

Building the Bioeconomy from the Classroom Up

The East Tennessee Model

January 2026



Table of Contents

| | |
|--|-----------|
| Executive Summary | <u>1</u> |
| ----- | |
| I. Introduction: A New Frontier, Rooted in Old Strengths | <u>3</u> |
| ----- | |
| II. National Context: The Urgent Need for a Domestic Biotech Workforce | <u>4</u> |
| ----- | |
| III. Origins: Vision from the Heart of Appalachia | <u>5</u> |
| ----- | |
| IV. Teaching the Next Generation of Scientists | <u>6</u> |
| ----- | |
| V. From Pilot to a Region Transformed | <u>7</u> |
| ----- | |
| VI. Lessons Learned from the East Tennessee Model | <u>10</u> |
| ----- | |
| VII. A Playbook for Other States | <u>14</u> |
| ----- | |
| VIII. Federal and State Policy Implications | <u>15</u> |
| ----- | |
| IX. A National Opportunity | <u>17</u> |
| ----- | |

Executive Summary

A Case Study on Regional Innovation and National Opportunity

An educational initiative in East Tennessee offers a model for how a rural region can build a coherent and scalable pathway into biotechnology by embedding hands-on, industry-aligned instruction within required high school coursework. Through a partnership with the BioBuilder Educational Foundation, regional leaders built an aligned pipeline that expands access to biotechnology, strengthens teacher capacity, and connects K–12 learning to postsecondary and workforce opportunities. The result is a model that demonstrates how rural communities can meaningfully participate in the emerging bioeconomy.

The work began in 2018, when Eastman Chemical Company identified biotechnology as a strategic workforce priority and partnered with BioBuilder—an MIT-founded nonprofit that brings engineering-based biology into K–12 classrooms. In 2019, one local high school embedded BioBuilder’s laboratory curriculum into its required ninth-grade biology course, supported by intensive teacher training and newly equipped laboratory spaces. Federal investments from the U.S. Department of Education and the National Network for Manufacturing Innovation accelerated growth, allowing the program to evolve into a multi-district biotechnology network with shared instructional foundations and clearly defined partner roles. What began as a single-school experiment has matured into a practical state-level blueprint for expanding biotechnology participation and aligning education with workforce needs.

The model succeeds because it was purpose-built. Biotechnology is introduced through required coursework rather than selective enrichment, ensuring that all students—not only those who would self-select into Science, Technology, Engineering, and Math (STEM)—gain early access to modern scientific fields. Cross-sector partners from industry, higher education, philanthropy, and K–12 districts share operational responsibility, allowing the system to grow quickly and maintain coherence. Pathways are intentionally stackable, giving students multiple ways to progress from foundational biotechnology instruction into advanced courses, micro-credentials, and employment.

Taken together, these shifts align with emerging federal priorities around national security, rural biomanufacturing infrastructure, credential portability, and coordinated biotechnology workforce development. As the United States moves deeper into the “century of biology,” the East Tennessee experience illustrates how regions can build local capacity and broaden participation in the bioeconomy starting in the classroom and extending outward through aligned partnerships and purposeful system design.

Take Aways

- **Make biotech universal, not optional.**

East Tennessee put hands-on, industry-aligned biotech into required high school coursework, giving every student early exposure—not just “STEM opt-ins.”

- **Build a coalition, not a program.**

Cross-sector partners (K–12, higher ed, industry, philanthropy, and national organizations) shared clear roles—creating a coherent, scalable regional ecosystem.

- **Scale + outcomes are real.**

The initiative grew from a 2019 pilot to ~900 freshmen in BioSTEM I across seven high schools + one middle school, with 1,400+ students across course levels; 80%+ reported stronger belonging/clearer career goals, and the model generated an estimated \$100 in local economic activity per \$1 invested.

- **Design “stackable” pathways to avoid dead ends.**

Learning is sequenced so students can move into jobs, community college credentials, bachelor’s transfer, or research track without restarting at each transition.

- **It’s a blueprint—and a policy agenda.**

The paper offers a replicable playbook for other states and identifies scale levers: national convening, infrastructure, credential portability, data/evaluation, and access.

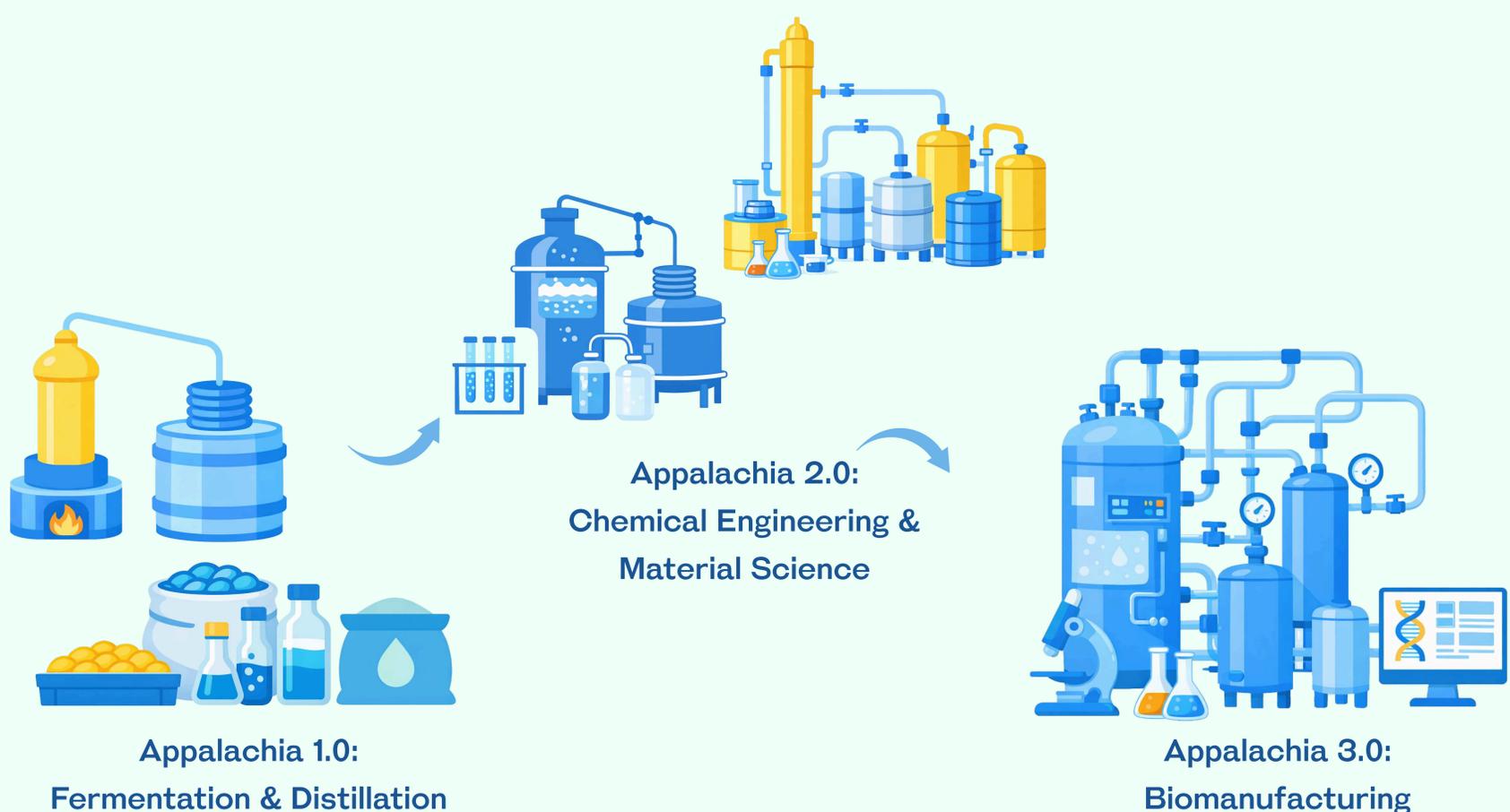
I. Introduction: A New Frontier, Rooted in Old Strengths

In the foothills of the Appalachian Highlands, chemistry and craftsmanship have long gone hand in hand. Generations of Tennesseans built their livelihoods on the art of fermentation and distillation—whether in the region's storied whiskey-making traditions, its food-preserving canneries, or its chemical manufacturing plants. That history, grounded in the manipulation of biological and chemical processes, forms a quiet foundation for the 21st-century revolution now underway in East Tennessee: the rise of biotechnology as a driver of regional prosperity.

This is the story of how one region—far from the coasts and major research hubs—became a proving ground for a new kind of workforce strategy: one that begins in high-school classrooms, connects students directly to career pathways, and grows local economic resilience from the ground up.

It's also the story of the BioBuilder Educational Foundation, a nonprofit born at the Massachusetts Institute of Technology (MIT), and of regional leaders in rural Tennessee who recognized that the nation's next generation of biotechnologists could be trained not just in university labs, but in high-school biology classrooms across America.

The East Tennessee experience shows what's possible when local vision, national expertise, and philanthropic leadership align. It also offers a clear blueprint for other states and for federal policymakers seeking to expand the U.S. bioeconomy.



II. National Context: The Urgent Need for a Domestic Biotech Workforce

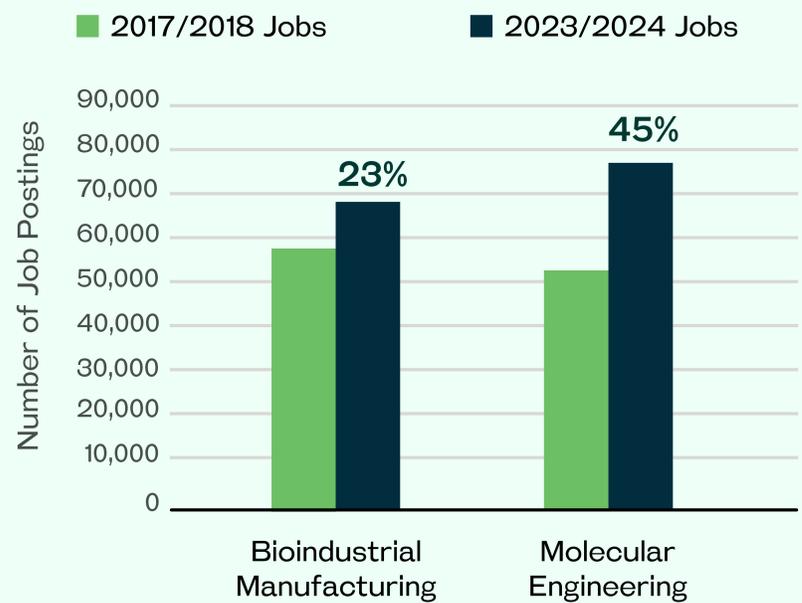
Biotechnology today underpins every dimension of national competitiveness. It can defend, build, nourish, and heal.¹ It is foundational to national security and economic resilience, yet its future depends on people: a skilled workforce ready to translate scientific discovery into innovation, individuals who will launch and lead new companies, and communities positioned to grow with the sector so that rising opportunities are broadly shared.

Authorized by Congress in 2021 to review the impact of biotechnology advances on current and future activities of the Department of Defense, the National Security Commission on Emerging Biotechnology (NSCEB) identified biotechnology as one of the most consequential arenas for 21st-century competition. The Commission's 2025 report, 'Charting the Future of Biotechnology: An Action Plan for American Security and Prosperity,' emphasized that biotechnology's transformative potential will remain untapped unless we close the domestic workforce gap.²

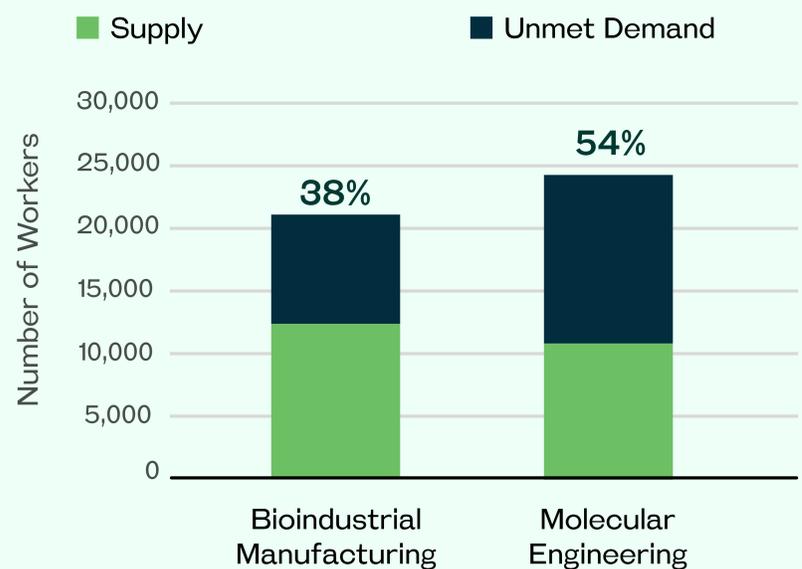
Across the United States, that gap remains wide. Even as the bioscience sector contributes more than \$3.2 trillion in total economic impact and employs 2.29 million workers, too few students are pursuing biotech pathways.³ Many high-school graduates lack access to laboratory courses. Many entry-level biotechnology jobs do not require a bachelor's degree, yet few students graduate with the hands-on skills or credentials to fill those positions.

This disconnect has left entire regions—especially rural communities and regions hit hard by the decline of traditional industries—on the sidelines of the nation's fastest-growing industry. For federal and state leaders, the question is no longer whether biotechnology will define the next century, but whether every community will have a stake in it.

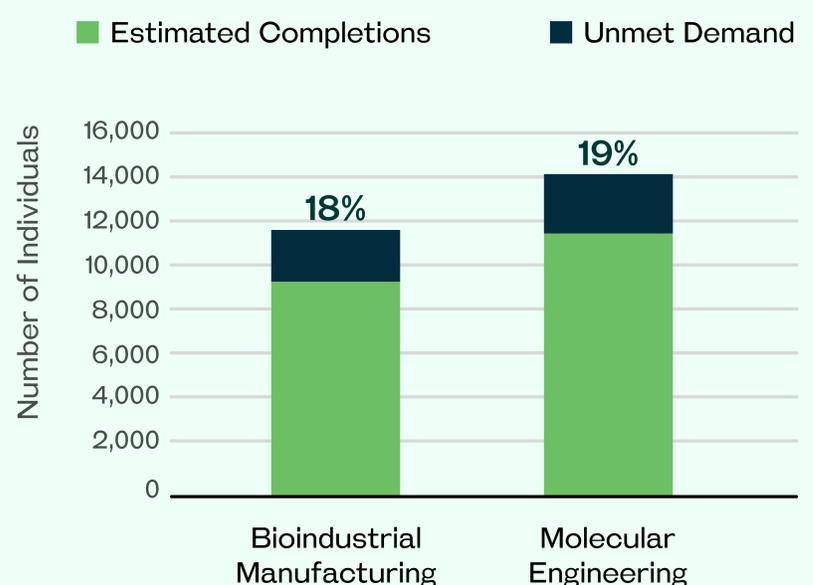
Demand for Emerging Biotechnology Workers Has Grown Over the Last Five Years



There is Unmet Demand for Talent in Almost Every Emerging Biotechnology Role



The Current Rate of Bachelor's Completions is Insufficient to Meet Current Demand for Emerging Biotechnology Talent



III. Origins: Vision from the Heart of Appalachia

The Northeast Tennessee story began in 2018, when David Golden, then Senior Vice President and Chief Legal and Sustainability Officer at Eastman Chemical Company, as well as President of the Eastman Foundation, began to search for next-generation, future-relevant education platforms to drive innovation in local school systems. Golden was on the executive team of one of the state's largest employers—a Fortune 500 company that had grown from local roots in Kingsport, Tennessee into a global chemical manufacturing giant.

While searching for such programs, Golden took what he describes as a “curiosity-driven detour” that became pivotal. He had been reading a book that referenced the emerging power of synthetic biology. Intrigued, he turned to the footnotes to chase down the underlying research. His first Google search yielded a reference to Dr. Natalie Kuldell and the BioBuilder Educational Foundation (BioBuilder). Founded by Dr. Kuldell, a longtime instructor in MIT's Department of Biological Engineering, BioBuilder's programs brought synthetic biology—the engineering of living systems—into high-school classrooms through hands-on labs, project-based learning, and teacher training.

Compelled by what he was learning, Golden read every article, interview, and program description he could find about BioBuilder and synthetic biology. From his research, the signals were clear. The tools of biotechnology were transforming not only healthcare and pharmaceuticals but also materials science, manufacturing, and sustainability. Northeast Tennessee, with its legacy of chemical expertise and culture of practical ingenuity, was well positioned to benefit, if it could build the human capital to match. Moreover, BioBuilder was a practical, engineering-driven approach to biotechnology education that aligned with Northeast Tennessee's strengths.

Golden's insight was simple but far-reaching: to attract new biotech enterprises and to help existing industry, Northeast Tennessee would need to cultivate a workforce fluent in the language of biotechnology. Golden viewed it as a “supply-chain challenge” with education being the longer part of the chain. Acting on instinct, Golden cold-called Dr. Kuldell and asked if she might be willing to meet with him. She agreed. When Golden visited BioBuilder's Learning Lab in Cambridge's Kendall Square, he saw high-school students working with professional-grade equipment running real genetic-engineering experiments and engaging with science the way industry scientists do. The experience convinced him that this was a missing piece in Northeast Tennessee's talent strategy.

David Golden, retired SVP Eastman Chemical Company



We needed to do what we could to deploy BioBuilder in the education system where we live—because biotechnology is becoming a strategic workforce priority, and building that talent is a long-lead ‘supply-chain’ challenge.



IV. Teaching the Next Generation of Scientists

The Eastman Foundation, East Tennessee State University (ETSU), and the BioBuilder Educational Foundation shared a vision: a regional education-to-employment pipeline that would expose students to biotechnology early, train teachers to deliver high-quality instruction, and connect learning directly to industry needs.

Their plan centered on a pilot within Kingsport City Schools. In 2019, Dobyms-Bennett High School, a flagship public high school with a long record of academic innovation, agreed to be the first site. The Eastman Foundation sponsored a custom offering of BioBuilder's teacher-training program, sending Dobyms-Bennett biology teachers and ETSU faculty to train in Cambridge, Massachusetts, at BioBuilder's Learning Lab @ LabCentral. There, they worked side by side with practicing scientists and experienced teachers, performing experiments from a student's perspective.

By the fall of 2019, BioBuilder was formally embedded into Dobyms-Bennett's 9th-grade biology curriculum, reaching every freshman. The Eastman Foundation, BioBuilder, and Carolina Biological Supply Company collaborated to equip new labs, ensuring that all students could participate in authentic biotechnology experiments.

The result was a surge of student engagement unlike anything teachers had seen.

Students at all levels—from remedial to advanced—were enjoying it so much they would ask when they got to do the next BioBuilder experiment, said Dobyms-Bennett High School teacher Evie LaFollette.

Wendy Courtney - STEM specialist



Students realize that they can do real science—not just read about it. They start to see themselves as part of something bigger.

That sense of possibility reflects the outcome when biotechnology instruction includes accessible, hands-on experiences that make science tangible for students. For teachers, this instructional model provides structure, confidence, and community. For schools, it offers a turnkey way to modernize science education. For regions like East Tennessee, it represents a new way to think about workforce development—one that begins not with job placement programs, but with curiosity and learning.

V. From Pilot to a Region Transformed

In 2021,

The Niswonger Foundation received an Education Innovation and Research (EIR) grant from the U.S. Department of Education to further the work across Northeast Tennessee. The initiative, dubbed STEM.LD, emphasized professional learning for teachers, out-of-school STEM opportunities for students, and advanced coursework in rural high schools to strengthen college and career readiness. BioBuilder's curriculum and teacher training made it possible to translate STEM.LD's priorities into classroom practice, and quickly embed biotechnology into required coursework and existing instructional pathways.

In 2022,

BioMADE, the federally funded Manufacturing Innovation Institute for bioindustrial manufacturing, awarded a grant to a BioBuilder-led team including ETSU and Arbor Biosciences. That Education and Workforce Development grant not only expanded access to biomanufacturing education for rural and urban schools—scaling what East Tennessee had pioneered into a model for other regions—but also supported the peer-reviewed study “Strengthening the STEM pipeline: impact of project-based synthetic biology program on high school students' science identity and competency,” published in *Frontiers in Education*.⁴

At this point, the Northeast Tennessee experiment had become something more—a movement linking education, workforce, and regional development.

By 2023,

East Tennessee's biotechnology education initiative had grown from a single classroom pilot into a regional network connecting high schools, colleges, industry, and philanthropy. What began with a few teachers in Kingsport fueled a broader ecosystem of opportunity with measurable educational, economic, and cultural effects. More than 80 percent of participating students reported BioBuilder strengthened their sense of belonging in science and clarified their career goals.⁴ The initial grant to BioBuilder from the Eastman Foundation in 2019 attracted regional follow-on funding for laboratory infrastructure, teacher training, and student opportunities, estimated to have generated \$100 of local economic activity for every \$1 originally invested in BioBuilder programming.

The Northeast Tennessee model is now reshaping how communities engage with science and opportunity. Biotechnology has moved beyond specialized research settings into local classrooms, student-led projects, and regional industry pathways.⁵ In Northeast Tennessee, high-school students now present capstone projects on renewable materials, sustainable food systems, and genetic design; local employers host facility tours for these students; and educators across districts collaborate to share biotechnology teaching practices.⁶

In 2025,

In August 2025, commissioners from the NSCEB visited ETSU and regional industry, including the Niswonger Foundation-powered BioBuilder Educational Foundation Learning Lab, to examine Appalachia's growing biotech education-and-workforce ecosystem and signal the region's national significance.⁷

During that visit, Dr. Linda Latimer, former ETSU Trustee, articulated how the region's culture has shifted:

Dr. Linda Latimer, former ETSU Trustee



““

The belief that biotech is for everyone has been central to how we're building the pipeline here in Northeast Tennessee. That's why we've worked to elevate bioliteracy at every level. We want our young people to grow up understanding biology and biotechnology the way previous generations understood computers and the Internet. They need it to be a source of opportunity. When our students see biotech as something they can understand, they can see it as something they can shape. That's why the introduction of BioBuilder in the kindergarten through 12th space is so brilliant.

Her remarks reflect more than a shift in perception; they capture a deliberate regional commitment to making biotechnology a shared source of identity, opportunity, and civic purpose. Biotechnology is no longer treated as a distant concept reserved for coastal hubs. It is becoming an intentional part of how Northeast Tennessee educates its students, engages its communities, and plans for its economic future.

Key Outcomes

- Eastman Foundation funding supported the initial training of teachers from Dobyne-Bennett High School and East Tennessee State University, enabling the integration of BioBuilder into secondary and postsecondary coursework.
- In partnership with the Niswonger Foundation, the initiative expanded to serve approximately 50 students at Volunteer High School
- By the 2025–26 academic year, enrollment reached 900 freshmen in BioSTEM I across seven high schools and one middle school, with more than 1,400 students participating across BioSTEM I, Biology I/BioSTEM II, and BioSTEM III.
- An EIR grant secured by the Niswonger Foundation established a full four-course CTE biotechnology pathway now operating in seven high schools across east and northeast Tennessee, enabling sustainable statewide adoption.
- Additional grants to ETSU, ETSU Research Corporation, and ValleyBrook Research Campus generated an estimated \$100 in local economic impact for every \$1 invested in BioBuilder adoption and teacher training.
- Eighty percent of participating students report increased science identity, and in 2025 ETSU students presented their work at an international competition.

\$1 invested in BioBuilder → \$100 Local Economic Activity



Among the study's findings: 88% of participating students reported increased interest in advanced science and pursuing life science careers.

VI. Lessons Learned from the East Tennessee Model

What makes East Tennessee's approach distinctive is not any single program or curriculum, but the system of relationships and structures that developed around it. Together, these elements form a purpose-built education-to-opportunity pipeline characterized by three core principles.

01

Deliberate Program Design

Regional leaders began with a simple premise: students who can access high-quality science education in high school will build an appetite for college and career opportunities in STEM fields. That principle drove the decision to redesign the high school experience so that biotechnology is built into required coursework for every student, rather than offered as a selective enrichment track.

Embedding BioBuilder into freshman biology created a structure that ensures universal exposure to hands-on biotechnology, strengthens scientific literacy, and introduces students to careers they may not have known existed. This broad, required introduction also reframed biology for families and students, elevating it from a perceived “low-level” science to a gateway into emerging regional industries. From this shared starting point, students can choose to move into standard comprehensive coursework or into progressively deeper Career and Technical Education (CTE) options.

Anchoring biotechnology in an established, state-approved CTE sequence called BioSTEM provided the structural stability that many school-based innovations lack. Its courses qualify for sustained support under Tennessee's investment in Student Education (TiSA) funding model, a point Dr. Vicki Kirk from the Niswonger Foundation emphasized when noting that too many promising programs “die...for lack of funding.” Aligning the pathway with existing state standards ensured that biotechnology could be implemented at scale without relying on temporary grants or one-time initiatives.

The result is a coherent and scalable system. Within just two years, enrollment in BioSTEM1 expanded from several hundred freshmen to nearly 900 across multiple high schools and a middle school, demonstrating both student interest and the ease with which schools could integrate the redesigned sequence.

Vicki Kirk, Niswonger Foundation



We need a large funnel on the front end—by making biotechnology part of required coursework, we can reach every student. And on the back end, we want a wide range of opportunities, from entering the workforce straight out of high school to pursuing a PhD.



Cross-Sector Partnership

Northeast Tennessee's biotechnology surge grew from a coalition whose strength lies in the region's own industrial evolution. What began generations ago with Appalachia 1.0—distillation, fermentation, and biochemical craft—matured into Appalachia 2.0 with Eastman Chemical's century-long leadership in industrial chemistry. Today's biotechnology movement, Appalachia 3.0, is the natural next chapter: a shift from materials to molecules, powered by the same culture of ingenuity, precision, and hands-on skill that has always defined the region.

No single institution could have catalyzed this shift. It required a cross-sector partnership in which each stakeholder contributed a distinct asset:

- **Kingsport City School District**

Played a catalytic role as the first district to embed BioBuilder into required high-school coursework. Under the leadership of Dr. Brian Cinnamon, Chief Academic Officer, the district deliberately shifted toward project-based learning, new STEM facilities at Dobyms-Bennett High School, and a commitment to giving all students access to advanced, real-world science experiences.

- **Eastman Chemical Company & the Eastman Foundation**

Provided early philanthropic investment and the industry leadership that validated biotechnology as a strategic regional priority. Their involvement rooted the effort in a century of regional process expertise.

- **ETSU & the ETSU Research Corporation**

Offered the academic backbone—scientific credibility, teacher-training capacity, translational research infrastructure, and the convening power needed to support a modern bioeconomy.

- **Niswonger Foundation**

Ensured regional reach. Through deep school-district relationships, coordinated professional learning, and the STEM.LD initiative, Niswonger translated ambition into classroom deployment across rural Appalachia.

- **BioBuilder Educational Foundation**

Supplied the pedagogical core. BioBuilder's hands-on synthetic biology labs, engineering-based learning model, and robust teacher development brought molecular design and experimentation directly into K–12 classrooms.

- **Industry & Federal Partners (Carolina Biological, BioMADE, Arbor Biosciences, Tennessee Hills)**

Expanded distribution channels, equipment support, experiential learning opportunities, and alignment with national bioindustrial manufacturing priorities. Tennessee Hills, with its roots in Appalachian fermentation and distillation, provided a culturally resonant link between the region's biochemical heritage and its emerging biotechnology future.

Together, these partners created a coalition that operated with coherence—sharing data, dividing responsibilities, and adapting quickly to changing conditions, including during the COVID-19 shutdown. The result is not merely a program but a functioning regional ecosystem.

The real value of this partnership is not that it is unique to East Tennessee; it is that it is replicable. Any region committed to innovation can assemble a similar coalition: an anchor industry, an engaged university, an educational intermediary, a strong curriculum partner, and aligned national organizations. Each region will bring its own history, culture, and industrial assets, but all face the same global demand conditions for biotechnology talent, advanced manufacturing capability, and innovation-driven economic growth.

Northeast Tennessee demonstrates that biotechnology education and workforce development can flourish anywhere there is shared vision, trusted partnerships, and a willingness to build together.

03

Stackable Pathways

A defining feature of the East Tennessee model is its commitment to structuring learning so that each step builds toward a range of real opportunities. Regional partners—including the Niswonger Foundation, ETSU, and the Tennessee State Collaborative on Reforming Education (TN SCORE) — agree that biotechnology pathways must offer multiple entry and exit points, enabling students to pursue:

- immediate employment after high school,
- community-college credentials,
- transfer into bachelor's programs, or
- advancement into research careers.

This approach directly mirrors the TN SCORE Credential Impact Framework, which identifies stackability as one of the core characteristics of a high-value credential—one that avoids “dead ends,” builds toward higher-level learning, and expands students’ economic options.

In August 2025, the NSCEB Biotech Across America Roadshow visited East Tennessee. They came to examine the region's purpose built educational pipeline because it confronts a national challenge they highlighted in Appendix F of their report:

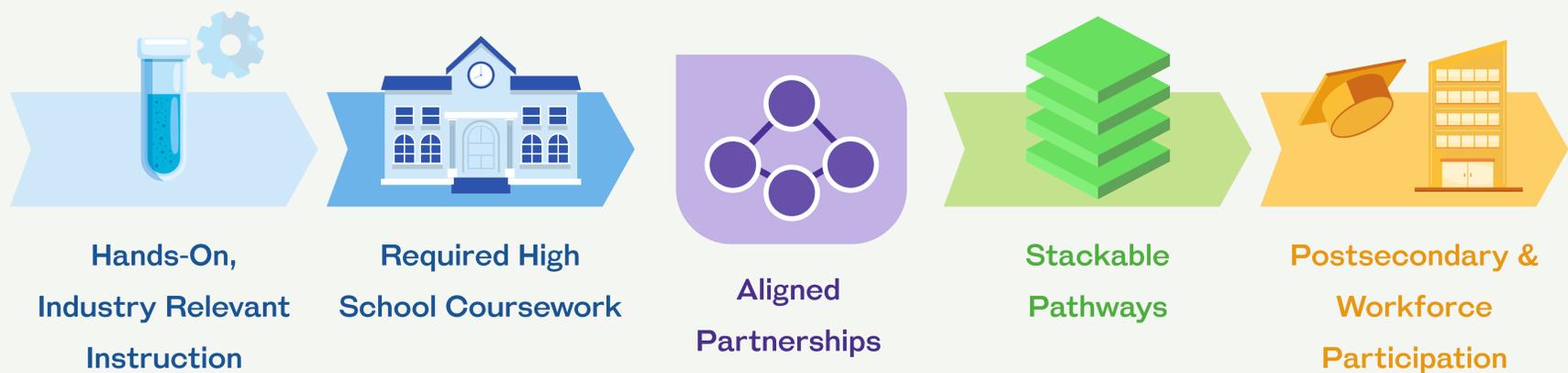


Educational institutions often operate in silos and do not coordinate their curricula, making it difficult for students to transfer or apply credentials across systems. Without ways of accumulating credentials, students must often repeat coursework, which requires additional resources and time before they can enter the workforce.

East Tennessee's regional partners built their system specifically to overcome this barrier. Deliberate alignment ensures that students carry their learning forward, rather than starting over at each transition point. It also makes biotechnology a viable pathway for students who might not otherwise navigate a fragmented credential ecosystem.

By contrast, the East Tennessee model shows that when pathways are sequenced, aligned, and reinforced across institutions, students can navigate biotechnology education in ways that are coherent, cumulative, and connected to opportunity—precisely the kind of multi-entry, multi-exit talent pipeline envisioned by national policymakers.

East Tennessee's progress is especially notable given the national headwinds identified as a hyper-fragmented credential marketplace,⁸ limited advising capacity (especially in rural communities),⁹ uneven alignment among CTE, dual enrollment, and labor-market demand,¹⁰ and short-term credentials that often do not articulate into higher-level awards.¹¹



VII. A Playbook for Other States

Rather than allowing coursework, credentials, or student progress to sit isolated within separate institutions, districts, or colleges, East Tennessee deliberately designed an educational pipeline that aligns instruction, opportunity, and economic development. The model can serve as a credible blueprint for other regions. Drawing on lessons from this region, other states can follow a clear sequence of steps:

- 1. Start with a Champion**

Identify a respected regional leader who can convene industry and education partners and articulate the opportunity.
- 2. Build Partnerships**

Link schools, colleges, nonprofits, industry, and state agencies around a shared vision of workforce development.
- 3. Align with Workforce**

Engage employers early to ensure that credentials and curricula match actual job requirements.
- 4. Train Teachers**

Invest in professional development that integrates science content with hands-on practice and peer support.
- 5. Pilot and Scale**

Launch in one or two schools, gather data, and expand through regional networks.
- 6. Sustain and Showcase**

Share outcomes, celebrate milestones, and reinvest in teacher and student leadership.

By beginning with a required introductory science class and building upward, East Tennessee created an experience that demonstrates that biotechnology education can thrive anywhere—urban or rural, coastal or inland — if approached deliberately and collaboratively. These steps form the backbone of a federal playbook for biotechnology workforce development—an actionable roadmap already tested on the ground.

VIII. Federal and State Policy Implications

East Tennessee's story also clarifies what policy frameworks are needed to replicate this success nationwide.

1. Federal Catalysts and Conveners

Federal leadership remains essential for accelerating regional models like East Tennessee's into a coherent national biotechnology workforce strategy. With the NSCEB concluding its mandate in 2026, the newly established Bipartisan Congressional Biotech Caucus has emerged as the next critical convener. Co-chaired by members of both parties, the Caucus was formed to sustain congressional focus on biotechnology's economic, workforce, and national-security implications and to champion policies that expand bioliteracy and ensure that communities across the country—not only legacy innovation hubs—benefit from the bioeconomy.

Alongside the Caucus, federal agencies can use their convening authority to set a unified national vision while still enabling regional adaptation—much as BioMADE has done for advanced bioindustrial manufacturing. A coordinated federal initiative could align the currently fragmented efforts across the U.S. Departments of Education, Labor, Commerce, and Defense, as well as the National Science Foundation, into a single biotechnology talent strategy capable of scaling local successes nationwide.

2. Infrastructure Investment

Building the bioeconomy requires modern laboratories, equipment, and training facilities—investments that are often out of reach for rural districts. Recent federal investments in biotechnology, including the National Biotechnology and Biomanufacturing Initiative, the CHIPS-funded Tech Hubs program, and NSF's expanded rural STEM investments, have begun strengthening regional capacity.

A national network of BioSTEM Hubs would extend this progress to K–12 systems, ensuring that every region, including rural districts, has the facilities needed to support biotechnology education and workforce development.

3. Credential Alignment and Portability

A federally coordinated framework for biotech micro-credentials is essential to guarantee that learning translates into opportunity no matter where a student lives. Tennessee's SCORE Credential Impact Framework shows how states can identify high-value, stackable credentials that lead to real jobs.

A national system modeled on this work would bring coherence to a fragmented credential landscape and ensure students and employers can trust the meaning of each credential across state lines.

4. Data and Evaluation

Continuous evaluation tracking student outcomes, teacher retention, and economic impact is essential. States can partner with higher-education institutions to collect and share this data transparently, guiding continuous improvement.

5. Ensuring Access

Federal and state governments play a critical role in removing structural barriers that keep rural, under-resourced, and historically underserved communities from participating in modern scientific and biomanufacturing fields. Making access real rather than aspirational requires coordinated policies that address the full pathway: expanding high-quality K–12 biotechnology instruction, strengthening student advising and navigation so young people understand and can act on emerging opportunities, and investing in teacher recruitment, preparation, and retention to ensure districts can sustain these programs over time.

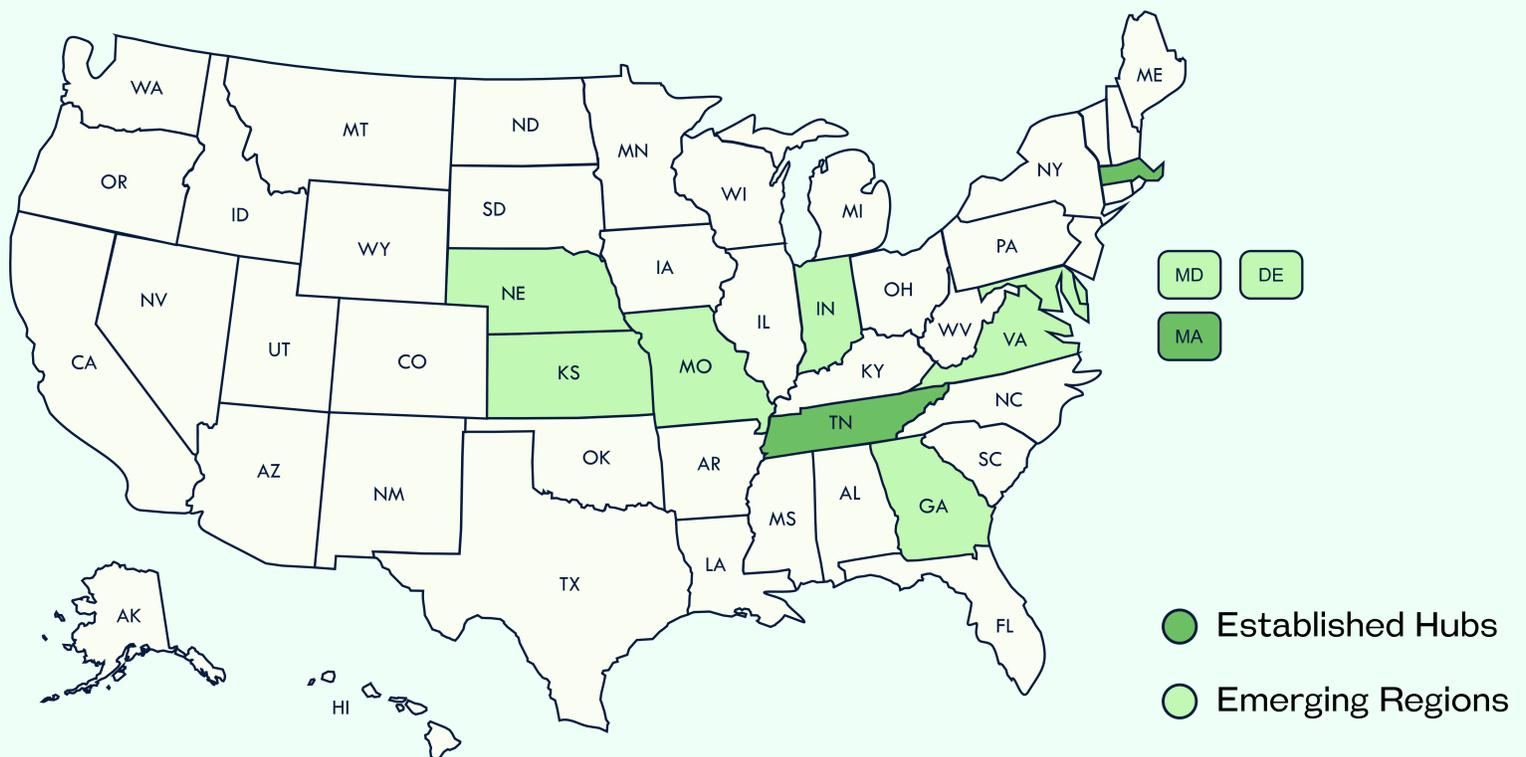
States can also use funding incentives to embed biotechnology within required coursework rather than limiting it to electives so that all students, including those who might not initially self-select into STEM, gain early exposure to emerging scientific and economic opportunities.

Finally, federal partners can support cross-district collaboration networks, particularly in rural regions, ensuring that even small systems benefit from shared professional learning, industry partnerships, and curricular resources.

Together, these strategies make biotechnology pathways accessible, navigable, and durable across every community.

IX. A National Opportunity

In just a few years, a small collaboration in the Appalachian Highlands transformed into a model of national significance. What began as a handful of teachers experimenting with synthetic biology labs in Kingsport has become a regional ecosystem of opportunity that is anchored by higher education, supported by philanthropy, coordinated with state and regional partners, and aligned with industry needs.



Scaling East Tennessee Model

The East Tennessee model demonstrates that with purpose, partnership, and persistence, education can be connected to economic development, and when students see themselves as creators of science rather than consumers of it, communities flourish.

That principle—learning how to work, and learning that you belong—may be the single most powerful tool the United States possesses for strengthening its future.



Every student deserves the chance not just to learn about biotechnology from a textbook, but to learn how biotechnology actually works—by doing the experiments, solving real problems, and collaborating the way scientists do.

Across the country, momentum is building. Philanthropic foundations are aligning workforce investments with local biotech clusters. The federal government, through initiatives like the Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy and the Genesis Mission that accelerates AI-powered innovation and discovery, has already signaled that biotechnology is a national priority. **But the East Tennessee experience reminds us that the true foundation of the bioeconomy is education.**

The story's lesson is clear: cultivating the biotechnology workforce of the future is not only about new technologies or infrastructure. It is about building human capacity—teachers, students, and communities equipped to participate in the century of biology.

If every state were to follow Tennessee's lead, the result would be not only a stronger workforce, but a stronger nation: one capable of defending, building, nourishing, and healing from the classroom up.

References

1 <https://www.biotech.senate.gov/final-report/chapters/executive-summary/>

2 <https://www.biotech.senate.gov/final-report/chapters/chapter-5/>

3 <https://bio.news/bioeconomy/u-s-biotech-generates-3-2-trillion-in-a-year-report-shows>

4 <https://frontiersin.org/journals/education/articles/10.3389/feduc.2024.1493356/full>

5 <https://news.etsu.edu/articles/etsu-helps-shape-the-future-of-us-biotechnology>

6 <https://peer.asee.org/biomanufacturing-engineering-for-the-appalachian-highlands-updates-on-the-development-of-a-scalable-bioengineering-program-in-rural-settings>

7 <https://www.biotech.senate.gov/roadshow-events/tennessee/>

8 <https://www.the74million.org/article/what-makes-some-cte-programs-great-while-others-fall-short/>

9 <https://hechingerreport.org/how-one-state-revamped-high-school-to-reflect-reality-not-everyone-goes-to-college/>

10 <https://careertech.org/resource/dashboard-top-employer-requested-credentials/>

11 <https://www.aei.org/research-products/report/holding-new-credentials-accountable-for-outcomes-we-need-evidence-based-funding-models/>

BioBuilder

Educational Foundation

