementation. A related challenge resulted from changing classroom structure due to the pandemic. Some were fully in person, others fully online, some hybrid, and a few classes underwent shifts between them. This presented a challenge for the teacher to arrange the class so all students could actively participate. Due to the virtual nature of the program, it became difficult to ensure all students completed the surveys after each session and at the completion of the program, resulting in a lowered completion rate. Additionally, the varying classroom medium meant that teachers often did not know how many students to expect on any given day given irregular attendance during online learning. These challenges helped to inform recommendations for adjustments to make for future programming.

2.4 Summer 2020 Pilot

In the summer of 2020, an initial first pilot was conducted between Third Room, MassBioEd, and four participating schools. This first pilot brought together two scientists from Cytiva (formerly GE Healthcare Life Sciences) to provide students with a problem of practice facing industry. During this pilot, the planning team met regularly to collaboratively develop the instructional design and experience. This first pilot consisted of three virtual sessions between the Cytiva scientists, teachers, and students over the period of one week. The first session focused on introductions and brief summary of each scientist's current work and educational and career pathway. The second session was a workshop led by Third Room in which a problem facing the company was introduced and discussed. The Third Room team asked students to work on ways to solve this problem offline over the next few days. The final session consisted of student presentations. The goal was for students to explore the problem solving process and then receive feedback from the professionals. Positive feedback from the first pilot led to an expanded second pilot starting in the fall of 2020.

"As an educator, my background is primarily in education. Though I have decent content knowledge, I have no science work-related experiences. I encourage my students to think like scientists yet I don't have connections to anyone who is actually doing the work." -Teacher

1 Tracking Coronavirus in Massachusetts: Latest Map and Case Count. The New York Times.

3. Pilot Summary

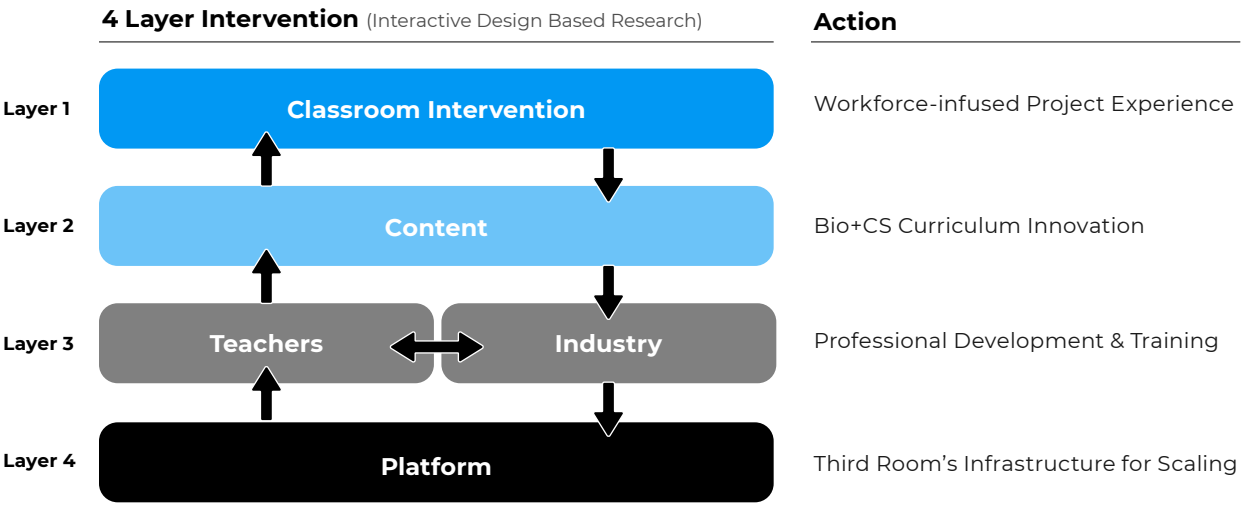
3.1 Programming

Each participating classroom was assigned 1-3 Career Ambassadors (life science industry professionals recruited by MassBioEd). The professionals were paired with the class based on teacher surveys. Each class participated in 3 virtual sessions with the professionals.:

- **Session 1:** Introduction and discussion about professional's educational and career backgrounds, their work, and company, with an opportunity for a Q&A.
- **Session 2:** Deep dive into a content area (based on subjects studied by the class, projects the professionals are working on) with the goal of helping students build background knowledge of problems that the industry is trying to solve. This session is also intended to scaffold to Session 3.
- **Session 3:** Expansion on Session 2 by providing opportunities for students to propose solutions to a challenge posed within industry. Students are guided to think critically from the perspective of someone in a career or organizations similar to the professional.
- **Overaching Framework:** The pilot is informed by Third Room's Equity Framework to support collective impact work. This framework illustrates the moving pieces of the pilot and corresponding action plans. Each of the 4 layers offer feedback loops with one another with the Third Room team, educators, MassBioEd, and industry professionals actively involved in the design and implementation of the pilot.

Third Room Equity Framework

Achieving equity in Bio+CS through a cross-sector model to inspire the modern generation of CS-driven leaders



The goals for this project are as follows:

- **Layer 1:** Bring industry professionals working at the intersection of biology, CS, biotechnology, life science, biomanufacturing, and clinical research into rural MA biology classrooms to introduce students to emerging STEM careers and problems that require computer science skills- considering local context and student interests, identities, backgrounds.
- **Layer 2:** Adapt/develop lesson materials to help Bio and CS students in HS see real application of classroom learnings to the work of life sciences professionals.
- **Layer 3:** Develop and implement professional development, ongoing support, and virtual resources to support the preparation and teaching of rigorous workforce-infused problem-based learning teachers and Career Ambassadors.
- **Layer 4:** Strengthen the sustainability of a cross-sector community of practitioners and industry via a new platform designed to scale industry-school collaboration at the organizational level (schools, districts, companies, trade associations) and individual level (students, teachers, industry professionals).

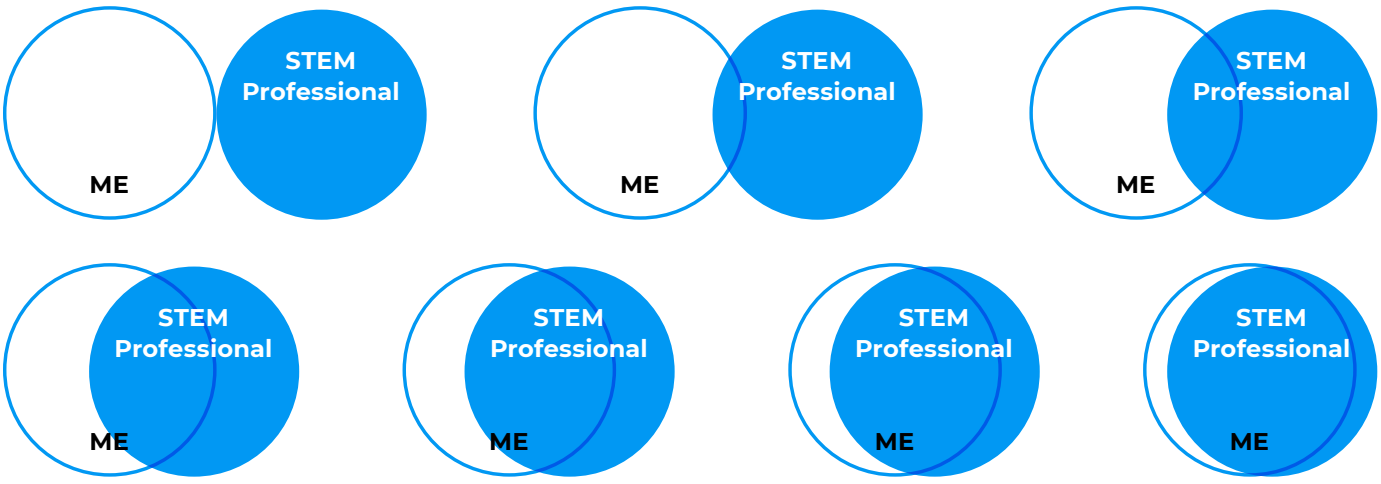
3.2 Our Research Base

The current set of solutions addressing socioeconomic disparities in STEM is largely focused on STEM skills and literacy. While such efforts are important and should continue to be improved, framing root challenges through academic content alone is problematic. The assumption is that gaps in the STEM pipeline is attributed to what students are not learning or what teachers are not doing. Despite the broad availability of data suggesting quantifiable gaps in hard skills like math or science, the skills-gap theory is an incomplete one.[1] There is fast-growing interest among researchers and advocates in a complementary view: who you know matters just as important as what you know. As Education Director at the Clayton Christensen Institute, Julia Fischer puts it, social capital is the invisible currency in education reform.[2]

Several considerations are at play here. The first is that mastery of academic content does not fully predict student motivation. Relevant blindspots include emotional engagement, which is a function of bonding and bridging social capital, both sub dimensions of social capital. Bonding capital refers to the need to connect with others within a particular community. Bridging capital refers to the need to connect with others outside of the community.[3] These social capital supports include providing validation, encouragement, identity-affirming messaging for students to opt into certain careers over others (e.g. STEM vs non-STEM). These findings are consistent with school psychology research including Possible Selves, Hope Theory, and Self Determination Theory. Exposing students to STEM professionals who share similar identities (e.g. race/gender) have shown to have positive effect on interest among females going into STEM careers.[4] The second assumption is that schools, as microcosms of their community, are insufficient at providing students with resources and power that have historically been denied from the community. While different forms of community power can be harnessed and grown from within -e.g. storytelling, placemaking, participatory methods, there are other sources of power at the institutional and societal level that can only be accessed through bridging social capital. In practice, these may be awareness of certain career opportunities, professional memberships that lead to prospective employers, or knowledge that combats stereotypes perpetuated in the school.

This pilot was heavily influenced by social capital theory and its links to identity development in adolescents as it relates to career and college trajectories in STEM. Helping students to see themselves in STEM and as a "STEM person" is an important tool in supporting those who are interested in a STEM career path as they begin to conceptualize their future.[5] With the goal of helping students build positive STEM identity, the program emphasized creating space for students and industry professionals to build rapport and improve student comfort seeing themselves doing the work of professionals they meet.

Student <> STEM Professional Identity Overlap Measure



1 Manno, V. Bruno. (2020). A Social-Capital Approach to Education Reform.

2 Fischer, F. Julia (2015). The invisible currency in education reform: social capital.

3 Saw GK. Leveraging Social Capital to Broaden Participation in STEM. Policy Insights from the Behavioral and Brain Sciences. 2020;7(1):35-43.

4 Lawner, E.K., Quinn, D.M., Camacho, G. et al. Ingroup role models and underrepresented students' performance and interest in STEM: A meta-analysis of lab and field studies. Soc Psychol Educ 22, 1169–1195 (2019).

5 Dou, Remy, Hazari, Zahra, Dabney, Katherine, Sonnert, Gerhard, & Sadler, Philip. (2019). Early informal STEM experiences and STEM identity: The importance of talking science. Science Education (Salem, Mass.),103(3), 623-637.

3.3 Participating Schools and Employers

For the pilot, 11 classrooms across 7 districts were selected to participate. Classes ranged in topic from Biotech to General Science and Engineering Design. The total number of students in the participating classes is 333. Most classes serve students in Grades 8-12, with one 6th Grade class participating. The 6th Grade classroom received a modified version of the program with only two sessions. In several cases, classes were split in several sections (e.g. Class X is split into Section A and Section B) that have different schedules. In these cases, only one section would be present for the live Career Ambassador session, except in occasional cases where students were allowed to leave their regularly scheduled class to join the session.

When possible, teachers engaged students who could not be present for live sessions with session recordings, class discussions about STEM content or career topics, engaged them in relevant projects, or collected questions for the Career Ambassadors from them.

Class Name	Grades of Students	Number of Students
8th Grade Science*	8	60
Anatomy & Physiology*	10, 11, 12	20
AP Environmental Science	11, 12	15
Biotech	11, 12	18
Biotech	10, 11, 12	25
Biotech	11, 12	25
Communicating Through Technology	9, 10, 11, 12	22
Engineering Design*	9, 10, 11, 12	22
General Biology*	10	55
General Science	6	11
Honors Biology/College Prep*	9	60
TOTAL		**333**

*indicates the class is broken into multiple sections

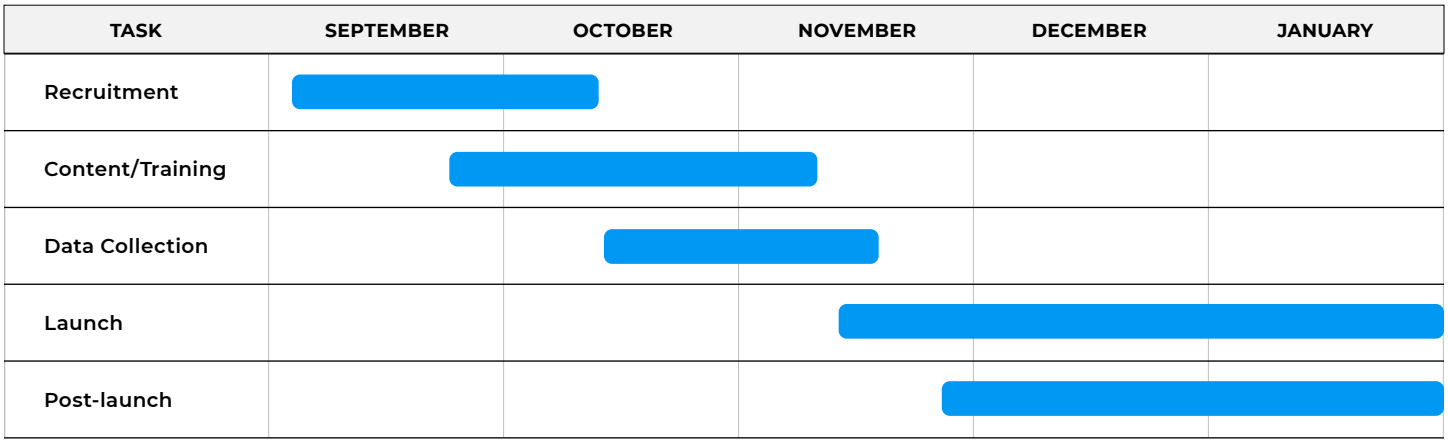
Most participating classes were paired with two Career Ambassadors, who would work together during the three sessions. Two classes had only one Career Ambassador, and one other had three. Career Ambassadors represented 12 different organizations. While in some cases, the Career Ambassadors from one class were colleagues at the same organization, in several cases the paired Career Ambassadors were from different organizations.

Participating Firms/Orgs	About	MA Office
agios	**Agios** creates differentiated, small molecule medicines for patients in three focus areas – malignant hematology, solid tumors and rare genetic diseases – based on our unique expertise in cellular metabolism and adjacent areas of biology.	Cambridge
ARRANTABIO	**Arranta Bio** is a contract development and manufacturing organization specifically established to focus on serving companies seeking to develop and commercialize therapies targeting the human microbiome.	Watertown
astellas	**Astellas Pharma US, Inc** is a U.S. affiliate of Tokyo-based Astellas Pharma Inc. Astellas is a pharmaceutical company dedicated to improving the health of people aroudn the world through the provison of innovative and reliable pharmaceutical products.	Marlborough
bluebirdbio	**bluebird bio** is pioneering gene therapy with purpose. From its Cambridge headquarters, bluebird bio is developing gene therapies for severe genetic diseases and caner, with the goal that people facing potentially fatal conditions can lieve their lives fully. education so that gene	Cambridge
Boston Children's Hospital	**Boston Children's Hospital** is dedicated to improving and advancing the health and well-being of children around the world through its life-changing work in clinical care, biomedical research, medical education and community engagement.	Boston
cytiva	**Cytiva** is a global provider of technologies and services that advance and accelerate the development and manufacture of therapeutics. Formerly part of GE Healthcare Life Sciences, we have a rich heritage tracing back hundreds of years, and a fresh beginning since 2020.	Marlborough
EVELO	**Evelo Biosciences** is pioneering therapies that modulate systemic immune response by acting on the gut-body network. Evelo has developed an integrated platform to develop oral biologics which harness the central role that cells play in the small intestine.	Cambridge
IPM INTEGRATED PROJECT MANAGEMENT	**Integrated Project Managment** provides strategic project management leadership services across a wide range of industries. Its Boston/Cambridge-area clients range from startups to global Fortune 500 firms and include some of the most innovative biotech, pharmaceutical, and medical technology companies in the area.	Maynard
NOVARTIS	**Novartis** uses science-based innovation to address some of society's most challenging healthcare issues. Novartis discovers and develops breakthrough treatments and find new ways to deliver them to as many people as possible. Novartis also aims to provide a shareholder return that rewards those who invest their money, time and ideas in our company.	Cambridge
PhagePro	**PhagePro** is a discovery-driven venture spun out of the Camilli Lab at Tufts University School of Medicine in Boston. PhagePro aims to use bacteriophages, which are viruses that specifically target and kill bacteria, to prevent bacterial infections.	Boston
SCHRÖDINGER.	**Schrödinger** develops an industry-leading computational platform that facilitates research efforts of the biopharmaceutical and industrial companies, academic institutions, and government laborarties world wide.	Cambridge
Valo	**Valo Health** is a technology company that is using human-centric data and machine learning computation to transform the drug discovery and development process. and failure rate.	Boston

3.4 Timeline

Career Ambassador Implementation Schedule from Sept. 2020 - Jan. 2021

Pilot Program Timeline



3.5 Implementation

The first Career Ambassador sessions began in October. When possible, sessions for one class were typically a week apart, but priority was given to ensuring the schedule worked for both class and Career Ambassadors. Sessions typically lasted between 30 minutes and one hour, based on class duration and teacher needs. Present at each session were the classroom teacher, students, Career Ambassadors, and in almost all occasions, a Third Room and/or MassBioEd representative. In some cases, teacher aides or school administration also joined.

Sessions typically began with a short welcome from a Third Room representative or teacher, where students were encouraged to turn on cameras if they felt comfortable doing so and encouraged to ask questions through the chat feature or by raising their hand. Career Ambassadors would typically lead the rest of the session with support from the teacher.

Sessions often involved a visual presentation, such as PowerPoint slides or other visual aids, and ended with a discussion or question and answer session. Several sessions included a problem-solving or applied learning sections where students worked in groups to address a question posed by the Career Ambassadors. The focus of an individual session was guided by teacher needs, resulting in some sessions that focus primarily on career questions and discussion and others that focused more on STEM content area discussion. This provided flexibility and allowed teachers to shape the program to best fit the needs of their class.

All program sessions took place over video call. When possible, sessions took place on Zoom using a link provided by the Third Room team. Due to school policy, some sessions took place on Google Meets, using a link provided by the teacher. When allowed by school policy, sessions were recorded.

Recordings were made available to the teacher for future use in their class or for viewing by students who were not present for the live session. In total, five classes were able to record sessions. Most classes had each student log on to the session using their individual device. We found this to be preferable as this allowed students to use the chat function, raise their hand, and unmute themselves to ask questions or add comments. In cases where the full group was present on one account, the teacher would facilitate questions.

Model	Description
In-person classes	In cases where the students and teacher were present in the school, teachers typically had each student log onto the session from their own device. However, in several cases, the teacher set up one camera to view the class and projected the speakers onto a screen at the front of the room.
Distance learning classes	In cases where teachers and students were engaged in online learning, each student would log on from their device at home. Most of the sessions were in this format.
Hybrid classes	In cases where some students were in person and some online, teachers typically had each student log on from their own device. However, in some cases a camera was set up in the front of the room and projected the speaker onto a screen while distance learning students logged in on their own devices.

3.6 Creating Engagement in a Virtual Space

An in-person format in which Career Ambassadors dialed into the class using Zoom.

At the beginning of each session, students were encouraged to turn on their camera if they felt comfortable doing so, but it was not a requirement for participation. In post-session interviews, several teachers mentioned that they saw more students with their cameras turned on than is usual, which they took as an indication of student interest and comfort in the sessions. Students were also encouraged to raise their hand or use the chat function for any questions or ideas. The chat function provided an avenue for student engagement that is unique to the virtual environment, and it was an extremely valuable tool in engaging students throughout the program. As most classes had two or more Career Ambassadors present for each session, one Career Ambassador was typically able to answer questions in the chat while the other presented material. In this way, students were able to have direct interaction with the Career Ambassadors even if they were hesitant to speak in front of the group.

"They were all very interested in it [the sessions], and that showed in the work they put in prior to the sessions. They were researching and looking at it [the CA backgrounds], and after the sessions, they were talking about [the sessions]. I think the interest level and enthusiasm and involvement was there at all times." - Teacher participant

In order to support student engagement in the virtual medium, Career Ambassadors were encouraged to ask open ended questions and actively solicit responses from students. In sessions, students were repeatedly encouraged to participate by unmuting themselves to ask questions or to put questions in the chat feature, giving them multiple avenues to engage. Career Ambassadors were also encouraged to use visual supports for their presentations, such as using slides, conducting lab tours, or sharing their screen to show their work. Several teachers reported that students were more actively engaged during these sessions than they typically are during class, and in many classes, engagement increased as the sessions progressed. In order to mitigate possible technical challenges, the Program Manager coordinated with teachers ahead of the sessions in order to identify which virtual platform the sessions would take place on and ensure the Career Ambassadors had access. The Program Manager or other Third Room or MassBioEd team members were present at almost every session, occasionally providing technical support. There were no instances in which technical obstacles prevented the completion of a session. Finally, as the program progressed, it became clear that another risk stemmed from schools' schedules changing on a weekly basis due to rapidly changing public health situations. Additionally, schools shifted between all in-person classes, online classes, and hybrid classes. These logistical challenges were mitigated by close and frequent communication between the teachers, the Third Room team, and the Career Ambassadors.

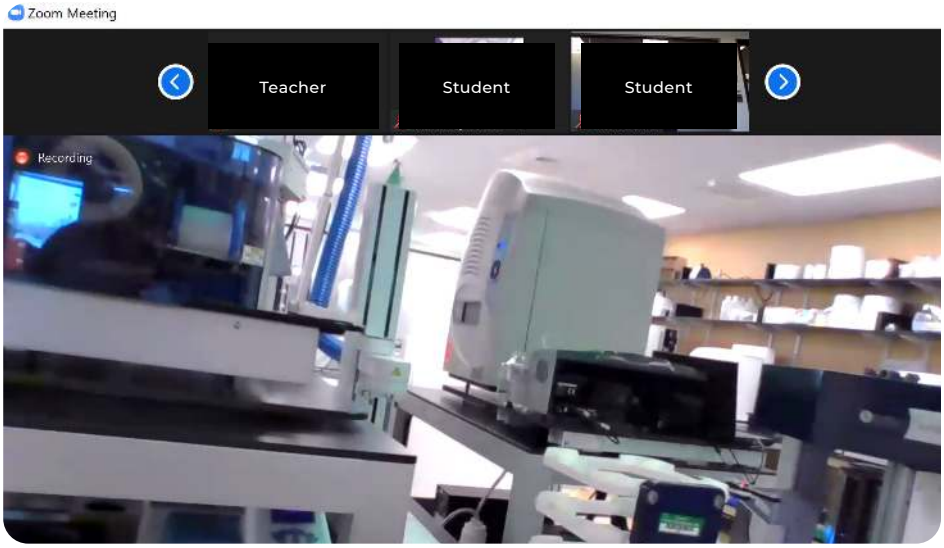
4. Results

4.1 Data Collection Methods

- Pre-program survey
- Post-program survey
- Session surveys
- Qualitative Interviews

4.2 Findings

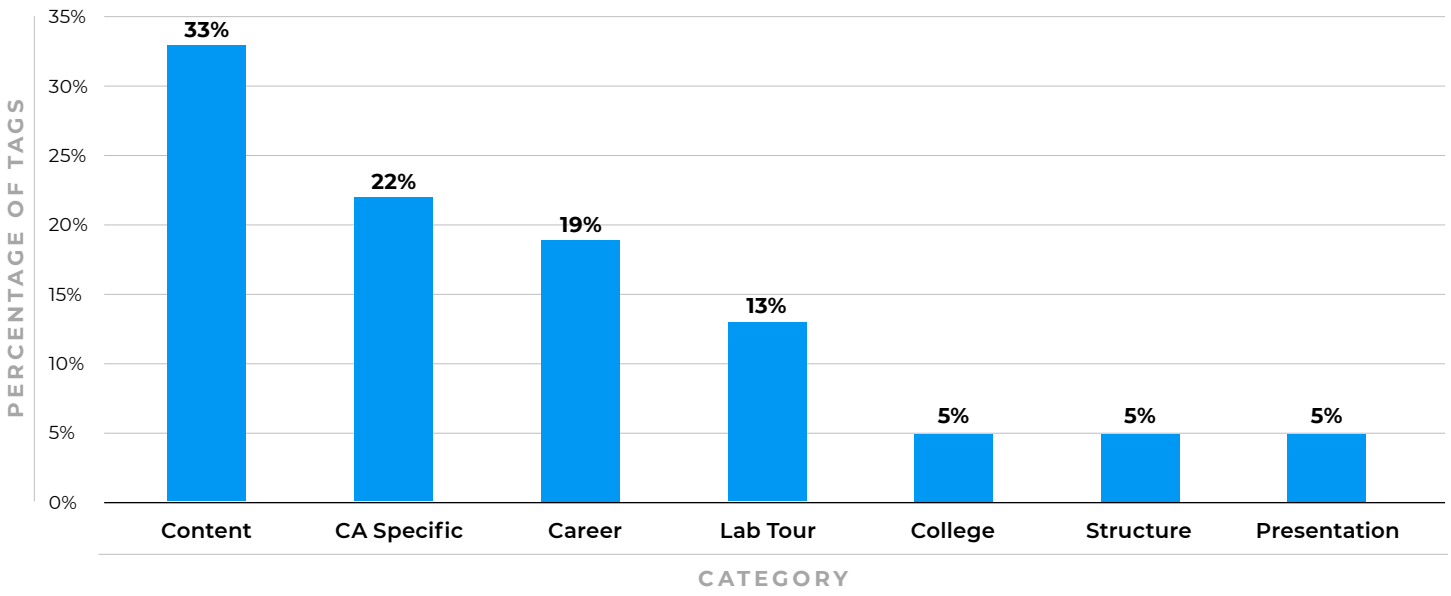
Top 3 most popular topics cited by students were related to the content covered, the CA Ambassadors, and future careers.



A live virtual lab tour led by a Career Ambassador

STUDENTS REPORT CONTENT TAUGHT BY AMBASSADORS AS MOST ENGAGING (137 STUDENT RESPONSES)

Student feedback was categorized into the following categories



Legend

Content: Learnings related to the topic covered in the session (e.g. drug discovery process)

CA Specific: Mentioned content related specifically to the Career Ambassador (e.g. life, projects, personality, experiences)

Career: Future work or job related

Lab Tour: Virtual lab (not all classrooms received a virtual lab field trip)

College: Mention of college or postsecondary education

Structure: Related to the flow and pedagogy

Presentation: Related to final presentation where students shared their ideas

Teachers are eager to participate.

The participating teachers were all extremely willing to put in the extra time and effort needed to bring this program to their students. Many held discussions with their students outside of the official sessions, and others assigned homework or in-class work related to these sessions. They were enthusiastic about meeting the Career Ambassadors and several initiated additional phone calls or discussions with the Career Ambassadors to further prepare for the sessions. Teachers value the opportunity for students to learn about the variety of jobs in these fields. They appreciate when CAs discuss work other people in their company do (such as sales, legal team, animal caretakers in a lab, lab equipment mechanic, etc.)

"As an educator, my background is primarily in education. Though I have decent content knowledge, I have no science work-related experiences. I encourage my students to think like scientists yet I don't have connections to anyone who is actually doing the work." - Teacher

"I actually think one thing that [the program] did change is the idea that a pharma company is big and evil—getting to meet scientists, getting to hear how they are passionate about helping people, made me less biased against these types of companies." - Teacher

Connecting the classroom to the real world is an instructional priority.

Several teachers shared that this is a goal they actively work towards in their classes and that it was a primary reason many of the teachers applied to the program. For example, teachers shared that they found it to be very valuable when the Career Ambassadors told students about specific aspects of their jobs such as how they use pipettes and lab books, which are tools the students have been using, providing a new context for the content students encounter in their classroom.

"In addition to being a great opportunity for students to kind of see a path that they might be interested in, and that is accessible to them, especially living in Massachusetts—there should be kids driving towards this all the time— it's a really good opportunity to see your students in a little bit of a different role, because they are interacting with these other adults. You see them do things that they don't always do for you and they step up to the plate. It's a good way to get your kids to where they are doing something real and they step up to the plate that way. It's pretty cool." - Teacher

"They were all very interested in it [the sessions], and that showed in the work they put in prior to the sessions. They were researching and looking at it [the CA backgrounds], and after the sessions, they were talking about [the sessions]. I think the interest level and enthusiasm and involvement was there at all times." - Teacher

"One of the main ways we try to get kids engaged with things is by connecting something they're learning to the real world... It's always helpful when you can really connect something to something real. It's always nice you have people from the outside speak about what they're doing and saying the things you might have said before...because it reinforces in the kids' minds that 'I'm in this class, but what I'm doing is not just this class—it's related to something broader.'" - Teacher

Teachers are interested in future programming.

During post-program interviews, many teachers indicated that they would be interested in being involved in future iterations of this program, even as early as in the spring of 2021.

"I think [the program] is perfect for showing students what they could be doing out there. I like that Career Ambassadors talked not just about the science they did but what some of their colleagues did. There was some marketing, people who ran trials, they kind of gave us a little taste of the fact they are just one part of this big system...It got [students] thinking about other ways [they could go into STEM], so if they didn't want to be a chemist or whatever—it was like a real-world, hands on thing. It did work nicely because I have them keep a lab notebook and the Career Ambassadors talked about their lab notebooks and they talked about using the pipettes...it was nice, they seemed to reinforce some of the stuff I was talking about...It seemed like it tied in with the class really well. Honestly, I just wish there was more of it." - Teacher

Career Ambassadors as relatable people to talk about STEM and careers.

Student feedback consistently demonstrated that students' favorite part of the experience was learning about the Career Ambassadors and their lives—how they got to where they are, the steps they took, and the things they do in their everyday lives; such as personal stories and anecdotes about hobbies. This casual engagement was a key component in students connecting with the Career Ambassadors. The presence and participation of industry volunteers was key to the success of the pilot and increased student engagement in a way that would not be possible without the industry volunteer presence.

"I am much more interested in having a career in this field. My knowledge of the different job options was widened. I think that I would likely want to pursue a career option in this field." - Student

"I think what clicked with the students is when [Career Ambassador] talked about his hobby...It put it into perspective, that they are real people...It made them more human." - Teacher

"I liked when the scientists discussed their experience in college and making their way to a career because it helped us understand the steps." - Student

Students appreciated hearing feedback from Career Ambassadors.

Students report specifically appreciating the opportunity to ask questions directly to the Career Ambassadors and having them answered in real time. This supports the programmatic decision to encourage Career Ambassadors to build in time for questions and conversation to their presentations.

"I liked session 3 the most because we could get advice on our current project." - Student

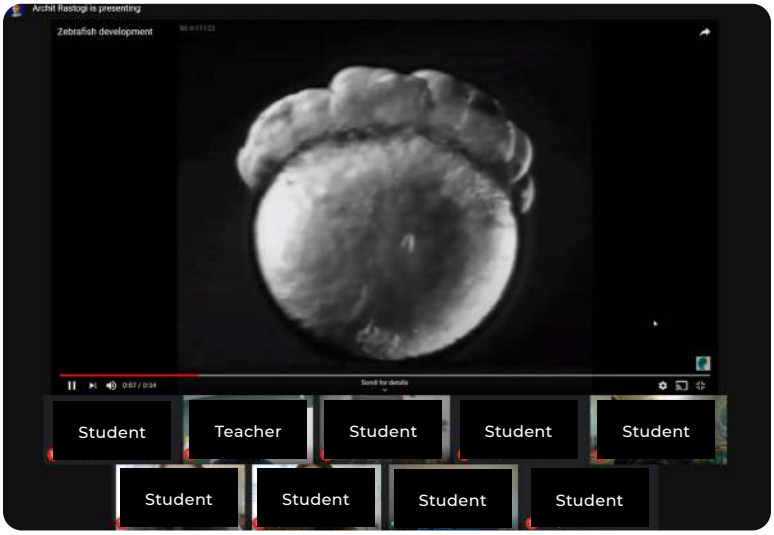
Virtual lab lab tours were very popular with students and low-lift to set up

In sessions during which the Career Ambassadors conducted a live virtual lab tour, invariably the student surveys would indicate that it was the favorite part. Students enjoyed seeing the workplace and equipment used by the Career Ambassadors in their work. This finding shows promise for virtual opportunities to engage with company labs.

Material highly relevant to current events.

For many of the classes, session content focused on biotechnology and biology. Career Ambassadors discussed timely subjects such as the vaccine development process, which students have heard about in relation to the COVID vaccines. In other classes, sessions focused on the educational backgrounds and career trajectory of the CAs, which was highly relevant for older students (11th and 12th grade) as they plan for higher education or a career.

"My favorite part was being able to talk about the process that went through to create a drug that I am currently on and how it came to be in the state it's currently in." - Student



Career Ambassador showcases the development of a zebrafish embryo to discuss genetic structures and mutations

5. Recommendations for Third Room Partnership

5.1 Recommendations for Scaling

The 2020-21 pilot revealed several foundational drivers for effective industry-school collaboration. Third Room plans to address these needs by developing tools and services to make it easy for companies and organizations to scale up industry-led STEM programming. **The following recommendations are intended for life science companies seeking to develop virtual programming to cultivate their talent pipeline starting at the high school level.**

Category	Pilot Revealed Need for	Recommendation
Training	Robust training to prepare industry professionals with effective strategies to engage high school students and educators.	**Partner with Third Room trainers for customized onboarding rooted in student developmental theory.**
Curriculum	Content that clearly articulates connection between the work of industry professionals and content that is taught in schools.	**Partner with Third Room content team to develop short subject-aligned presentations and activities that industry professionals can faciliate to maximize impact on students.**
Matching	A system to collect information from students, educators, and industry professionals to select the best partnerships.	**Use Third Room AI to auto-generate matches between industry professionals and classrooms based on a variety of topic, identity, and career indicators.**
Communication	A centralized platform for communication and scheduling logistics.	**Use Third Room's in-app messaging to schedule meetings and communicate.**
Follow-up	A system to enable follow-up communication and further relationship building and social capital growth.	**Use Third Room's connections feature to grow and keep track of students reached/impacted and turn those connections into future talent leads for internships.**

Third Room is committed to building tomorrow's talent today. We are seeking the support of life science companies that share this commitment.

Contact info@thirdroom.co to discuss how we can fit into your social mission and broader talent strategy.

5.2 Sector Implications for Employers

MA's K-12 students represent the next generation of industry workforce and talent, and life sciences industry leaders and stakeholders should continue to nurture their interests in STEM more broadly, and the life sciences more specifically. MassBioEd is appropriately investing in a multi-pronged approach to education and career exploration, but continued hands-on engagement is critical to developing student interest in STEM, both academically and for career pursuits. The industry more broadly needs to start cultivating high school students, motivating them in their academics, exciting them about life science careers, and incentivizing them to pursue post secondary eduation in programs that lead to jobs in the sector.

Volunteers involved in the pilot program are a part of MassBioEd's Career Ambassador Program, which builds a bridge from the classroom to careers by connecting life sciences industry professionals with students to provide a greater understanding of the industry through career awareness engagements. These volunteers include bench-level research scientists and project leaders, clinical research professionals, computational scientists, business development mangers, and others. Some have recently entered the workforce, while others bring years of industry experience and hold positions of high responsibility. All are provided the essential resources to effectively motivate students and share relevant career information about the vastly growing life sciences industry.

There is a need for more qualified people in all areas of the life sciences industry, as can be seen from findings in MassBioEd's 2021 Life Sciences Employment Outlook[1] and therefore, a need for more students to prepare for these careers. Reaching out to high schools and bringing authentic career information early is essential to achieving this goal. This pilot has shown the potential of volunteerism to meet the growing demand from teachers and students for additional life sciences programming. For companies seeking to strengthen their social impact mission while addressing future talent needs, building inroads into high schools is essential and can be relatively low-lift as demonstrated in this pilot. The time is now for the life sciences industry including companies, roundtables, corporate philanthropy, and government to work together on defining its shared purpose, vision, and commitments for MA K-12 stakeholders.

5.3 Sector Implications for Rural School Districts

In order to serve their students and their communities, rural school districts must provide students with effective career guidance, which encourages them to think critically about the connection between their educational choices and future careers. Recent research by the OECD[2] on teenagers' career aspirations points to the need for connecting classroom learning to to future economic lives, addressing information asymetries about specific professions and challenging stereotypes about who enters those professions, and expanding students' understanding of the labor market (with a focus on occupations that are poorly understood and of strategic importance).

The pilot work shows that rural districts have a path to reach these goals - a path which is not resource intensive and which circumvents the obstacles presented by the distance between rural districts and centers of economic development in the state of MA. If rural districts are to compete with suburban and urban schools, they must be able to offer effective career guidance in their high school classrooms leveraging partnerships with industry professionals. In addition to connecting students to professionals, districts should also empower subject teachers to scaffold the learning experience and embed such experiences into the curriculum. This calls for investing in innovative student and educator friendly tools that can keep track of the relationships built over time and consistently offer on-demand access to diverse networks of professionals willing to engage with high school students. This pilot and continued work moving forward provides evidence for administrators even in urban contexts that virtual engagement with professionals working in the MA region should be considered an essential part of the learning environment.

1 MassBioEd. (2021). 2021 Life Sciences Employment Outlook.

2 OECD. (2020). Teenagers' career aspirations and the future of work.

Acknowledgments

ORGANIZERS

THIRD ROOM

MASSACHUSETTS RURAL SCHOOLS COALITION

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