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Boost Opportunities for Science Learning With Regional Alliances

Local collaborations among schools, higher education institutions, businesses, and community groups can achieve what top-down directives cannot.

By many metrics, Tennessee struggles in science education. The number of candidates finishing teacher preparation programs fell nearly 40% from 2014 to 2020; if that trend continues, the state will produce no new teachers by 2030. But there are lessons in the Volunteer State that other regions could learn from. For example, in southeastern Tennessee, an alliance of local schools, businesses, universities, and other groups has come together to improve science teaching and learning. Volkswagen, a member of the local alliance, provides the Chattanooga Fab Institute, where teachers can learn 3D printing, microcomputing, and other technologies, and then use these experiences, along with a technology lending library, to build skills and creativity in their classrooms. In partnership with the Public Education Foundation (PEF) of Chattanooga, the alliance supports a cohort of teacher fellows every year to work across community partners and within their schools and classrooms, thus building and reinforcing regional connections.

All of this work has helped reset school expectations such that schools involved in the alliance scored 76% on a 2020–21 *Ready Graduate* indicator report—in contrast to an average of 40% for other Tennessee schools. Although many districts were not initially strong in science education, researchers have found clear improvements. One teacher said the collective work of improvement "made me a better teacher and kept me in the classroom longer." When Vanderbilt University researchers asked students in a small focus group whether the community supported their learning, one described how "cool" it was when people from local manufacturing companies visited their engineering classes. The cooperation found in southeastern Tennessee is also formalized and sustained through the PEF STEM Innovation Hub, which leads initiatives across the state.

Tennessee's experience exemplifies an idea championed in the National Academies of Sciences, Engineering, and Medicine's 2021 report *Call to Action for Science Education: Building Opportunity for the Future.* That report, which all three of us worked on, called for better, more equitable science education from kindergarten through postsecondary education (K–16). It emphasized the need to both prepare a workforce and build foundational science literacy for everyone, regardless of race, ethnicity, home language, geographic location, or financial circumstances. The report also identified a key strategy to reach that goal: regional alliances for STEM opportunity, in which K–12 schools, postsecondary institutions, informal education, business, industry, philanthropies, and other stakeholders all join forces to align local needs to local assets. In the years since the release of that report, we have engaged in conversations with a wide range of educators, community organizers, policymakers, and other stakeholders, which has provided compelling examples of how such alliances can come together to achieve tremendous advances.

Science education for today's priorities

This is not the first time that the United States has recognized a need to improve science education. The Sputnik moment of

1957, with calls for better science education, led the National Science Foundation (NSF) to exponentially increase funding for a strong science curriculum, which translated into new K–12 textbooks. The focus was on preparing the best and brightest for the growing science, math, and engineering workforce. Equity and inclusion were not priorities in the space race.

A quarter century later, in 1983, the National Commission on Excellence in Education released *A Nation at Risk: The Imperative for Educational Reform*. Advances in the Japanese auto industry and declining academic performance among US students triggered the concern, but the report called for an educated citizenry, not just a scientific elite, to have a sound understanding of scientific thinking. It even briefly alluded to "the voluntary efforts of individuals, businesses, and parent and civic groups to cooperate in strengthening educational programs"—what we now call regional alliances. Still, the recommendations focused elsewhere: on improving curriculum, increasing student time for learning, and correcting the shortage of math and science teachers.

The fresh insight from *Call to Action for Science Education* is for regions to embed formal education within their own specific context, with an emphasis on access and opportunity. Across the nation, we have seen a path to achieve both an informed citizenry and capable workforce by recruiting local industry, community, and philanthropy into supporting science education and allowing learners' experiences to be tailored to their local context. The best way to identify local priorities, secure local resources, and improve communities is to draw on connections across the breadth of community stakeholders such as local business, colleges, citizen groups, and both the formal and informal education sectors. We call these models Alliances for STEM Opportunity.

The potential for this regional model can be seen in the national Defense Science, Technology, Engineering, and Mathematics Education Consortium (DSEC). This consortium is part of the Department of Defense Education Activity, the umbrella agency that provides education for children of military members stationed on bases in the United States and abroad. It serves nearly 70,000 students in 160 schools, each of which partners with local businesses, industry, and postsecondary institutions. The alliances operate by five guiding principles: engage K–16 students in meaningful experiences, serve students who are underrepresented, connect learning to Department of Defense workforce needs, use DSEC as a lever to amplify the work of regional hubs, and use data to improve over time.

Though DSEC is a national organization, region-specific connections are key. The Dayton Regional STEM Center in Ohio connects 57 schools and community partners, including Wright-Patterson Air Force Base, which offers an Air Camp for students, and the center's teachers benefit from its STEM Fellows program. Another hub, Center for Research on Educational Equity, Assessment, and Teaching Excellence, at the University of California, San Diego, has a range of distinctive features, including a summer math academy as well as student internships and apprenticeships with the Naval Information Warfare Systems Command. This school system placed well above the national average in the 2022 National Assessment of Educational Progress. It's hard to know how much the regional alliance approach contributed to this performance, but the fact that a high-performing national school system has adopted the regional alliance approach may be its own endorsement.

Helping success breed success

A regional alliance can help strengthen teacher training and ensure that lessons are relevant to students' lives as well as collect data to assess weaknesses and guide iterative improvement. The approach also strengthens communities by creating a more engaged citizenry and able workforce.

Although regional alliances will look very different in terms of specific priorities, resources, and projects, initiatives tend to fall into a common set of actions:

- Develop supportive pathways in science learning—in and out of the classroom—throughout K–16
- Develop, recruit, and retain a diverse science teaching workforce
- Provide teachers and learners with time, quality materials, and resources
- Connect people across sectors to advance evidence-based teaching and learning
- Implement accountability and well-designed assessments
- Document progress to drive iterative improvements

Stable regional alliances help success breed success, particularly when they strengthen an educational continuum for K–16. High school students who go on to higher education generally do so close to home, so coordination between regional schools and postsecondary schools can help to better align curriculum, expectations, and other requirements. High school teachers involved in alliances will have a better sense of what higher-education instructors expect their students to bring into the classroom, and those instructors will have a better idea of what students have already been taught. Such coordination can keep students from feeling stranded as they move from high school into higher education. It can also create opportunities including dual enrollment in high school and community college, early college coursework, and more effective community college programs.

Engaging postsecondary schools is also an important strategy to counter teacher shortages. Labor markets for teachers are primarily local rather than national, so postsecondary schools should consider how they can help train enough teachers for their own communities.

Links with the local industry (say, practicums around mining, biotech, manufacturing, or agriculture) can produce further synergies, creating a workforce that keeps businesses in the region and jobs that keep young people from moving away.

When these alliances are most successful, they provide students with a strong science education in their earliest years that can continue without disconnects as they move through the K–16 continuum. When students do not have access to robust science learning experiences in the elementary grades, they are not well positioned to pursue advanced science courses in high school. If students are not ready for those courses or their high schools do not offer them, it is harder for students to navigate STEM paths after high school graduation. Many students, particularly Black, Latino/a, and Indigenous students, as well as those living in poverty or rural areas, lack support to transition from high school to postsecondary science courses and may not know how to pursue their STEM-related career goals. Stronger alliances among local philanthropies, schools, postsecondary institutions, and industry can reduce these gaps to help keep students from falling through them.

Opening paths toward STEM careers has advantages that go beyond creating more scientists: those who venture down this path, or even know that the possibility exists, are more likely to view science as accessible and relevant to their world. A robust comprehension of science is crucial for individual, societal, and global well-being. All students deserve the opportunity to experience the wonder and joy that understanding the world around them can bring and to acquire skills in scientific thinking that enable them to participate in society and democracy. The twin goals of equity and high-quality schooling are crucial for the economy and for society, and we think regional Alliances for STEM Opportunity are the best way to serve both.

Leaning into alliances

The United States' K–12 and postsecondary education systems are decentralized, meaning there is no unifying driver to maintain quality and ensure equity. STEM alliances can elevate the importance of science in community conversations about education, the workforce, and quality of life. While it is crucial to ensure that the people closest to the work of learning and teaching are included—teachers, principals, district leaders, faculty, lecturers, department chairs, and students—the formal K–16 enterprise alone cannot provide all students with the broad STEM learning possibilities that should be available to them. An alliance's collective understanding of education infrastructures, unique needs, and local assets can marshal the appropriate resources along the K–16 continuum, providing relevant context and richer experiences to motivate learners.

One thing that we've noticed in our conversations is that it is crucial that Alliances for STEM Opportunity have a coordinating hub or formal convener to integrate efforts. More than a decade ago, Battelle's nonprofit science education organization began supporting regional alliances in its home state of Ohio in collaboration with the Ohio Department of Education. It has since begun managing and supporting regional alliances in 20 states, often through a series of public-private partnerships. For example, the Tennessee STEM Innovation Network, created in 2010, supports eight regional alliances, including the one described at the beginning of this article. The opportunity to learn across states is facilitated through Battelle's national STEMx network.

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In Idaho, hubs were created by Idaho Business for Education, a group of regional businesses that helped launch multiple STEM alliances in different regions of the state, around which communities can coalesce. Each alliance connects K–16 formal and informal education, industry, and other community leaders who support quality instruction, teacher education, and teacher professional development. They explicitly prioritize reaching those most distant from STEM resources, using the local knowledge and expertise of hub partners to deliver programming. Its board of directors includes representatives from Idaho National Lab, regional medical organizations, the mining industry, ranchers, and tribal councils.

Our handful of examples does not imply that every regional alliance needs to be sponsored by a larger organization—it simply represents the ones that are the easiest to find. Indeed, we suspect that many independent STEM alliances doing very good work may only be known within their own communities and may not use terms like "innovation hub" or "STEM Opportunity Alliance."

Articulating a regional vision

The first step of a regional STEM alliance is to articulate a vision for its community and develop a plan of action to meet it. Decades of improvement efforts show how important it is to have a vision that aligns policies with practices and focuses on areas most needing improvement, such as lack of access.

Importantly, efforts should aim to strengthen connections *across* the alliance; one-off initiatives are often less effective. For example, although classroom visits can be good outreach, scientists can be more effective by forging stable alliances between schools and other institutions rather than making isolated presentations in classrooms. Multiple, ongoing connections within an alliance are possible: scientists who work for local employers can share the kind of scientific knowledge and skills that students will need to work in their industry; formal and informal educators can draw on regional features to engage students in scientific practices and concepts; and postsecondary institutions can design pre-service teacher programs that prepare future teachers to understand how people learn, framed in the contexts of local schools.

Support for alliances

Regional alliances are powerful because education is a local issue in the United States. But successful widespread adoption of the alliance model will require support from communities outside of the education sector as well. States can provide infrastructure to support local or regional alliances, whether from state agencies or state-level organizations such as the Idaho example above, and philanthropies can provide financial support and foster links to their own networks.

The federal government also has multiple crucial roles to play in supporting alliances. The White House Office of Science and Technology Policy can further elevate the importance of science education by establishing a regional emphasis for students to learn from their STEM Opportunity Alliance as a key goal of fostering an ecosystem for STEM that is rooted in equity, inclusion, and scientific excellence. Congress could increase attention to science in the next Elementary and Secondary Education Act reauthorization. The National Science Foundation can prioritize alliances in the research projects it funds. Another opportunity for support could be through the NSF-funded Regional Innovation Engines, launched in May 2022. These engines do not currently emphasize education, but they do engage across sectors with the other stakeholders in science, which could help incubate individuals and efforts in nascent regional STEM alliances.

We believe that NSF Engines could be more valuable to a region and enjoy greater community support and engagement if they expanded to include support for alliances outlined in *Call to Action for Science Education.* For example, central Florida was awarded one of the 10 inaugural NSF Engine grants to build semiconductor capacity. To ensure the community has workers with the expertise to work in semiconductor plants and companies that will service the plant, it needs to prioritize high-quality opportunities for student learning. Valencia College, a local postsecondary institution that primarily serves associate degree students, is well positioned to contribute. The college seamlessly integrates K–16, serving as a strategic link between local schools and postsecondary institutions, specifically the University of Central Florida. The college also works with BRIDG, a public-private partnership that matches work in government and academic labs with industry needs, including a workforce. That experience connecting across sectors could apply in larger ways if linked to the innovation engine.

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With wide regional variation in economies of innovation as well as in STEM education, creating sustained community support and engagement through Alliances for STEM Opportunity is a powerful way to bring about local improvements to science education. The federal government is well positioned to conduct research and provide resources, but regional alliances are essential to empower communities to find their most effective route to better science education. Importantly, they provide a venue for people to find common ground so that progress does not get lost to political polarization. Galvanizing regional STEM alliances offers a powerful lever to deliver better, more equitable K–16 science education in service of not just a competitive workforce, but also a better civic society.

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