

Board 10: Work in Progress: Design of a Full-Time Summer Research Program for High School Students

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Marla Hilderbrand-Chae is a Ph.D. student in the UML Biomedical Engineering Program where she researches engagement and mentorship in engineering education at the high school level. Hilderbrand-Chae has consulted for and presented at conferences sponsored by J-WEL, the World Education Lab at MIT, and has worked in partnership with Boston Scientific's Division of Equity and Inclusion group in developing a high school science mentorship program for underrepresented minorities (URM). She was a founding member of a STEAM Innovation Program at an urban vocational technical school servicing URM in STEM, where she taught Biology, Chemistry, and Biotechnology. Hilderbrand-Chae has a Masters' Degree in Genetics from Tufts University Medical School and now researches transfection efficiency influenced by substrate stiffness.

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Adam St. Jean is an Associate Teaching Professor and the Associate Chair for Undergraduate Programs in Biomedical Engineering at UMass Lowell. He received his Ph.D. in Chemical Engineering from the University of Massachusetts Amherst in 2012. His current research interests include 1) the influence of pre-college experiences on student career paths, and 2) engineering identity/experiences for the LBGTQ+ community.

Dr. Yanfen Li, University of Massachusetts, Lowell

Dr. Yanfen Li is an Assistant Professor in Biomedical Engineering at the University of Massachusetts Lowell. She received her Ph.D. in Bioengineering from the University of Illinois at Urbana Champaign in 2018. Dr. Li has extensive experience in engineering education focusing on recruitment and retention of underrepresented and under resourced students and engineering pedagogy. Her work spans the areas of curriculum instruction and design, program design and evaluation, and the first-year college experience. Dr Li's research group aims to further the development of a diverse workforce in engineering and STEM. She is the PI of a NSF Scholarship in STEM grant aimed at supporting high achieving, low-income students to complete their bachelor's degrees and continue on to graduate school. She has received several teaching awards including the UMass Lowell Award for Excellence in Innovative Teaching in 2021 and the Biomedical Engineering Teaching Award from the American Society for Engineering Education in 2021.

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Program Overview

The PROPEL Careers Program is a paid high school summer research internship open to students over the age of 16 attending eligible high schools in Massachusetts and is located at a large state university campus. Eligibility is determined by the Massachusetts Life Science Center, the funding entity, and includes Chapter 74 Vocational Technical High Schools, high schools located in “Gateway Cities,” and high schools in cities with a population of at least 25% classified as low income [1]. High school students participate in projects sponsored by Principal Investigators with daily mentorship provided by graduate students and post-doctoral candidates in these labs.

The internal program goal is to provide as many of the research internship spots to potential first-generation college students and underrepresented minorities (URM) in STEM, described by the 2023 Report on Diversity in STEM: Women, Minorities, and Persons with Disabilities [2] as Hispanics or Latinas/os, Blacks or African Americans, and American Indians or Alaska Natives. Efforts to lower application barriers for URM included instituting a unique application process prioritizing STEM interest and excitement rather than GPA, test scores, and prior experience, video introductions to the labs and projects, and an in-person faculty meet-and-greet held prior to the application deadline. Intentional programming through orientation workshops and Professional Development (PD) sessions was implemented to build employability skills in the areas of communication and networking and to give exposure to a variety of STEM careers. 20 students participated in the program, 4 were URM in STEM and would be first generation to go to college.

Improving Accessibility Through the Application Process

A subset of URM, Multi-Language Learners (MLL) are underrepresented in STEM [3] and are challenged with learning not only social English but STEM literacy, a difficulty often compounded by STEM teachers with little or no training in teaching MLLs [4]. Additionally, the pull-out model of Multilanguage Learner language acquisition in schools often requires students to attend English Language instruction in place of content area classes [5], beginning with removal from social studies and science classrooms [6]. Combined with educational opportunities generally only presented in English [7] and inaccurate assessment results that may artificially lower GPAs [7], these factors generate a potential hardship and disadvantage in any STEM internship application process.

In attempts to remove these barriers, the traditional cover letter and resume application format were substituted with visual application requirements designed to reflect a candidates’ enthusiasm for STEM topics and an insight into persistence and problem-solving abilities. Additionally, the PROPEL team created 1-2 min. videos with host labs that relate the lab focus and the summer internship project. Applicants were asked to write a brief, 250-word essay reflecting on a personal or academic challenge. This enabled the PROPEL application committee to assess communication skills, resilience, and approaches to problem-solving. Next, a creative presentation of a STEM interest or pursuit asked candidates to reveal their motivations in pursuing the PROPEL

STEM Interest or Pursuit

Choose an option (or develop your own creative presentation):

- Brief Instagram campaign
- Science Social Media Campaign
- Canva Infographic or google slide(s)
- Podcast or video

Demonstrate your excitement for science, research, and exploration!

Think about a STEM-related experience or topic that inspired you to pursue a science/STEM internship

- What influenced your interest in this topic?
- What are steps you have taken to learn more?

Show /relate/discuss:

- Something you have designed, or thought of designing
- Experiments or projects you have done or wish to do
- A recent discovery in science that interests you and the impact of this discovery

internship through a choice project of their own design (Figure 1). The wide array of choices in how applicants demonstrate their curiosity included visual components like Canva graphics or a Google slide. Next, candidates were requested to view the summer project videos and rate them in order of interest level.

Figure 1 – Student were asked to demonstrate how they connect with STEM through the choice of a variety of visual, spoken, or video components to express their enthusiasm.

Student Recruitment from a Title 1 High School

The PROPEL program was advertised in this large, diverse local high school through a school newsletter, an email blast to students, and daily announcements as mentioned above. Additionally, a graduate student from the PROPEL team visited the school and was available near the cafeteria during all lunch periods (3 hours). The goal behind this in-person visit was not only to increase the visibility of PROPEL, but to build confidence in students who may not think they would qualify. The graduate student brought hard copies of application materials and talked students through the application process, the excitement of bench science and how it differs from traditional classroom science. and answered any student questions about the program. 18 students interested in the PROPEL spoke with the graduate student. This personal interaction may have had a positive impact on applications as the largest cohort of applicants originated from this school, comprising 73% of total completed applications. Future work will be needed to formally assess the effects of the in-person visit.

Meet-the-Faculty Event

In order to alleviate the pressure of the interview process, an event was organized before the application deadline in which the Principal Investigators (PIs) from host labs visited the high school to meet with potential applicants. Students were asked to come up with questions for each faculty member based upon the lab videos. To facilitate success, a PROPEL team member met with students prior to help brainstorm questions. 17 students and 6 faculty or their post-doc/graduate student representatives attended, and, in a speed-meeting format, students were in pairs and talked with PIs or their lab representative for 7 minutes before rotating to the next PI/lab representative.

2023 Demographics

Recruitment strategies were aimed at increasing the URM applicants by placing less emphasis on previous STEM experiences and the development of a formal resume and cover letter, hoping to lower the application load and lessen feelings of inadequacy or imposter syndrome as described in Chakraverty, 2022 [8] . Figure 2 displays the initial applicants and their ethnicities compared with the ethnicities of those who completed the application. The largest number of applications came from candidates of South Asian and White backgrounds, with Southeast Asian and Hispanic/Latine numbers next highest. All Southeast and East Asian applicants completed the application process, and of the remaining applicants who failed to complete the process, the majority stopped the process before completing the final portion of the application that included the essay, STEM interest or pursuit, and lab video rankings.

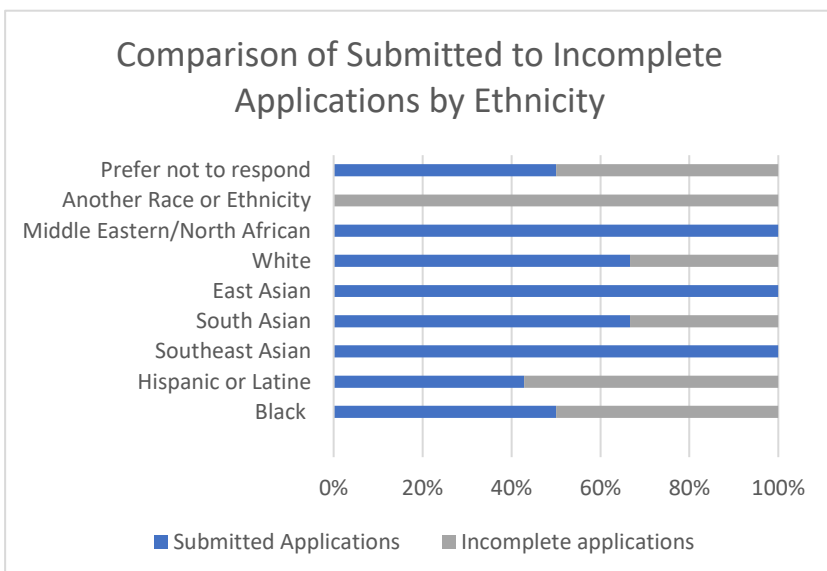


Figure 2 –

In order to further understand the application process, the ethnicities of those students who initiated the application process were compared with those who completed the application. East Asian – China, Japan, Mongolia, North Korea, South Korean and Taiwan. South Asian - Afghanistan, Bangladesh, Bhutan, India, Maldives, Pakistan, Nepal and Sri Lanka. Southeast Asian - Burma, Brunei, Cambodia, Indonesia, Laos, Malaysia, Singapore, Thailand, Timor-Leste, Philippines, and Vietnam

PROPEL Orientation – a Communication Workshop to Transition to a Professional Academic Environment

A PROPEL organizer with high school science and Career Tech Education (CTE)

experience developed a 1 hour, 2-part communication workshop for PROPEL interns and their graduate student/post-doc mentors. Part I presented interns with difficult STEM lab-specific communication scenarios

and served as prompts for individual, and then small group brainstorming. Ideas were shared out with the whole group and discussed. In part 2, each grad student/post-doc mentor was told to deliver a scenario to 2-3 interns who could then work together to develop a response. Table 1 in the Appendix lists the small groups scenarios and the soft skills the reasoning for their inclusion. This communication workshop was designed to not only offer communication skill-building for the interns, but also to provide grad student/post-doc mentors with insights for future interactions with their PROPEL interns.

PROPEL Program Evaluation - The PROPEL Program Provided STEM Exposure and Experience

After completing the PROPEL Careers program, the high school PROPEL interns expressed overwhelming positive feelings toward pursuing a STEM major in college and towards STEM careers in general. Figure 3 shows post-program survey results indicating that all interns value a career in science and intend to pursue the field, whether or not they get a degree in a STEM area.

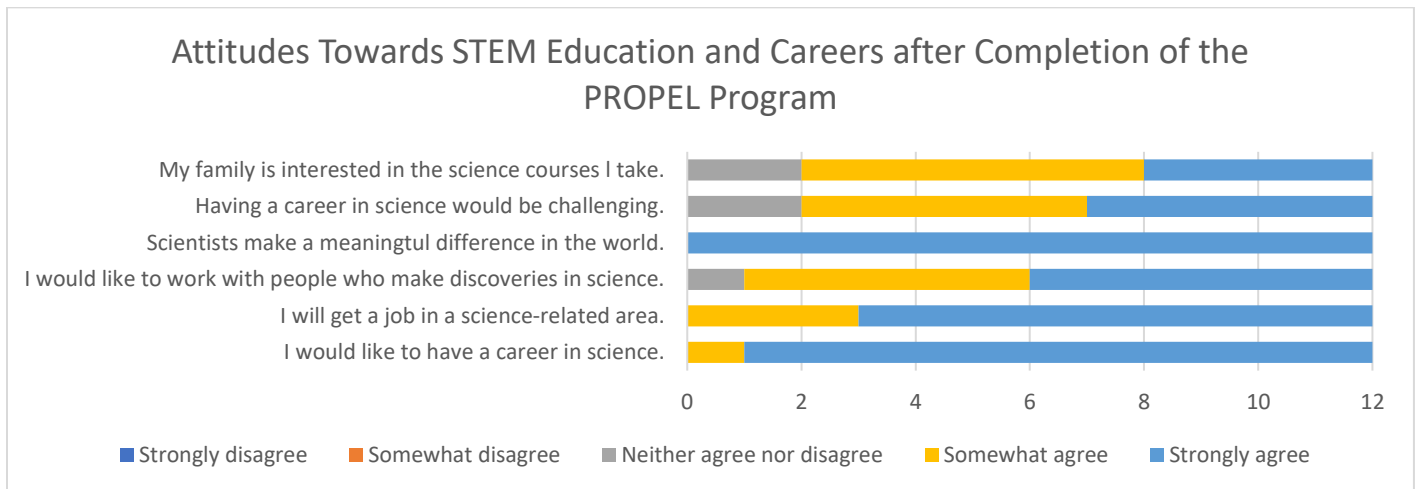


Figure 3 – Attitudes toward STEM. Participants overwhelmingly have positive feelings of what scientists do, and are interested in careers in science.

When asked if they accomplished their goals for the program, all 12 respondents indicated that they got the exposure and experience needed in the STEM career arena. In addition, three interns emphasized a new awareness about various STEM career pathways, one commenting on the potential rewards of a STEM career:

“I got to know a lot about STEM Careers and the paths available to me. And along the way I found a new goal. Make my work fulfilling. I feel I’ve achieved that.”

When surveyed on areas for improvement for the program, interns mentioned enhanced communication between the program organizers and the professors/mentors in the labs, more time with their professors, and more time spent with other interns. Interns’ favorite parts of the program included time working with PhD students, spending time with other interns, and gathering for the professional development lunches each week.

Future evaluation of the PROPEL program includes survey-specific questions on the application process, in particular investigating motivations for applicants and barriers for others failing to complete application. Additionally, high school student reactions to the Communication Workshop and the Professional Development Lunch topics will be surveyed before and after programming to determine engagement, STEM identity development, and efficacy.

* This work was determined to be a program evaluation and exempt from further review by the University of Massachusetts Lowell IRB.

References

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Appendix

Table 1- Communication Workshop Prompts. The graduate student/post-doc mentors delivered these scenarios verbally to the PROPEL interns, who were asked to brainstorm a response.

Scenarios delivered by Mentors	Employability/Soft Skills Addressed
You were on time and have been waiting outside the lab for someone to get you. After 30 minutes, your mentor comes out and seems annoyed. “What happened? How long have you been here? Why are you late??”	Introducing the intern to the idea of accountability in a professional work environment and that they may encounter unfamiliar expectations. For example, who do they report to on a daily basis and how should they connect with this person when needed?
“I’ve been talking for about an hour about important aspects of the research we will be doing - why haven’t you been writing this down?”	This scenario allows the intern to think about how to record and document information that they will need to access later. In high school, this is often done for them by teachers supplying classroom slide decks and other resources.
“I sent you a video last night to watch in preparation for what we are doing today - it seems like you haven’t watched it. How come?”	This scenario offers exposure to the difference between school and work expectations and the related consequences for failing to meet these expectations.
“You were late today - Why didn’t you tell me you were running late? We needed to start the experiment right at 9am exactly!”	The intern can experience the need for professional communication and learn to ask the questions - who do they report to? Do they have their mentor’s preferred method of contact? When is it important to communicate information?