

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 30 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

FY2021-2022: Revenue: \$1.2M Expenses: \$1M

Board of Directors

7 of 10 are female

2 of 10 URM

3 FT employees, 6 PT employees, 2 PT contracted program managers

BioBuilder activity

In 47 of 50 states (missing Nebraska, North Dakota, Wyoming)

Last year:

~200 schools directly participated in Learning Lab, BioBuilderClub, Professional Development,

Apprenticeship training, and online

84% of students participated in online programming at no cost

800 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: New England Biolabs, LabCentral, Ginkgo Bioworks

Key Activities & Programs

Transforming the way people learn and teach life science

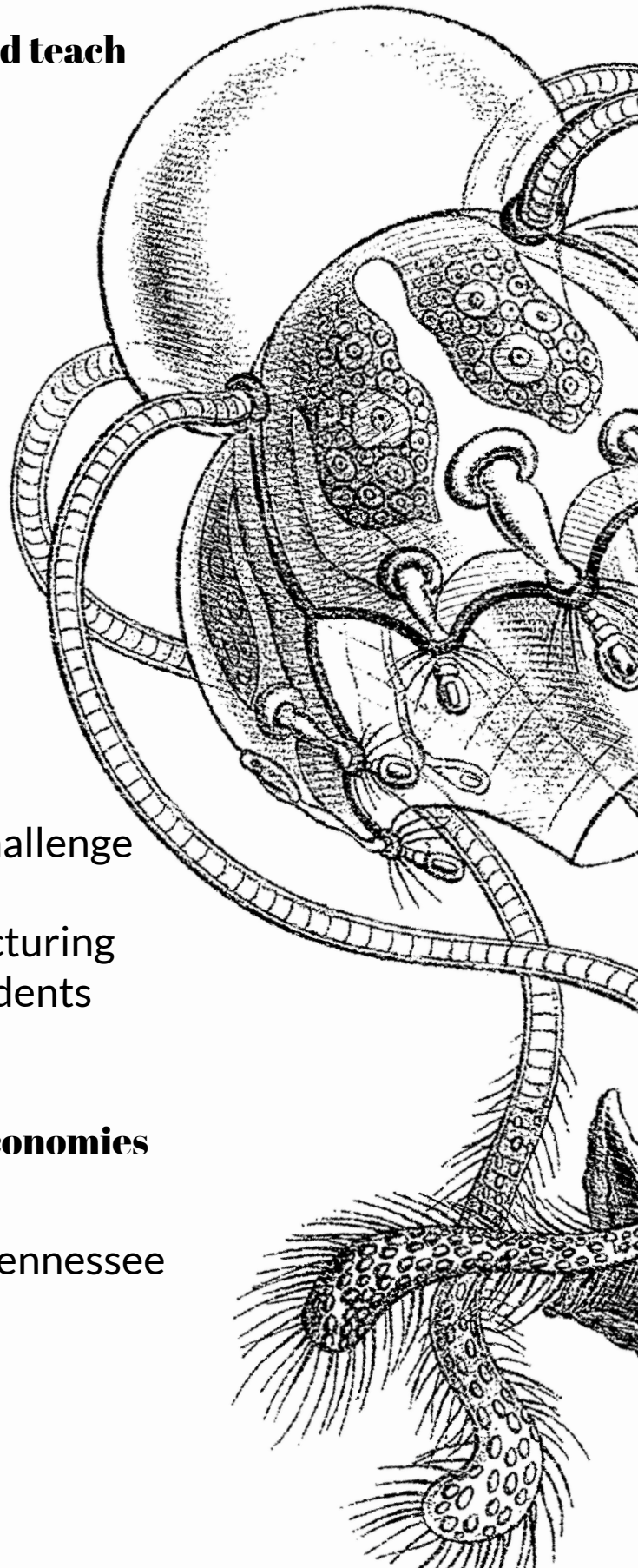
- ➡ Professional Development
- ➡ BioBuilderClub
- ➡ Idea Accelerator

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

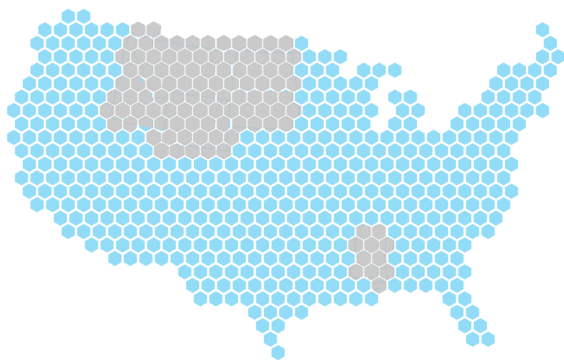


BioBuilder's professional development workshops help classroom teachers meet continuing education requirements, training them with a unique problem-based learning framework for life science that brings today's scientific innovations into their classrooms and labs.

"I would like to express my sincere gratitude for giving me the opportunity to be part of the BioBuilder workshop at UC Berkeley. I enjoyed every minute of it."

- Orenda, Workshop Participant

since 2011



>28,000

Estimated Students
Engaged

600+

Teachers received
hands on training

75+

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

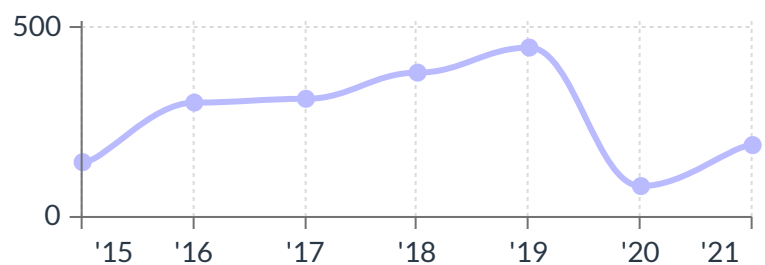


The BioBuilderClub teaches high school students to use synthetic biology to develop novel biotechnologies. Teams combine engineering approaches and scientific know-how to design, build, and test their own project ideas. Over the last nine years, the BioBuilderClub has engaged more than 1800 students and 120 mentors from around the world. Participants have come from 25 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"

- Veni, 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

25% of participating teams have published their work in BioTrevs, a peer-reviewed journal for high school synthetic biology

Idea Accelerator



BioBuilder's Idea Accelerator is a problem-based, online curriculum offered monthly to students who imagine and invent ways synthetic biology can make the world better. This three week curriculum provides asynchronous lectures, biodesign assignments, feedback from practicing bioengineers, and a Project Showcase for teams to share their work.

Since 2020

650 Students have participated

in BioBuilder's Idea Accelerator

77% at no cost to them or their schools

Includes five hours of asynchronous lectures and three hours of drop-in office hours

Program features weekly Career Conversations with practicing bioengineers

Students are given feedback on their project ideas before they are presented and documented online

To date: participating schools have come from 13 states and four countries

Prepares students and teachers to engage in other BioBuilder Programs

"You all have done a truly remarkable job putting together a curriculum that engages and excites students during a very stressful year. This is such important work."

- Michael, Teacher Assistant

Transforming the way people learn and teach biology

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.

In its first year, the Learning Lab @Ginkgo hosted:

500

Students and Professionals

28

Workshops

Training

100

Industry Professionals

16

Apprentices

2

Summer Interns

BioBuilder's first Learning Lab inside LabCentral in Cambridge MA was 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 25 states and 11 countries,

We have collectively welcomed over 2700 individuals through August 2022

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

"I am finally taking the time to tell you what a wonderful experience you provided for me over the summer. You are such a gracious person to have hosted all of us there and you make sure everyone's needs are met and then some with nice finishing touches"

- Kevin, Workshop Participant

Training a skilled workforce for biotechnology and biomanufacturing

High School Apprenticeship Challenge



BioBuilder's Apprenticeship Challenge prepares Boston-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



Students Accepted

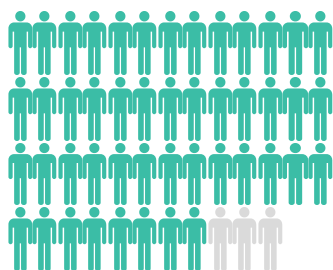


Graduates



92%

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



Students come from 36 Boston-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

90% of accepted students complete the program

90% of graduates secure summer internships

Training a skilled workforce for biotechnology and biomanufacturing

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.

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

"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

Training a skilled workforce for biotechnology and biomanufacturing

"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.

"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

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.

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

March 14, 2022

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.”

Read more at... <https://www.send2press.com/wire/training-the-biomanufacturing-workforce-biobuilder-leads-regional-partnership-with-federal-funding-awarded-through-biomade/>

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.

Contact Us



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