

BioBuilder

Educational Foundation



**Inspiring students to learn
and love science**

Background

Since 2007, BioBuilder has been converting authentic biotechnology research into innovative hands-on laboratory content and novel problem-based learning modules that can be implemented by high school students and their teachers everywhere. Established by Dr. Natalie Kuldell from MIT's Department of Biological Engineering at MIT, BioBuilder was recognized as an independent non-profit organization in 2011. Since then, BioBuilder's openly accessible curriculum has made substantial impact in secondary and post-secondary life science education in nearly every state and more than 66 foreign countries.

BioBuilder's long-term goal is to launch young innovators on their paths to college and careers, inspiring them become scientific leaders and part of our nation's skilled workforce. BioBuilder's curriculum in synthetic biology raises awareness and delivers core knowledge, training and professional competencies so that students become bio-citizens with a leg up and a way in to the community of STEM professionals.

Year recognized as a 501c3: 2011

FY2022-2023: Revenue: \$1.6M Expenses: \$0.98M

Board of Directors

4 of 7 are female

2 FT employees, 14 PT employees, 1 PT contracted program manager

BioBuilder activity

In 49 of 50 states (missing North Dakota)

Last year: ~170 schools directly participated in Learning Lab, BioBuilderClub, Professional Development, Apprenticeship training, and online

2194 workshop participants and visitors to the BioBuilder Learning Lab @Ginkgo Bioworks in the past year

Key Partners

O'Reilly Media: textbook

Carolina Biological Supply Co: lab kits

Learning Lab sponsors: Allston Labworks, LabCentral, Ginkgo Bioworks

Key Activities & Programs



Transforming the way people learn and teach life science

- Professional Development
- BioBuilderClub
- BioTechBuilder

Training a skilled workforce for biotechnology and biomanufacturing

- BioBuilder Learning Labs
- High School Apprenticeship Challenge
- Biotechnology and Biomanufacturing Certificate for High School Students

Partnering to establish inclusive bioeconomies

- "Growing the Future" in rural Tennessee

Professional Development

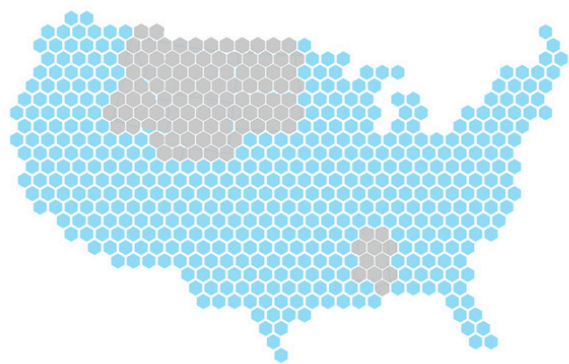


BioBuilder's professional development workshops help classroom teachers meet continuing education requirements, training them with a unique problem-based learning framework for life science that brings today's scientific innovations into their classrooms and labs.

"I would hope anybody teaching this program would have access to the same kind of content-rich PD that we got to have this week."

- Kingsport TN Workshop Participant

since 2011



>65,000

Estimated Students
Engaged

560+

Teachers received
hands on training

95

Workshops for
educators

Ready to implement lessons and labs to engage students in life science engineering

Co-taught by Executive Director, Dr. Natalie Kuldell, and one of BioBuilder's expert high school teachers

Aligned with state and national science standards and frameworks

Flexible hybrid format

Includes BioBuilder textbook and lab kit

Transforming the way people learn and teach biology

BioBuilderClub

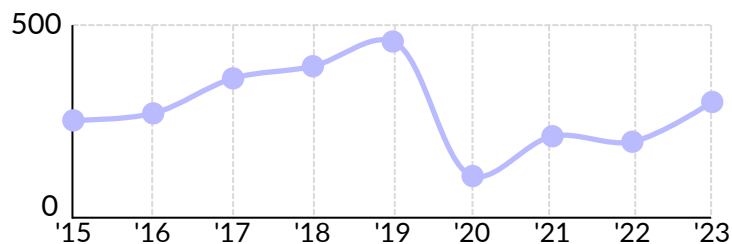


The BioBuilderClub teaches high school students to use synthetic biology to develop novel biotechnologies. Teams combine engineering approaches and scientific know-how to design, build, and test their own project ideas. Over the last ten years, the BioBuilderClub has engaged more than 2500 students and 196 mentors from around the world. Participants have come from 27 US states, three Canadian provinces, and nine countries.

"My experience in BioBuilder, I'd say was the main driving factor towards me deciding what I wanted to pursue in college"

- Andover MA BiobuilderClub student

of student participants each year



Participation costs less than \$50/student

Each team is mentored by a professional bioengineer

All teams receive research-grade lab materials to support their projects

The season concludes with an international Final Assembly where students present their work

36% of participating teams have published their work in BioTreats, a peer-reviewed journal for high school synthetic biology

BioTechBuilder



BioTechBuilder is an award-winning curriculum that prepares students for purposeful and wealth-building careers in biotechnology.

Developed in partnership with industry-leading companies, BioTechBuilder is a complete solution for educating a future-ready workforce that will solve some of the world's greatest challenges with life science.

Our off-the-shelf curriculum combines 45-minute lessons and lab training, preparing students for professional certifications and micro-credentials.

Lab Skills introduced essential lab concepts and techniques for making solutions and growing cells.

Foundations introduces DNA protein analysis techniques with molecular framework techniques.

Applications introduces industrial biotech applications and commercialization practices in industries such as biomanufacturing and synthetic biology.



"BioTechBuilder has truly set a new standard in biotechnology education with its hands-on curriculum focused on skill-building, perfectly aligned with the needs of the biotech industry."

- Lance Bard, Best of STEM Awards judge

BioBuilder Learning Labs



BioBuilder's Learning Labs put scientific content into context, training students, teachers, and community members where high potential startups and industry leading companies work.

The Learning Labs include state-of-the-art classrooms and professionally equipped laboratories that have provided hands-on lab experiences to visitors.

Since opening in 2021, the Learning Lab @Ginkgo hosted:

1900
students and
industry
professionals

including multiweek programs to train
187 industry professionals

47 apprentices **4** summer interns

more than
110
workshops

BioBuilder's first Learning Lab inside LabCentral in Cambridge MA opened in 2017

In 2021, BioBuilder opened a second Learning Lab in Boston's Seaport, inside Ginkgo Bioworks headquarters

Learning Labs have provided hands-on lab experiences to visitors from 29 states and 11 countries

We have collectively welcomed over 4100 individuals through August 2024

BioBuilder hosts the Apprenticeship Challenge and summer student internships in our Learning Labs

BioBuilder has been a really important opportunity for me to be introduced to the STEM field and learn both the hard and soft skills needed for success.

- Vanessa, Workshop Participant

High School Apprenticeship Challenge



BioBuilder's Apprenticeship Challenge prepares Boston and Worcester area high school students for successful summer internships in biotechnology companies, universities, and research institutions. Accepted students attend weekday after-school sessions focused on technical knowledge and professional skills, and Saturday morning sessions that provide hands-on training in lab techniques and research thinking.

"The rigorous activities, unique interactions, and overall vibrant ambiance of the program was just a huge help, and I will never find the right words to express just how truly grateful I am for it."

- Edward, 2019 Apprentice

Applicants

357 ▼



Students Accepted

187 ▼



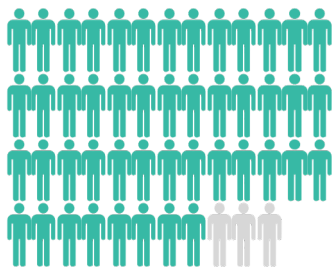
Graduates

163 ▼



92%

are the first in their family to attend college in the U.S.



Students come from 48 Boston-area high schools and 8 Worcester-area high schools

Attendance is mandatory, three times/week from March through May
Networking opportunity provided at professional poster session to present student biodesign projects

91% of accepted students complete the program

92% of graduates secure summer internships

Biotechnology and Biomanufacturing Certificate for High School Students



BioBuilder's curriculum provides the technical content for a series of classes that lead to a work certificate for area high school students enrolled in Massachusetts' Innovation Pathway Program. Classes familiarize students with the technical and conceptual underpinnings of 21st century biotechnology and teach essential laboratory skills that are required for success in today's biotechnology industry.

"The outcomes of this project will aid in advancing bioindustrial manufacturing across the U.S."

- Thomas Tubon, CWDO, BioMADE

BioTechnology and BioManufacturing Certificate for High School Students

Students go through a 2 year program

Students gain proficiency with essential laboratory tools and skills that are required for success in today's biotechnology industry.

Students apply their growing understanding and developing technical skill to a semester-long lab experiment

No academic pre-requisites

Technical Class 1

Foundations of Modern BioTechnology

2x/Week
15 Weeks

90 Hours

Technical Class 2

Applications of Modern BioTechnology

2x/Week
15 Weeks

90 Hours

"Growing the Future" in rural Tennessee



BioBuilder's curriculum can effectively and inclusively start high school students on a path to become the scientists and skilled workers that the U.S. needs for the growing bioeconomy. Since 2018, BioBuilder has been collaborating with decision-makers in Kingsport, Tennessee to leverage their regional strengths and build a world-class bioeconomy in the southeast. BioBuilder's general strategy has been to first build the skills and confidence of local teachers. Their capacity leads to school-based programs that foster student interest and skills. Subsequent introduction of BioBuilder's school-to-work programs recruits university and company participation which, over time, opens more workforce and higher education placements.

\$1 invested in BioBuilder in 2019 has grown to \$100 of economic activity in the Appalachian Highlands of East TN.

"I ranked this project my number one choice when Dr. Heise presented the client projects to our class last fall"

- Kouame, ETSU MBA student

First high school in the US to train all students with BioBuilder

Grant and Foundation funding supported BioBuilder training for local educators

Successful partnerships established with local academic, philanthropic and industry leaders

Pipeline for students to pursue community college training or BioEngineering degree at ETSU

BioBuilder Launches Skills Training Curriculum to Prepare Students for Careers in Biotechnology

“High school students should be given a chance to experience what the work is like before they choose one career path over another. We’ve seen how offering more exposure to “real-world” science and STEM career skills can excite students about science and help them decide to pursue careers in this field. The launch of BioTechBuilder is an example of our continued commitment address the gaps in the bioeconomy workforce.”

- Dr. Natalie Kuldell

To continue to provide opportunities for students without a college degree to embrace careers in STEM, the BioBuilder Education Foundation has launched BioTechBuilder. The off-the-shelf curriculum offers lessons and lab trainings as a complete solution for educating a future-ready workforce to support the growing biotechnology industry. After completion of the program, students are prepared to take micro-credentialing assessments that support their immediate entry into the biotech workforce after high school graduation, helping address the skilled labor shortage impacting the biotech industry today.

According to the U.S. Bureau of Labor Statistics, nearly 40% of students are now taking time off after high school or choosing not to go to college altogether. Through strategic partnerships with industry leaders, such as UCB, BioMADE, Ginkgo Bioworks, and Daicel Arbor Biosciences, BioBuilder has developed a curriculum that prepares students for meaningful careers in the bioeconomy with or without post-secondary education. BioTechBuilder is designed to support students nationwide who want to begin their biotechnology and biomanufacturing careers after high school. It provides a direct link to entry-level STEM positions with industry-recognized micro-credentials required to be successful employees.

Biotechnology curriculum piloted in Worcester schools seek to spark interest in subject

“BioTechBuilder is designed to be a stackable curriculum starting with the basics of working in a laboratory environment, including working safely with personal protective equipment and proper disposal of materials. Once those basic skills are established, more advanced topics involving topics like DNA, biotechnology, and synthetic biology can be explored.”

- Eric Casey

A former instructor at the Massachusetts Institute of Technology conducted a pilot program at Worcester Public Schools as part of the effort to create the next generation of biotechnology workers.

The program, called BioTechBuilder, aims to give high school students hands-on experience in the field, offering them the opportunity to consider employment opportunities in the field regardless of whether or not they end up enrolling in college.

The eight-week pilot program at WPS concluded in May. Natalie Kuldell, executive director of Newton-based nonprofit BioBuilder Educational Foundation, said the pilot program was a success and she’s looking to make the program available to interested teachers nationwide in the coming months.

“I couldn’t have gotten it off the ground without the really wonderful openness to trying new things that I have found in the Worcester area,” Kuldell said.

The need for talent in the biotechnology field is high in Central Massachusetts, she said.

‘Education needs it’: Massachusetts science program aims to be accessible in schools across country

“We really do want to work through the public school system, because that’s a chance for students to get some experience in this field when it doesn’t cost them time or money, to see if they can turn up,” said Kuldell.

“Try this lab coat on for size and see if it’s what they want to do.”

- Dr. Natalie Kuldell

Helping local students find a love of science that can translate into high-paying jobs. That’s the goal of a program spun out of MIT that’s gaining traction in high schools across the country. BioBuilder helped a Malden native earn a new job in the biotech industry.

“It’s a dream come true,” said Kevin Fuentes.

After graduating from Tufts University, Kevin Fuentes is getting ready to start a new job.

“I think my parents really wanted me to accomplish something difficult that could be lucrative for me, to just, you know, I grew up not in the most suitable financial situation,” said Fuentes.

Kevin was introduced to BioBuilder while at Malden High School.

“Seeing people who were so excited and so passionate about the things that they were doing, and that kind of lit a fire in me as well,” said Fuentes. “And I think it was the first time that I could have ever imagined myself as a scientist in any capacity.”

BioBuilder Executive Director Natalie Kuldell created a science curriculum for high school students bringing engineering and problem solving into the classroom

Read more at... <https://www.boston25news.com/news/local/education-needs-it-massachusetts-science-program-aims-be-accessible-schools-across-country/34G7P25MH5ERND3SLQNW6JEPAE/>

Winners Announced for “Educators Pick Best of STEM® 2024” Awards

2024 Award Winner: BioBuilder Educational Foundation

Product: BioTechBuilder

Category: CTE Champion: STEM

Catapult X and the Teich Group announce the winners of the Educators Pick Best of STEM® 2024 Awards, the only awards program judged by STEM educators. The awards program, operated in partnership with the National Science Teaching Association (NSTA), MCH Strategic Data, and the National Association of Biology Teachers (NABT), spotlights innovative products, technologies, and services that are changing the world of STEM education.

These STEM products were subject to a two-part evaluation process. First, by an expert panel of educator judges, including Dr. Linda Johnson-McClinton, Dr. Rachelle Dené Poth, Dr. Lance Brand, Dr. Jeffrey Crapper, Dr. Omah M. Williams-Duncan, Jamica Craig, and Erin Barr. Once judges selected the finalists, more than 267,000 STEM educators were given the opportunity to evaluate the finalists via survey.

“The 2024 Best of STEM winners were selected by educators for their innovation, cross-disciplinary approach, and focus on providing students with opportunities to address real-world challenges,” said Daylene Long, CEO of Catapult X and founder of the Best of STEM Awards. “Judges noted that these forward-thinking companies deliver transformative tools that enrich classroom experiences and encourage students to engage thoughtfully with the world around them.”

Local Non Profit Lays Foundation for RHS 2020 Graduate, Angel Muthemba's STEM Career

By the end of my time at Biobuilder, I secured a full-time internship with a biotech startup in Cambridge. I remember thinking to myself
“Wow, I think I’m actually becoming a scientist.”
- Angel Muthemba

This spring, RHS alum Angel Muthemba graduated from Emmanuel College earning a degree in Neuroscience and a minor in Data Analytics. However, her journey into the STEM field started as student scientist through BioBuilder's Apprenticeship Challenge at age 16.

The daughter of Kenyan-immigrant parents, Muthemba originally started college on a different path. “I was going to work towards becoming an Oral and Maxillofacial Surgeon. I made the switch when I realized that I don't want to give up the research component of my job responsibilities. I wanted to do something where I can work independently, on a team and be able to interact or chat with patients that I'm working towards helping. Before I declared my major sophomore year, I remember being in my Methods & Statistics II class (shout out Dr. Lin) and my friend Angelyna was talking to me about neuro engineering. I fell in love instantly. I then found out that there was a data analytics minor at my school, and it just felt like a match made in heaven. If my school had a data analytics major I would've double majored.”

Her experience with Biobuilder was extremely intimidating at first. “I was the youngest student in our cohort at the time and I hadn't even taken chemistry yet. A good amount of foundational content taught was related to chemistry. I found lab math to be overwhelming — I wasn't confident in myself. Dr. Kuldell along with Kate Schneider single handedly gave me the reassurance and confidence I needed to succeed through the program.

Training the Biomanufacturing Workforce: BioBuilder Leads Regional Partnership with Federal Funding Awarded through BioMADE

The BioBuilder Educational Foundation announced that they are to lead the “Regional Partnerships for Training the Biomanufacturing Workforce in Worcester, MA” project. The project was funded through BioMADE, the Bioindustrial Manufacturing and Design Ecosystem, which is aimed at accelerating bioindustrial manufacturing knowledge, capabilities, and workforce in the U.S.

“This project will create industry-informed training for the workforce of the future, and brings together a diverse group of partners in Worcester’s growing biomanufacturing industry,” said Thomas Tubon, Chief Workforce Development Officer for BioMADE. “The outcomes of this project will aid in advancing bioindustrial manufacturing across the U.S.”

BioBuilder is working with Worcester Public Schools (WPS) to offer a credit-bearing after-school program for high school students to prepare them for biomanufacturing careers. In 2021, the Massachusetts Department of Elementary and Secondary Education approved an Innovation Pathway for Life Science for Worcester Public Schools. It is through this Innovation Pathway that the Regional Partnership will address the talent pipeline.

BioBuilder’s Founder and Executive Director said, “By adapting our proven educational content to address workforce needs, we can help Worcester’s talented high school students be career-ready. BioMADE funding will also help us build student relationships to local industry and our post-secondary educational partners.”

Game Changer

“This grant is a game changer when you look at the portfolio of STEM education tools the Niswonger Foundation is taking to 21 school districts and touching the lives of 57,000 students in a pretty dramatic way,” said David Golden, East Tennessee State University (ETSU) College of Business and Technology Allen and Ruth Harris Chair of Excellence and a member of the foundation board. “I don’t think anything like this is being done anywhere else in the United States.”

It started with word from the U.S. Department of Education that \$185 million in grants would be awarded in December 2020 to school districts, higher education institutions and not-for-profit organizations to provide professional development opportunities to teachers of high needs students. In Greeneville, Tenn., the Niswonger Foundation saw the call for grant applications as something more than just an opportunity to train teachers. So, the foundation put together a proposal with partners from the Massachusetts Institute of Technology (MIT) to Purdue University’s Polytechnic Institute to the University of Alabama at Huntsville to East Tennessee State University, and more.

The Rural Tennessee STEM LD (Science, Technology, Engineering and Math Learning Design) proposal put forth by the foundation will train teachers throughout northeast Tennessee. But, that’s just the start. The training and professional development the teachers in northeast Tennessee receive through the STEM LD-funded programs will qualify them to teach classes ranging from cybersecurity to synthetic biology to next-generation engineering.

Students in most of the schools served by the grant-funded programs would never have had the opportunity to learn those subjects without the foundation’s involvement.



Bio 101 for the Digital Tech Team

March 17, 2022

A few months ago, a number of us on the Digital Tech team had the opportunity to participate in a pilot of an introductory course in molecular and synthetic biology. Developed and taught by Natalie Kuldell and BioBuilder specifically for the “non biologists” working at Ginkgo Bioworks, this week-long class was roughly divided evenly between classroom instruction and hands-on lab time.

For the “non-biologists” working at Ginkgo Bioworks, this week-long class was roughly divided evenly between classroom instruction and hands-on lab time.

"Perhaps the most astonishing feature of biology is that it runs on digital code in the form of DNA, which makes it possible for us to imagine building such living machines. The code is made up of A's, T's, C's, and G's, and we can read and write it to program cells like we program computers." As a software engineer, this idea has always intrigued me, but until taking this course I had never fully appreciated the depth of this statement.

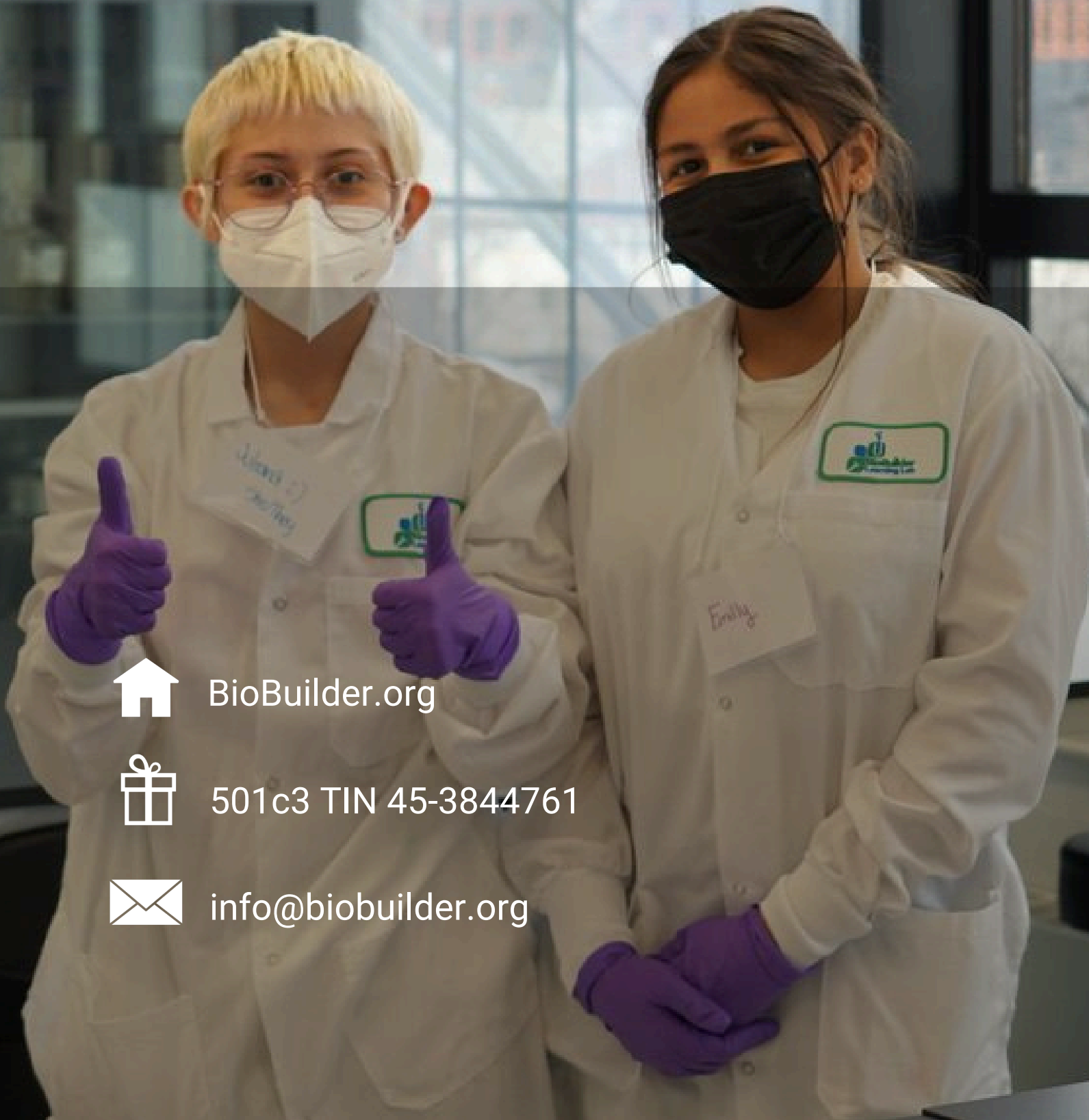
We transformed different plasmids into samples of bacteria — which is to say, we actually inserted DNA into living organisms and “programmed” them to do things for us!

I joined intending to help make biology easier to engineer. But at some point, I thought, “how do I contribute without a biology background”?

Having the opportunity to go to BIO101 was an eye-opener for me on how engineering biology works and how the magic happens in the lab. We learned how DNA is structured, the different types of DNA, retrieving reagents, growing overnight cultures, verifying DNA, testing it, how to analyze it, and much more.

Read more at... <https://www.ginkgobioworks.com/2022/03/17/bio-101-for-the-digital-tech-team/>

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