Biogen-MIT Biotech in Action - Summer 2020
Executive Summary

12/07/20

Background

Biogen Inc., founded in 1978, is a global leader in biotechnology. The company's innovative therapies assist people living with serious neurological and neurodegenerative diseases as well as therapeutic adjacencies. The company also exerts leadership in STEM education through its Biogen Community Lab, established at its world headquarters in Cambridge, Massachusetts in 2002 to support youth and educators residing in the surrounding communities. A second Community Lab opened at Biogen's Research Triangle Park (RTP) facility in North Carolina in 2014. Together, the labs have engaged more than 50,000 middle and high school students in hands-on biotechnology activities. Students are also given opportunities through the labs to interact with scientists and other biotech professionals.

Biogen Community Labs' programming went online in the summer of 2020 as it joined forces with MIT's Lemelson-MIT Program to preserve a summer learning opportunity for 400 high school students during the COVID-19 pandemic. The purpose of this joint work was to help young people—especially those underrepresented in STEM—to:

- discover their passion for health sciences, biotechnology, invention, and innovation;
- experience problem finding and problem solving in ways that mirror the biotechnology, university, and innovation sectors;
- expand their knowledge and laboratory skills in STEM;
- develop skills aligned with those that are essential to the future of work and career explorations; and
- identify their personal strengths and capabilities and next steps for growth.

Program Design of Biotech in Action (BIA) and Opportunities for Learning

Collaborators created a state-of-the-art, one-week, fully online program that was delivered in a face-to-face virtual format in real time (synchronously) to high school students. Groups of 80 students engaged with Biogen instructors, other students, and professional mentors via Zoom for 28 hours during each of the five weeks (400 students total). During this time, students engaged in full-group discussions (29% of the time), small groups with one instructor for every 10 students (17%), smaller groups of five students for team work (41%), and in combinations of small groups: two instructors and 20 students (8%). Self-reflections via short videos at the end of the day accounted for 5% of the time. A total of 94% of the students completed the program.

Enabling technologies included Zoom, online games, Labster (online virtual labs in a game-like environment), PowerPoint, Flipgrid, Canvas, Start Up Tribes for mentoring resources, and Docusign for permissions. These technologies made it possible for students to learn from:

- talks with nine senior-level scientists and leaders from Biogen and MIT;
- the personal experiences of a patient with Parkinson's disease who works at Biogen;
- informal talks with Biogen employees, STEM professionals affiliated with Biogen, and individuals affiliated with MIT who are working to invent solutions to real-world problems;
- the formal presentation from a team of high school inventors of an assistive device for people with neurogenerative diseases;
- daily coaching and mentoring by Biogen Community Lab instructors in small groups;
- technical assistance in mastering new technologies for learning and online collaboration;
- online simulated lab experiences in a game-like 2D environment; and
- small-group sessions with other students to conduct research, produce a research poster and present findings to others.

Students Served

The 400 high school students resided primarily in North Carolina and Massachusetts and were evenly divided across grade levels. Approximately 45% of enrolled students came from households earning $90,000 or less. Nearly one-third (27%) of enrolled students came from households earning between $0 and $55,000. Student participants' ethnicity data are shown in Table 1.

Table 1
Ethnicity Data

Ethnicity (self-reported)	Enrolled students (*n*=400)
Asian	126 (31%)
African American/Black	75 (19%)
European (Caucasian)	71 (18%)
Latino/Hispanic	40 (10%)
Other student self-reported categories	87 (22%)
No answer	1 (0%)

Assessment of Student Learning and Development

Evidence of the benefits students gained from participating in BIA were derived, in part, from pre- and post-experience surveys for 171 of the 400 students. Constructs from the Knowledge and Attitudes Toward Biotechnology and Careers survey measured the change in students' 1) views of and interests in biosciences, 2) perceptions about their learning, and 3) career-related skills. Items pertaining to these areas are shown in Table 2 below.

Table 2
Assessment Instrument

Construct	Question statement
	Learning biology and life science is interesting.

1. Views of and interests in biosciences	Learning biology and life science makes life more meaningful. I enjoy learning biology and life science. Biology and life science can be used to improve the lives of others.
2. Perceptions about their learning	I have developed a knowledge of biology and life science. I have learned laboratory techniques used in biology and life science research.
3. Career-related skills	I have a vision for my future. I know the steps to achieve my vision. I am aware of jobs in biology and life science fields. I take responsibility for my own learning. I collaborate with peers. I work with people who approach things differently. I work up to my ability. I am empathetic to the needs of others. I can identify real-world problems to solve. Invention can be used to improve the lives of others. I can apply my skills to solve real-world problems. I am persistent. I embrace challenges.

The largest gain was achieved on student views within the construct of "perceptions about their learning"; 64% of the students strongly agreed (scalar response of 7) that they developed a knowledge of biology and life science as well as lab techniques through the program. Students also felt that they significantly increased knowledge of STEM careers and career-related skills within Construct 3. The smallest impact, though still significant, was observed on questions within the first construct that assessed student views of biosciences and biotechnology and their interest in learning biosciences.

We compared the gains of Latino/Hispanic and African American/Black students (underrepresented minority students or URMs) to those of White and Asian groups to determine if there was a difference. We found:

- Before joining BIA, the Asian and URM groups differed significantly on Construct 1 with students' views of and interest in biosciences (mean pre-survey score: Asian 6.62; URM 6.29) and on Construct 2 regarding their perceptions about the learning (mean pre-survey score: Asian 5.90; URM 5.40). There were no statistically significant differences between the three groups on Construct 3 regarding career-related skills.
- After participating in BIA, students in the URM group achieved greater learning gains than their White and Asian peers on Constructs 1 and 2 (views of biosciences, interest in biosciences, and perceptions of their own learning). In particular, URM students achieved the biggest gains on four items:
    - Learning biology and life science makes life more meaningful (average gain of URM students=.67).
    - Biology and life science can be used to improve the lives of others (average gain of URM students=.37).
    - I collaborate with peers (average gain of URM students=.58).

- I work with people who approach things differently (average gain of URM students=.69).

These findings suggest that the BIA experience helped URM students realize the value of biology and life science. Through working with others during the BIA program, URM students more readily recognized and appreciated these collaboration opportunities. Additional insights into students' accounts of their experiences were generated by the ethnographic research conducted as part of this study, including the telling cases of particular students. The research also traced the work of the BIA program team, iterations of the program as improvements were made across the five weeks, and instructors' perceptions of their own learning journeys.