

Board 160: Empowerment in STEM Day: Introducing High School Girls to Careers at National Laboratories (Work in Progress)

Dr. Baishakhi Bose, Lawrence Berkeley National Laboratory

Baishakhi Bose is currently a Postdoctoral Scholar at Lawrence Berkeley National Lab (LBNL). Her current research focus is on life cycle assessment of novel polymers, building materials and plastic recycling processes. She obtained her PhD. in Materials Engineering from Purdue University in 2021. Since 2014, she has taught courses in Civil, Materials and First Year Engineering to undergraduates, and mentored undergraduate and graduate students in STEM to foster research and professional development skills. She also has relevant experiences in organizing undergraduate research symposium/conferences, hosting professional development workshops, providing guidance on undergraduate/graduate school application. Currently, she serves as a Teaching Scholar for the K-12 STEM Education Program at Berkeley Lab and is involved with curriculum development of K-12 outreach at LBNL.

Lydia Rachbauer, Lawrence Berkeley National Laboratory

Lydia Rachbauer is a Project Scientist at the Lawrence Berkeley National Laboratory in Berkeley, California, as part of the Deconstruction Division at the Joint Bioenergy Institute. She holds a bachelor's degree in Food Technology & Biotechnology, a master's degree in Biotechnology, and received her PhD from the University of Natural Resources and Life Sciences, Vienna, in the field of Environmental Biotechnology with a focus on microbial gas conversion by anaerobic consortia. She joined Berkeley Lab in 2019 for her postdoctoral research on the microbial mechanisms for deconstruction and conversion of the complex polysaccharide structures in marine seaweed. Currently, Lydia works on acetogenic C1 conversion and microbial chain elongation to produce precursors for sustainable aviation fuels (SAFs). She also serves on the Women's Support & Empowerment Council ERG as co-chair of the Empowerment Subcommittee in support of the Lab's IDEA efforts to foster community at Berkeley Lab and empower the next generation of scientists and engineers.

Elina Dluger Rios

Dr. Faith Marie Dukes, Lawrence Berkeley National Laboratory

Faith started combining her passions for science and education as an instructor with Science from Scientists while working on her PhD thesis on waste remediation using photocatalytic semiconductors. She went on to develop educational programs as the Education Coordinator at the Massachusetts Institute of Technology Museum before transitioning to Washington, DC as an American Association for the Advancement of Science, Science Technology Policy Fellow. During her time as a Fellow, she served at the National Science Foundation in the Education and Human Resources Directorate.

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Baishakhi Bose^a, Lydia Rachbauer^a, Elina D. Rios^a, Faith M. Dukes^a

^aLawrence Berkeley National Laboratory, Berkeley, CA.

Abstract

In the US, women are still vastly underrepresented in STEM (science, technology, engineering, and mathematics) careers, and various studies have shown that girls' interest in STEM careers wane as high school progresses. With this challenge in mind, Empowerment in STEM Day was organized by Lawrence Berkeley National Laboratory (LBNL), hosting 47 high school students from 6 public high schools in the area. This one-day event was designed and executed through a collaboration between the Women's Support and Empowerment Council (WSEC) and the K-12 STEM Education and Outreach Program at LBNL. The main goal of this program was to provide high school girls, who have little access to STEM career role-models in their immediate surroundings with insights into how a career in STEM looks like. Invitations to participate in the program were sent out to six local high schools in the Bay area asking educators to identify female students that were interested in STEM. Each high school participant was provided with an opportunity to experience a national laboratory environment, learn more about summer workshops and paid summer research internship opportunities at LBNL for high school students, and engage directly with LBNL's employees through job shadow, career mapping and speed networking sessions. In this paper, we will present an overview of the event organization, challenges faced during planning and execution of the event, discuss the lessons learned from the first Empowerment in STEM Day and suggest strategies for incorporating such events at other national laboratories and academic institutions as part of a vital effort into recruiting and retaining more high school girls in STEM-based careers. Additionally, since this was the first in-person event hosted by LBNL's K-12 Program after the pandemic, we will also share the strategies implemented at the event so as to engage both remote and on-site employees as volunteers.

keywords: national laboratory K-12 outreach, STEM outreach, high school girls, career development

Introduction and Background

Women are underrepresented in most science, technology, engineering and mathematics (STEM) fields, and to remediate this situation, numerous targeted interventions have been designed (Wang & Degol, 2017). Previous studies have suggested that interest in STEM declines at approximately age 11 for girls, and continues to decline as they progress through their high school education (Stoeger et al., 2013). Therefore, to ensure gender equity of retention in STEM, it is imperative to provide high school girls with the resources that they need to pique their interest and empower their decision to pursue a STEM career.

Events that are targeted towards increasing STEM engagement in high-school students exist in many forms in both universities (Jeffers et al., 2004; Wasburn and Miller, 2003; Zurn-Birkhimer and Holloway, 2008; Lighty et al., 2004) and national laboratories (Mills et al., 2001; Wang et

al., 2013). However, an important consideration that was highlighted by Prieto-Rodriguez et al. (Prieto-Rodriguez et al., 2020) was that to empower the formation of STEM identity, events need to not only comprise of inclusive curriculum and pedagogies but also provide ample exposure to female role models. Keeping this in mind, one of the goals of this event was to provide high school girls, who have little access to STEM career role-models in their immediate surroundings with insights into how a career in STEM looks like, in addition to providing them with ample opportunities to interact with female role models at Lawrence Berkeley National Laboratory (referred to as LBNL in subsequent sections). This was done through the collaboration of the K-12 STEM Education and Outreach Program (referred to as K-12 Program in subsequent sections) with the Women’s Support and Empowerment Council (WSEC) at LBNL, and selecting a keynote speaker and volunteers for the event that would serve as female role models.

This event is part of the career awareness continuum (See Figure 1) of the work-based learning opportunities provided by the K-12 Program at LBNL. The goal of such events is to broaden students’ career options via awareness of different careers and the role of education in the field, in addition to providing students with relevant resources that would allow them to participate in career exploration and career preparation related programs. The career awareness events are short in nature (from an hour to day-long) and aim to provide pre-collegiate students with exposure to STEM career pathways.

Event Implementation

Invitations for participation were sent out to six public high schools in the Bay area, allowing for 10 students from each institution. Schools were selected based on proximity, the percentage of minority population and students that are from socioeconomically disadvantaged households. The districts that we prioritized include a 90% minority population and identify ~50% of their student population as economically disadvantaged. Additionally, these particular schools had the lowest rate of participation at the previous summer programs offered by LBNL. The additional outreach opportunity provided by this event would serve as the necessary advertisement and motivation to increase the number of student applications from this particular group. Out of the 60 students that were selected, 47 high school girls participated in this day-long event. For brevity, in the following sections, the event will be described as STEM Day.

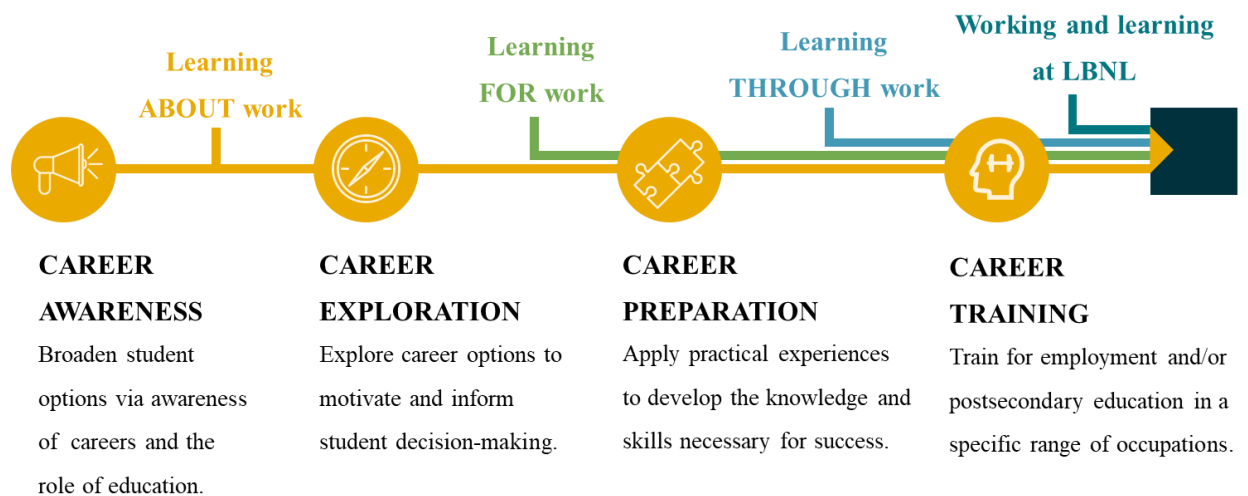


Figure 1: Work-based learning continuum offered through various programs/events by the K-12 STEM Education and Outreach Program at LBNL.

The event was advertised on multiple laboratory platforms to recruit volunteers from both STEM and STEM-adjacent fields, and consisted of not just women, but also allies. Volunteers underwent a virtual informational training session where they were briefed regarding the activities and their responsibilities, and provided with resources regarding the “Do’s and Don’ts of mentoring”. Also, they had to undergo a background check and complete online training on best practices for working with minors as well as mandated reporter training since they were going to be interacting with minors.

In addition to the virtual informational session, the organizers communicated periodically with the volunteers through emails to highlight their assigned session and responsibilities. On the day of the event, prior to the beginning of each session, volunteers underwent a briefing from one of the STEM Day organizers to ensure each volunteer was able to provide students with resources that the event was designed for. For all the activities throughout the day, volunteers were instructed to ensure these key-takeaways for the participants through the conversations and interactions throughout the day:

- Not all career pathways are linear.
- There may be certain experiences/internships/mentors that can help attain a career.
- Mistakes and challenges are part of the job in any STEM career.
- Different opportunities/internships available at LBNL for pre-college and college students.
- What life of STEM/STEM-adjacent professionals look like on a daily basis.

Table 1: STEM Day Schedule.

Activity	Duration (min)
Breakfast	30
Welcome by organizers and short briefing about day’s activities	15
Opening remarks by keynote speaker	15
Students assigned to groups and LBNL’s volunteers	15
Group 1: Career mapping and speed networking Group 2 Facility tours and job shadowing	120
Lunch with LBNL’s volunteers	60
Group 2: Career mapping and speed networking Group 1: Facility tours and job shadowing	120
Closing remarks and dismissal (including informational talk on upcoming internships)	15

The structure of the program was built around three key activities: job shadow, career mapping and speed networking (See Table 1). Each activity was designed with careful consideration to ensure that it provided career awareness to participants, as well as provide resources towards

career exploration and preparation (as highlighted in the earlier section and Figure 1). Below is a short description of each activity.

Job Shadowing: Each group consisted of 2-3 volunteers and 4-5 students, for a 2-hour period to tour previously assigned facilities at National LBNL. Some volunteers also chose to do live demonstrations of their research work, while touring the facility. During this time, volunteers were briefed to discuss their STEM career pathways, their daily responsibilities and answer questions by the students. Based on the informal feedback received from the volunteers, it was helpful to have more than one volunteer per group, as it kept students engaged during the entire time period, and students got to interact in the workspace of more than one LBNL’s employee. This opportunity also allowed us to have job shadows throughout several buildings which was greatly appreciated by students. In future iterations of the event, we have plans to shorten job shadow activity time so that volunteers are able to focus on high level content and take advantage of students’ undivided attention.

Career Mapping: Each career mapping session was of 20 minutes with 4-5 students and one volunteer. The volunteer was asked to share their career story, as students mapped it on a piece of paper. The students were provided instructions along with a question bank (see Appendix), that helped in mapping the volunteer’s career pathways, and were also encouraged to ask questions of their own. Below is a generalized career mapping questions list that the students were provided with, along with a general example of the final career map.

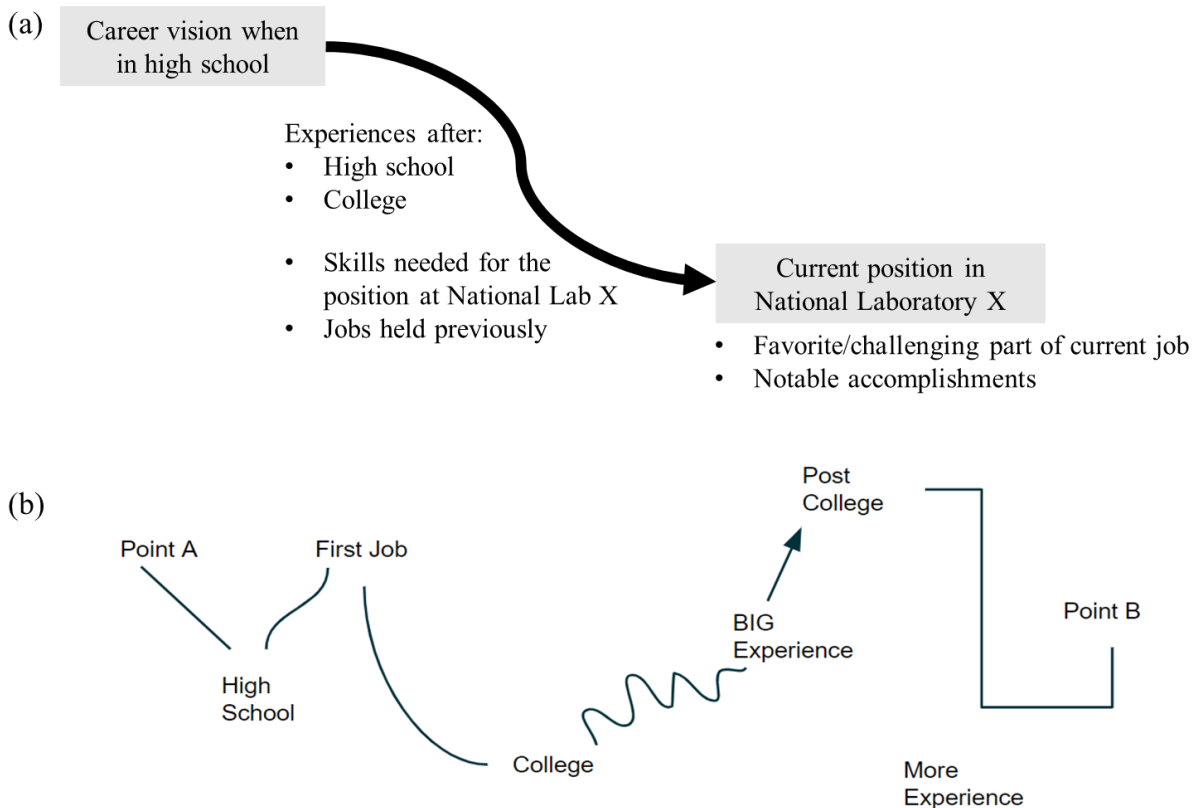


Figure 2: (a) Sample questions students were provided with for career mapping activity along with (b) an example.

Speed Networking: Each session consisted of a 10-minute interaction of one volunteer with two students. Students were encouraged to ask questions to learn about the volunteer's profession, and the volunteer got to learn about the students' interest, favorite subjects, career goals and provide relevant career resources accordingly. Based on informal feedback, we found that career mapping and speed networking provided participants with similar opportunities of interactions with volunteers. As such, we have decided to focus on either of the two activities in future iterations of the event. However, all students and volunteers appreciated the time to discuss the volunteer's experiences.

Since this was the first in-person event organized by LBNL's K-12 Program post-COVID, the event was planned in a way to incorporate both remote and in-person employees as volunteers. For the speed networking activity, volunteers could choose to join remotely. Based on participants' informal feedback and logistics involved in ensuring a smooth transition to virtual interactions, it was seen that students were able to be more engaged in in-person interactions with volunteers. For future iterations of the event, based on informal feedback from volunteers and participants, speed networking will be conducted only in an in-person setting. To engage participation of volunteers who work remotely at LBNL, interested volunteers would be utilized during the planning and curriculum development stage of the event.

Event Impact and Future Goals

Following the success of the event and partnership with WSEC, the K-12 program at LBNL is organizing six additional day-long events in collaboration with additional employee resource groups in 2024. The future events will follow a similar structure and aim to target as many high schools in the area as possible. As LBNL provides transportation for students participating in the event, one of the limitations of the event is that students from high schools that are not within 30 miles of LBNL cannot be invited for this event. In future, similar events could be arranged in virtual platforms to reach out to students across the country.

One of the goals of the event was to provide students with resources regarding internships/opportunities at LBNL pertaining to career exploration and preparation. Two such summer internship programs at LBNL that were highlighted to participants of STEM Day are Science Accelerating Girls' Engagement (SAGE) and Berkeley Lab Director's Apprenticeship Program (BLDAP). Based on surveys conducted for the summer programs, a number of students in these two programs in the summer of 2023 were also participants of the STEM Day event earlier in the year.

Overall, the program was received well by students, educators, and LBNL's volunteers. The STEM Day organizers are very optimistic regarding the future of the event at LBNL. Specific improvements to be included in future iterations of the event include:

Logistical Improvements:

- Plans made by the K-12 Program to continue the program during the next school calendar year with updates to job shadowing, workshops, and additional activities that connect more employee resource groups (other than WSEC) to the participants. To date, the program has hosted more than 200+ students from October 2023 through February 2024, using the protocols first implemented during the January 2023 Empowerment in STEM day.

- New elements of the program have also included providing transportation, lunch, and snacks for students and teachers, adding an application workshop for summer programs.
- Now that points of contact for schools and internal partnerships have been identified, planning will begin earlier in the year. In terms of scaling, there are plans to host two larger career days in the upcoming fall 2024 and spring 2025 to reach at least 150 students in one day. Programs currently have a capacity of 60 students per visit, to adequately handle transportation logistics of participants.

Activities Improvements:

- Expanding job shadows to new facilities and engaging STEM-adjacent staff to take part in hosting and lunch networking activities.
- In future iterations of the event, school districts will be provided with themed days (engineering, biosciences, computing, etc.) so that they have a better understanding of what to expect during their visit.
- Based on informal feedback received from volunteers, in future iterations of the event, before each activity, the student participants would be briefed on expectations and learning outcomes of the activity. Also, participants and their teachers will be sent resources on what to expect on the day of the event in advance.

The format of the program is scalable and is conducive to providing resources to pre-collegiate students, regardless of their age and other social identities. Additionally, with minor logistical changes, this event could be conducted at universities, industries and also on a remote platform. Currently, the organizers are also working on collecting formal feedback from participants to provide improvements in future iterations.

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Appendix

Career Mapping Exercise Instructions to Participants

In groups, you will have the opportunity to interview various LBNL employees. Take turns asking questions from the Question Bank below. Use the blank paper provided to draw out their answers to create a career map.

You do not need to ask all the questions listed below. Additionally, if there are additional questions other than those listed that might be relevant to the career map, you are welcome to ask them.

Question Bank:

1. What is your position at LBNL? (this should be placed at the bottom/end of the sheet).
2. What job/career did you think you would have in high school? (This should be placed at the top/beginning of the sheet).
3. What experiences did you have after a) high school, b) college?
4. What are some of the jobs you have had before your position at LBNL?
5. What are some of the skills needed for your current position.
6. What is your favorite aspect of your job? What are some of the challenging aspects?
7. What are some of your most memorable accomplishments that aren't measured in metrics?
8. What is a memorable moment you experienced that shaped you today?