



STATE OF STEM:

Challenges and Opportunities

January 2023



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Suggested Citation

Ziker, C., Johnson, J., & Paredes, P. (2023). The State of STEM: Challenges and Opportunities. *Manhattan Beach, CA. STEMconnector.*



STEMconnector is a professional services firm committed to increasing the number of STEM-ready (Science Technology Engineering Math) workers in the global talent pool. We engage stakeholders across the corporate, postsecondary, nonprofit, government, and K-12 sectors to enable optimal outcomes for historically underrepresented and underserved individuals. Our Research Team focuses on complex problems and research-based solutions designed to improve the STEM workforce. We work with STEM innovators and thought leaders across sectors to inform, inspire, and connect organizations with a passion for and vested interest in re-envisioning and growing a STEM-ready workforce. Visit <https://stemconnector.com> to learn more.

Letter from the CEO

At STEMconnector, we are excited to release our updated State of STEM report. The research for this update to our seminal work in 2018, occurred throughout the year 2022, as our planet started to recover from the effects of the pandemic. Our annual STEMconnector summit in October of this year was live for the first time since 2019. We were thrilled to host the Deputy Secretary of Education Cindy Martin as our keynote speaker. Dr. Martin chose to unveil the YOU Belong in STEM initiative from the Biden-Harris administration at our conference, and our member organizations were enthusiastic and energized by the focus this administration is placing on STEM and STEM education. The department's goals for the YOU Belong in STEM program are summarized as:

- **Goal #1:** Ensure all students from PreK to higher education can excel at rigorous, relevant, and joyful STEM learning;
- **Goal #2:** Develop and support our STEM educators to join, grow, and stay in the STEM teaching profession; and
- **Goal #3:** Invest in STEM education strategically and sufficiently using American Rescue Plan and other federal, state, and local funds.

In the final quarter of 2022, we heard of technology company layoffs. However, it is also worth noting that we are at a 16-year high in terms of talent shortages,¹ with STEM jobs being the hardest to fill. Earlier in 2022, we saw the Biden administration embarking on ambitious plans to build a thriving semiconductor industry in the United States with the \$52 billion Chips and Science Act. The success of this program will rely on the ability to attract and retain skilled STEM workers. Over the last five years, STEM has had a large and growing impact on the nation's GDP, accounting for \$25 trillion in economic output and producing \$2.3 and \$1.2 trillion in federal and state tax revenues, respectively.²

STEM is clearly mission-critical to the national security and prosperity of the United States and key to our role as a global technology innovator. I would like to sincerely thank all the contributors to this body of work for your time and wisdom, and thank Dr. Cindy Ziker and her team for distilling their research into this framework. We hope you find this report informative and useful.



A stylized, handwritten signature in black ink.

Dr. Jo Webber, FRSC, CChem

1. ManpowerGroup. (2022). ManpowerGroup Talent Shortage Study. <https://go.manpowergroup.com/talent-shortage>

2. Aerospace Industries Association, American Association for the Advancement of Science, American Chemical Society, American Geophysical Union, American Physical Society, Consortium of Social Science Associations, Council on Competitiveness, Federation of American Societies for Experimental Biology, Institute of Electrical and Electronics Engineers – USA, & Semiconductor Industry Association. (2020). STEM and the American Workforce | FTI Consulting. <https://www.fticonsulting.com/insights/reports/stem-american-workforce>

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Introduction

The past few years have brought unprecedented changes to workforce development in science, technology, engineering, and mathematics (STEM). Political issues, along with the COVID-19 pandemic and the Ukraine war, present challenges that have drastically altered the STEM landscape. This report seeks to illustrate the forces that are at play in this complex system by examining the STEM talent gaps and the factors that impact the current STEM workforce.

In developing this study, researchers conducted over 80 interviews with key informants representing K-12 education, postsecondary institutions, government agencies, and industry. These findings revealed insights and recommendations for implementing innovative and resilient initiatives that support a sustainable STEM workforce and informed the development of a conceptual framework (logic model) for measuring their impact.



Methodology

Research methods for this study utilized a four-stage process that included conducting over 80 semi-structured interviews with key informants, representing expertise from education, industry, government, and non-profit organizations. Using the PEST framework,¹ researchers at STEMconnector conducted an environmental scan of the STEM ecosystem that included an analysis of the political, economic, sociocultural, and technology (PEST) factors that impact workforce development within the STEM landscape.

This study investigated the following research questions:

- What are the gaps that need to be addressed in order to strengthen STEM workforce development?
- What are the factors that are impacting the current STEM landscape?
- What are the opportunities for advancing progress in STEM?
- What are the trends that are making a difference?



This research utilized a four-stage process:



Stage 1
Literature Review



Stage 2
Key Informant Interviews & Site Visits



Stage 3
Analyzing & Synthesizing Data



Stage 4
Communicating & Reporting Findings

Reviewed over



100
Citations

Conducted over



80
Interviews

Attended



8
Events

Conducted



7
Site Visits

Redefining the STEM Talent Gaps

In 2018, STEMconnector’s report entitled “State of STEM: Defining the Landscape to Determine High-Impact Pathways for the Future Workforce”² identified five STEM talent gaps that interact with each other across the STEM ecosystem, creating an overall opportunity gap for students, educators, employers, and job seekers. We leveraged this prior work to redefine these gaps in the context of current societal and workplace challenges, in order to address the research question: “What are the gaps that need to be addressed in order to strengthen STEM workforce development?”



Fundamental Skills Gap:

The mismatch between the skills that employers rely upon in their employees, and the skills that job seekers possess.



Belief Gap:

Negative beliefs that can hinder the ability of individuals to see themselves in STEM careers.



Postsecondary Gap:

Student enrollment and retention gaps in STEM degree programs and credentialing opportunities that result in fewer STEM graduates who are ready for the workforce.



Geographic Gap:

Lack of access to STEM jobs and training resources, due to proximity and interconnectivity.



Demographic Gap:

A lack of equitable representation of diverse talent in STEM, based on gender, race, and backgrounds (first generation).

STEM Talent Gaps

Fundamental Skills Gap

Transformations in the nature of work bring challenges to STEM employers who require a well-prepared workforce. The term “skills gap” describes a fundamental mismatch between the skills that employers rely upon in their employees, and the skills that job seekers possess. This mismatch can make it difficult for individuals to find jobs and for employers to find appropriately trained workers.³

COVID-19 has amplified gaps in academic preparedness in the basic skills that are necessary for success in STEM careers, such as mathematics skills. Recent data from the 2022 National Assessment of Educational Progress (NAEP) revealed national average score declines in mathematics for fourth- and eighth-graders that were the largest ever recorded in that subject.⁴

The figure below depicts the change in average scores between 2019 and 2022 in NAEP mathematics content areas.

Results from the 2019 & 2022 National Assessment of Educational Progress ⁵

Grade 4	Content area	2022 score	2019 score	Change
	Number properties and operations	239	243	↓5
	Measurement	235	239	↓5
	Geometry	230	234	↓4
	Data analysis, statistics, and probability	233	237	↓4
	Algebra	239	243	↓4
Grade 8	Content area	2022 score	2019 score	Change
	Number properties and operations	271	279	↓8
	Measurement	272	280	↓8
	Geometry	273	278	↓5
	Data analysis, statistics, and probability	269	279	↓10
	Algebra	281	289	↓8

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), various years, 1990–2022 Mathematics Assessments.⁵



Interviews with experts in academia, government agencies, non-profit organizations, and industry found that employers perceive gaps among potential employees in the following areas: communication skills, ability to work as a team, lab skills, digital skills, collaboration skills, and soft skills, such as dressing appropriately and showing up on time. Shortages in these skills makes hiring and retaining STEM workers a challenge.

The pandemic exacerbated the need for trained teachers with the skills to teach STEM subjects, such as computer science, engineering, and biotechnology, as well as the equipment and resources for hands-on instruction. The skills gap includes digital and soft skills,⁶ as well as technical and content knowledge deficiencies, employability skills, collaboration skills, leadership skills, and communication skills.

“Often in group work, students don’t want to work together. They think, “Well, what’s in it for me if I help this other person?” They don’t have epistemic empathy toward knowledge construction together, towards somebody else’s perspective. How do we create classroom cultures that inspire that communal feeling and bring it to the forefront?”

Dr. Zahra Hazari, Professor, Teaching and Learning;
STEM Transformation Institute
Florida International University

Belief Gap

The ‘belief gap’ is based on negative beliefs about an individual’s abilities in STEM, which can be held by students, parents, adult learners, educators, counselors, and employers in the STEM workforce. Research suggests that teachers’ and practitioners’ belief in students’ STEM abilities can influence students’ interests, as well as educational and professional pursuits, and can result in a lack of students and adult learners seeing themselves in STEM careers.⁷

Belief in one’s ability to perform a specific task is referred to as self-efficacy, defined as a judgment about one’s ability to organize and execute the courses of action necessary to attain a specific goal in a given domain.^{8,9,10} On average, individuals with high STEM self-efficacy perform better and persist longer in STEM disciplines relative to those lower in STEM self-efficacy.⁷

Masters and Meltzoff argue that sense of belonging plays a particularly important role in students’ STEM interest and academic outcomes.¹¹

Research indicates that students from under-represented groups in science fields may be especially likely to struggle with feeling that they are recognized by others as belonging to a field of science professionals.¹²

Factors that may negatively contribute to a sense of belonging include imposter syndrome, unconscious bias, discrimination, and stereotypes about STEM ability, culture, and identity.^{11,13} A lack of role models and mentors with compatible backgrounds and an unwelcoming environment in STEM fields may inhibit a sense of belonging and present barriers to developing a “STEM identity”.

Studies have shown that having a strong STEM identity is critical to pursuing a STEM career and is a significant factor in the lack of diversity in STEM fields.^{14,12,15,16}

Early exposure to role models in STEM careers can inspire interest in pursuing a STEM career pathway and contribute to the development of a STEM identity.

“As a minority student in the field, I was always someone interested or looking for scientists that were like me.”

Hailey Lenn Gordon, Executive Director
STEM Pathways Program Boston University

“Our underrepresented or marginalized populations should have the opportunity to have exposure and access, build confidence in STEM experiences, and become familiar with language and acumen as early as possible. As a result, they don’t come into STEM environments during their educational journey feeling like this is unfamiliar territory. They’re not saying, this journey wasn’t designed for me...it was designed for someone else. Based on those experiences and that inclusive journey, they can make the objective and empowered choice to say, I BELONG here.”

Errika Moore, Executive Director
STEM Funders Network



Postsecondary Gap

The COVID-19 pandemic resulted in decreased postsecondary enrollment rates, teacher shortages, and the need to overcome the social effects of isolation, which continue to pose a threat to STEM workforce development. Inflation and the cost of college have led to a distinct decline in postsecondary enrollment.

According to the National Student Clearinghouse Research Center's Spring 2022 report:¹⁷ total postsecondary enrollment fell to 16.2 million, marking a one-year decline of 4.1 percent or 685,000 students. A special analysis of spring freshmen in 2022 highlights distinctive pandemic-related enrollment trends. Nearly 340,000 students started college for the first time in the spring of 2022, an increase of 4.2 percent from spring 2021. However, the growth was not enough to return community college freshman enrollment to pre-pandemic levels, with the freshmen numbers still running 7.9 percent (17,000 students) below spring 2020's levels.¹⁷

Percent Change in Enrollment from Previous Years By Institutional Sector: 2018-2022

	Spring 2018	Spring 2019	Spring 2020	Spring 2021	Spring 2022
All Sectors	-1.3%	-1.7%	-0.5%	-3.5%	-4.1%
Public two-year	-2.0%	-3.4%	-2.3%	-9.5%	-7.8%
Public four-year	-0.2%	-0.9%	-0.6%	-0.6%	-3.4%
Private nonprofit four-year	-0.4%	3.2%	-0.7%	-0.8%	-1.7%
Private for-profit four-year	-6.8%	-19.7%	-1.9%	-1.5%	-0.2%

Retrieved from National Student Clearinghouse Research Center, (2022).
[Spr2022_CurrentTermEnrollment_Appendix.xlsx \(live.com\)](#) ¹⁷

Other challenges that contribute to the postsecondary gap include low or no salary increases for faculty, a need for faculty professional development, and a lack of industry-aligned curriculum. Though mentored internship opportunities have been found to successfully prepare students for the workforce, interviewees reported that companies are often unwilling to pay interns that may not matriculate into full-time employees. There is a high need for partnerships between universities and industry.

“Undergraduate research, especially in STEM, is really critical to both undergraduate success and also graduate success. Research experiences contextualize the learning from their classes, leading to a deeper understanding and preparing them for graduate work.”

Sundiata “Sunji” Jangha, Director of Pipeline Programs
 University of Maryland, Baltimore County

Collaboration between K-12, postsecondary, and industry are essential to a robust STEM ecosystem.

“I think the ecosystem needs to find creative solutions and equal partnership, it cannot be all on the institution's side, the student's responsibility, nor completely the industry member's effort. Each one of the groups in that triangle is trying to accomplish different outcomes based on their sector. At the same time, in the end, we want it all to come together to have a talented and effective workforce. Therefore, commitment from everyone to do an equal part in the partnership is really important to the desired result.”

Maria Reyes, New Product Introduction Program Manager
 Google Cloud

Geographic Gap



The geographic gap involves a lack of education and job training opportunities, as well as a lack of STEM jobs in areas proximal to the job seekers. Gaps in opportunities to learn (OTL) may be significantly impacted by shortages of highly qualified teachers and faculty, as well as a lack of industry partnerships with higher education institutions that can provide internships to prepare students for the STEM workforce.

According to Saw, & Agger,⁸ “For rural and small-town schools, being geographically remote may contribute to barriers and limited opportunities in terms of STEM-related teaching and learning.” Their research indicates that rural high school students had significantly fewer opportunities to take advanced math and science courses, compared with their suburban counterparts; rural students were about 20 percentage points less likely to have access to a calculus course on-site compared with their suburban peers (62.7% vs. 82.9%); and rural–suburban disparities in course offerings, favoring suburban students, were also observed in AP calculus (AB/BC), AP statistics, and advanced biology, chemistry, and physics courses.¹⁸

Teachers, especially those skilled in math and science, are a foundational school resource that play a key role in student outcomes.^{19,20} However, structural barriers to recruiting and retaining qualified teachers in remote areas persist, namely, the remote locations of schools and uncompetitive salaries.^{21,22}

Complications due to COVID-19 have amplified teacher shortages across the country. Researchers studying K-12 teachers in California found that while many teachers find their work rewarding, a majority said they felt exhausted and stressed, with burnout cited as the top reason for leaving the profession.²³ In rural districts, even one teacher leaving can have a significant impact on staffing and course offerings.²³

The geographic gap is also impacted by a lack of access to resources, including reliable internet service. The digital divide refers to the gap between demographics and regions that have access to modern information and communications technology and those that don’t.²⁴ Differential access to broadband between urban and rural communities poses a barrier to rural residents and Native American populations living on tribal lands.²⁵

“Many times, we think of diversity in terms of racial or socioeconomic, but urban versus rural is another way to look at diversity. Some urban schools have access to the internet, technology devices, and WiFi hotspots... but many rural communities may not have access to those technologies. Even if they have a device available, the connectivity is spotty or so unreliable they may be unable to connect and therefore, are not able to engage.”

Dr. Ronda Hamm, Global Academic Relations Leader
Corteva Agriscience

Demographic Gap

The demographic gap refers to a lack of equitable representation in STEM, based on gender, race, backgrounds (first generation), and other characteristics. Among scientists and engineers, more men than women were employed full-time in 2019 (13.3 million men versus 10.7 million women) and about twice as many women were employed part-time (3.0 million women versus 1.6 million men).²⁶ Women account for almost half of the total U.S. workforce, but as of 2019 accounted for only 27% of the STEM workforce.²⁷

Hispanic or Latino and Black or African American workers are underrepresented in STEM, with the greater discrepancy being among those with a bachelor's degree or higher than those without a bachelor's degree.²⁸ Black and Hispanic adults are less likely to earn degrees in STEM than other degree fields, and they continue to make up a lower share of STEM graduates relative to their share of the adult population, while women remain a small share of degree earners in fields like engineering and computer science and are significantly underrepresented in the workforce.²⁸ Hispanic or Latino workers make up 18% of the U.S. workforce but represent 14% of STEM workers. Similarly, Black or African American workers make up 12% of the U.S. working population but represent only 9% of STEM workers.²⁹

In 2018, among U.S. citizens and permanent residents, Whites earned 57.9% of bachelor's degrees in science and engineering fields and Asians earned 10.7%; Hispanic and Latino graduates were awarded 15.1% of science and engineering bachelor's degrees; Black or African Americans, 8.5%; and American Indian or Alaska Natives, 0.4%.²⁶



A review of literature and insights from interviewees found that, in addition to women and underrepresented minorities, untapped talent pools in STEM include people with disabilities (PWD) and LGBTQ+ individuals. Thurston et al.³⁰ reported that individuals with disabilities enter postsecondary education and enroll in science and engineering fields at about the same percentage in which they are represented in the general population, however, graduation rates and the number of PWD who go to graduate school and enter the science and engineering workforce are less representative of the population.³⁰

"It is very important that our students begin to see early on that the most diverse teams are the most impactful teams because there's no one way to solve any problem. We solve those problems by getting input from diverse sources."

Dr. Willie May, Vice President
Research and Economic Development
Morgan State University

Factors Impacting the STEM Workforce

The state of STEM is influenced by a constellation of elements that are instrumental in changing the dynamics of the STEM workforce. Using the PEST framework developed by Harvard Professor Francis Aguilar,¹ researchers at STEMconnector conducted an analysis of the political, economic, sociocultural, and technology factors that impact workforce development within the STEM ecosystem. Each factor is considered in relation to the STEM talent gaps previously defined.

Political Factors

Political factors with the potential to make revolutionary changes to the STEM landscape include recent historic federal investments in STEM education. The Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act will provide unprecedented funding for K-12 science, technology, engineering, and mathematics (STEM) networks that support education and career development for students and adult learners seeking training in STEM fields. It will support policy reforms, research, and data collection to identify and lower barriers facing women, minorities, and other groups underrepresented in science, technology, engineering, and mathematics (STEM) studies and research careers.³¹

According to the White House Briefing Room, The CHIPS and Science Act of 2022 will provide STEM opportunities to more Americans to participate in good-paying skilled jobs.³² To ensure more people from all backgrounds and all regions and communities around the country, especially people from marginalized, under-served, and under-resourced communities, can benefit from and participate in STEM education and training opportunities, the CHIPS and Science Act authorizes new and expanded investments in STEM education and training from K-12 to community college, undergraduate and graduate education.³²

With oversight from the National Science Foundation (NSF), The CHIPS and Science Act of 2022 will provide funding for PreK-12 STEM education, Rural STEM education research, and formal, hands-on learning opportunities.³³ STEM Learning Ecosystems will be eligible to apply for funding from the NSF for a new K-12 STEM grant program that supports scale up best practices in STEM through new NSF-funded centers.³³

Other legislation that is expected to have a powerful impact on the STEM workforce is the Infrastructure Investment and Jobs Act, which is intended to provide \$47.5 billion dollars to bring broadband across the United States and establish the Broadband Equity, Access, and Deployment Program, which will provide states with funds for broadband deployment and digital equity.³⁴



Economic Factors

COVID-19, unemployment, and inflation have disrupted the U.S. economy across sectors. Recent corporate layoffs and a lack of willingness to return to in-person work environments have resulted in economic stress across STEM sectors.

At the start of the pandemic, unemployment rates spiked between March and April of 2020 and remained high compared to their pre-pandemic levels; unemployment rates for those in the STEM labor force (16–75 years old) were well below those of the non-STEM labor force.³⁵ With businesses closed and many people socially distancing at home, STEM unemployment jumped from about 3% in March 2020 to 9% in April 2020—but for those in non-STEM occupations, unemployment shot up from about 5% to 16% during the same period.³⁶

According to the Bureau of Labor Statistics' Occupational Employment and Wages:³⁷

- There were nearly 9.3 million STEM jobs representing 6.6 percent of total U.S. employment
- The six largest STEM occupations were related to computers and included software developers (1.4 million) and computer user support specialists (654,310). The largest STEM occupations not related to computers were civil engineers (304,310) and industrial engineers (293,950).
- STEM occupations had an annual mean wage of \$100,900, compared with \$55,260 for non-STEM occupations. Ninety-two of the 105 STEM occupations had mean wages significantly above the all-occupations average of \$58,260.³⁷

Historic legislation was recently passed that invests in combating the negative forces impacting the economy, while targeting the climate crises. The Inflation Reduction Act of 2022 is designed to fight inflation, invest in domestic energy production and manufacturing, and reduce carbon emissions by roughly 40% by 2030.³⁸ The act's massive investments to fight the climate crisis will also help improve job quality in clean energy industries and incentivize the expansion of workforce training pathways into these jobs, which will help lift many people into the middle class.³⁹ It also incentivizes registered apprenticeships, which serve as a training and employment pathway into these high-quality jobs.³⁹

In September of 2022, President Biden signed The Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy.⁴⁰ This is intended to: increase the bioindustrial manufacturing workforce, secure national supply chains, and catalyze economic growth in bioindustrial manufacturing.⁴⁰



Sociocultural Factors

Sociocultural factors that are critical to training, recruiting, and retaining a resilient STEM workforce include awareness of STEM careers, work-based educational opportunities, and culturally inclusive workforce environments. Exposure to STEM careers through industry professionals offers students, teachers, and parents a chance to build their awareness of the types of jobs that are available across sectors.

“Exploring what could be done to help more students pursue great careers in STEM revealed the number one reason kids are not pursuing STEM and computer science careers is - they don’t know about them! This why career awareness is important.”

Sheila Boyington, CEO Thinking Media - Learning Blade,
National States Chair at Million Women Mentors

Employee volunteer programs that bring experts into the classroom help to expand students’ career horizons and inform teachers about the skills needed in the STEM workforce. Professional development through teacher externships in workplace settings helps to build teachers’ awareness of how to align curriculum to meet industry needs.

“We placed 41 teachers with 32 different industry partners across the state. As a part of their STEM externship, the participating teachers had to develop lesson plans based on the academic standard practices, for their students to show what we’re doing in our science class or math class directly relates to these jobs.”

Lawrence Cooper, STEM Program Manager
Alabama STEM Council

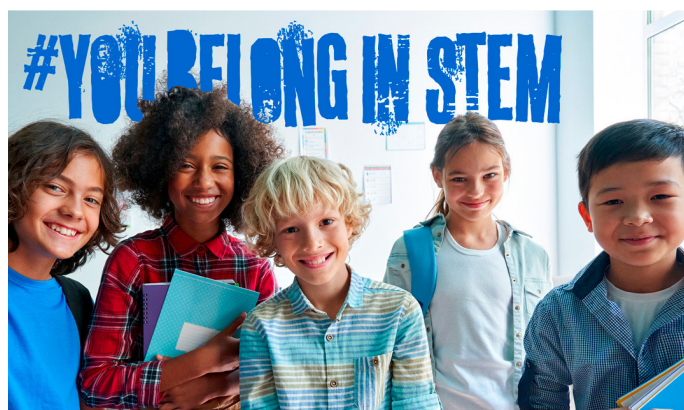
At the high school and college levels, there is a high demand for apprenticeships, internships, and mentoring, to cultivate career aptitudes, research skills, and lead to sustainable employment. Interviewees noted that mentorship is critical to career development

and emphasized the need for mentors who are trained in inclusive mentoring practices that foster a sense of belonging in STEM fields.

“There are now quite a few apprenticeship and internship programs for high school students, as well as similar opportunities for people who are enrolled in two-year colleges. Many laboratory positions at biotech and pharma companies do not require the person to have a Ph.D., Master’s Degree, or even a Bachelor’s Degree – there are all sorts of opportunities for younger people, or people making a career-change or re-entering the workforce later in life, to join the biomanufacturing workforce without a four-year degree”.

Dr. Joshua Finkelstein, Executive Director
Biological Design Center at Boston University

A new initiative from the U.S. Department of Education, called “YOU Belong in STEM”, is intended to address this issue. According to Deputy Secretary Marten, “We are also challenging narratives about who belongs in STEM learning and careers that, over generations, left out millions of girls and young women, students of color, students living in poverty, Native American and Alaska Native students, students with disabilities, and other marginalized students. Every student, no matter their background or zip code can meet and exceed their unique potential to learn and thrive in STEM education.” ⁴¹



Technological Factors

Technological factors that have influenced the STEM ecosystem include advancements in the use of artificial intelligence (AI), automation, and an increased demand for cybersecurity skilled workers.

Preparing the future workforce for STEM jobs that require training in artificial intelligence and automation is a priority for the manufacturing industry and companies that are developing autonomous vehicles. The global robotics market reached a value of \$33.2 billion in 2021.⁴² While it is predicted that in some fields, workers will be replaced by robots, there is a high need for skilled robotics technicians, engineers, and computer scientists who can manage and maintain an automated workplace.

AI tools are significantly influencing productivity in the workplace,⁴³ while transforming STEM education. In higher education, AI is being leveraged to improve aspects of learning using intelligent tutoring systems, virtual assistants, automated assessment, and adaptive course delivery, which experts predict will allow faculty to tailor courses to each student's progress, reduce their workload, and improve student engagement at scale in classes with high enrollment.⁴⁴

Cybersecurity is a rapidly growing field with a high demand for skilled workers. According to Cybersecurity Ventures, "The number of unfilled cybersecurity jobs worldwide grew 350% between 2013 and 2021, from 1 million to 3.5 million."⁴⁵ This need prompted companies like Microsoft, Google, IBM, Apple, and Amazon, along with Code.org, to commit to teaching cybersecurity concepts to K-12 students over the next three years, launch an instructional cybersecurity video series, and help provide job placement for 250,000 people in cybersecurity jobs by 2025.⁴⁵



Certification in technology courses are a popular resource for workforce development in a variety of STEM fields. Courses in digital literacy, as well as AI and data analytics, are essential for tech jobs that may or may not require a degree.

"The Microsoft Office certification portfolio is the most popular one that we offer because students use PowerPoint, Word, Outlook, and Excel every day and will continue using as they enter the job market. Both instructors and students see the value of earning these certifications. The other big certification program that resonates with instructors and students is our Fundamentals portfolio. This portfolio covers the basics of core Microsoft technologies and is a great place for students to start if they are exploring careers in technology. We have Azure Fundamentals, Data Fundamentals, AI Fundamentals, and Power Platform Fundamentals, which is especially interesting to what we call 'citizen developers.' Fundamentals is a good start to get people interested in technology and related careers."

Dr. Liberty Munson, *Director of Psychometrics*
Microsoft

Trends in STEM

An investigation of the current trends in STEM education and workforce development revealed an increased emphasis on hybrid learning, extended reality (XR) learning environments, and game-based learning.

Hybrid work environments that allow for an in-office work schedule, as well as remote working from anywhere, have become the preferred model for many workers. However, employee productivity and engagement are an ongoing concern for managers, who may be challenged by this approach.⁴⁶

In education, the Hyflex learning model is becoming the new normal. According to the National Education Association, “Hyflex learning is a modality of teaching that presents the components of hybrid or blended learning in a flexible course structure that gives students the option of attending sessions in the classroom, participating online, or doing both.”⁴⁷

XR technologies, such as virtual reality, augmented reality, and mixed reality are decreasing the time that it takes to become workforce ready. The affordances of XR learning environments include the low degree of risk associated with virtual training activities involving dangerous materials, cost savings due to decreased time in becoming workforce-ready, and the accessibility of virtual experiences from distant locations. Investments in XR labs that provide multimedia immersive experiences are becoming more common in higher education institutions.

“There have been discussions about the campus possibly being the site of special XR experiences, particularly for students who do not have the broadband required for connecting at home or do not have the optimal hardware, like a headset. The university would provide students with the capacity to access XR at a new level not available to them elsewhere that allows them access to other worlds and new learning experiences.”

John Stuart, Distinguished University Professor
Florida International University

Game-based learning is another trend that is shifting how training is delivered. According to Jennifer Javornik:

“Games are unique, in that we can create an identity for the learner in a game. Research shows that by asking a player to step into the role of someone else, they also kind of absorb that identity - (unique perspective), and it could build confidence in their ability to learn.”

Jennifer Javornik, Vice President
Partnerships and Business Development
Filament Games



Conceptual Framework for Enhancing the STEM Workforce

This examination of the state of STEM informed the development of a conceptual framework that illustrates the inputs, outputs, outcomes, and impact of implementing initiatives that support the STEM workforce. The **inputs** represent the stakeholders that are influenced through their engagement in STEM initiatives. The **outputs** are examples of activities that were reported by key informants to have the power to make a difference. The **outcomes** describe the desired end result. The **impact** is the degree of progress made toward the long-term goal that is expected to be achieved through the described efforts. Examples of initiatives that have the potential to move the needle in STEM workforce development are described on the following pages and in the appendix.

Overarching Goal: To increase the number of diverse, well-prepared students and employees in STEM careers.

Assumptions: Participation in STEM engagement activities will result in increased interest in, knowledge of, and pursuit of STEM careers.

Instruments to measure impact include: Surveys, interview & focus group protocols; micro-credential completion rates; hiring rates; transfer rates from community college to university STEM programs; graduation and retention rates in STEM fields; and hiring rates, & job promotion rates in STEM careers.

Inputs	Outputs	Outcomes	Impact
			
Students	Exposure to STEM Careers	Increased Awareness of STEM Careers	It is expected that exposure to STEM activities will result in increased student interest, awareness, and knowledge of STEM careers, resulting in a well-prepared STEM workforce that will meet the needs of the U.S. economy.
Teachers	Accessible Hybrid Learning	Highly Trained STEM Teachers	
Adult Learners	Industry-Aligned Professional Development	Inclusive STEM Working Environments	
Industry Partners	STEM Resources	Well-Prepared STEM Workforce	

Opportunities in STEM Workforce Development

Examples of K-12 STEM Education Programs



Corteva Grows

The Corteva Grows Science Outreach program supports projects and programs that aid in educational achievement and development, fueling a knowledgeable and diverse agricultural workforce in communities around the world.



Thinking Media - Learning Blade

Learning Blade was developed to provide an engaging and exciting way to introduce students to STEM careers through engaging missions. Learning Blade has found that this type of approach fosters interest and encourages students to pursue a STEM-related career path.



EiE, Museum of Science, Boston

EiE offers curricula, training, and materials needed to implement engineering and computer science. EiE builds a standards-aligned STEM foundation for the youngest learners, opening up exciting new career paths, and providing possibilities to middle-schoolers while implementing hands-on engineering across districts.

Examples of Postsecondary Education Programs



Tuskegee University - Ag Industries Study Tour

Tuskegee University Study Tour of Agricultural Industries enhances students' knowledge of agriculture industries, provides exposure to internships and career opportunities, and teaches about the skills and preparations needed to pursue said careers.



Florida International University STEM Transformation Institute

The FIU STEM Transformation Institute is a multidisciplinary collaboration promoting active learning and supporting more than 12,500 undergraduate STEM majors across FIU's colleges and schools. FIU's experts develop research-based education practices to prepare students for successful careers in STEM teaching or fields.



Dallas College - STEM Insitute

The STEM Institute was established to provide a transformative experience for scholars as they pursue their education with Dallas College, in preparation for university transfer and to fill a critical workforce need for prepared professionals in STEM fields. The Institute includes support for all areas of STEM.

Opportunities in STEM Workforce Development

Examples of STEM Competitions



iGEM

The iGEM Foundation is an independent, non-profit organization dedicated to the advancement of synthetic biology, education and competition, and the development of an open, collaborative, and cooperative community. Multidisciplinary student teams from all over the world compete for medals and awards by designing, building, and testing projects using cutting-edge synthetic biology.



FIRST Robotics

The FIRST Robotics Competition is the ultimate Sport for the Mind, combining the excitement of sport with the rigors of science and technology. Under strict rules and with limited time and resources, teams of students are challenged to raise funds, design a team “brand,” hone teamwork skills, and build and program industrial-size robots to play a difficult field game against like-minded competitors.



Thermo Fisher Scientific Junior Innovators Challenge

The Thermo Fisher Scientific Junior Innovators Challenge builds on the company’s longstanding commitment to widespread and equitable access to STEM education through skills-based colleague engagement and a focus on outreach and equity programs.

Examples of STEM Internships



Abbott - High School Internship Program

The Abbott High School STEM internship strives to harness the next generation of STEM leaders. Abbott targets students from diverse schools near areas where they operate, recruiting the best students for the job based on ability.



NASA Internship Programs

NASA offers internships for high school, postsecondary, and international students, as well as fellowships for graduate students.



Science Undergraduate Laboratory Internship at National Labs

The Science Undergraduate Laboratory Internships (SULI) program encourages undergraduate students and recent graduates to pursue STEM careers by providing research experiences at the Department of Energy (DOE) laboratories.

Conclusion

The state of the STEM workforce is evolving at an incredible speed, transforming the way workers prepare for jobs, as well as the way they experience employment in a post-COVID era. This report offers insights from the research literature, as well as experts from academia, government, non-profits, and industry, who have found ways to navigate through recent crises, in order to support the development of a sustainable STEM economy. What was revealed through interviews, presentations, and face-to-face events is that there is a strong commitment from the field to work collaboratively across sectors to improve access to opportunities in STEM careers. Harnessing the power of new technologies, innovative learning models, and inclusive work environments is likely to have positive repercussions among those engaging in the STEM ecosystem.



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Acknowledgments

STEMconnector is grateful to the many stakeholders who made this report possible. We appreciate the time and expertise of our interviewees, the generosity of our site visit partners, and the commitment of our membership to improving the STEM workforce. Many thanks for your contributions!

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Appendix: Resources

The following provides examples of STEM initiatives that are designed to improve STEM opportunities and have a positive impact on the STEM ecosystem. Links were retrieved as of December 2022.

K-12 Programs	Description	Link to Website
Tennessee STEM Innovation Network - STEM/STE(A)M Designation	Tennessee STEM and STE(A)M School Designation provides a roadmap for schools to successfully implement a STEM/ STE(A)M education plan at the local level. The tools and resources created define the attributes necessary for a school to create a comprehensive STEM/ STE(A)M learning environment for its students. All K–12 schools serving students in Tennessee are eligible.	https://www.tnstemdesignation.org/
Tennessee STEM Innovation Network - Classroom Opportunities	TSIN provides several opportunities for educators to engage their students through STEM. Each of these programs encourages critical thinking and problem solving skills to ignite a passion for STEM in the workforce of tomorrow. Opportunities include Statewide Design Challenge, STEM Classroom Grants, and Defined Learning	https://www.tsin.org/classroom-opportunities
Tennessee STEM Innovation Network - Elevate TN	Elevate TN seeks to create a pipeline of skilled workers in Tennessee. The statewide web portal is available for any educator that serves grades 8 - 12 in any subject area including CTE programs of study. This portal provides students with job-shadowing and internship experiences, career exploration, and resume-building activities developed around local employer needs. Students can earn industry-recognized badges for their resumes while building skills that will support CTE industry credentials.	https://www.tsin.org/elevateTN
Alabama STEM Council - STEM EXPLORERS	STEM EXPLORERS is an engaging and interactive 30-minute television episodes focusing on how science and technology is applied across Alabama. It highlights core concepts of STEM, based on curriculum content from the Alabama Math, Science, and Technology Initiatives (AMSTI), through experiments and demonstrations conducted by science educators from across the state.	https://stemcouncil.alabama.gov/stem-explorers/
National Science Foundation - Discovery Research PreK-12 (DRK-12)	The Discovery Research PreK-12 program (DRK-12) seeks to significantly enhance the learning and teaching of science, technology, engineering, mathematics and computer science (STEM) by preK-12 students and teachers, through research and development of STEM education innovations and approaches.	https://beta.nsf.gov/funding/opportunities/discovery-research-prek-12-drk-12
Micron Technologies - Chip Camp	For entering 8th and 9th graders, Micron Chip Camp provides an inside, hands-on look at how memory chips are made. Learn about the engineering process from Micron staff and college engineering students in camps held in-person and online every summer.	https://www.micron.com/gives/students/k12-student-resources/chip-camp
Micron Technologies - Girls in Tech	Girls Going Tech (GGTech) integrates interactive STEM activities with STEM careers. Women who work at Micron in STEM careers share information and answer questions about their journeys to their current jobs. STEM activities that offer insight into the engineering design process are guided by Micron employees.	https://www.micron.com/gives/students/k12-student-resources/girls-going-tech
Micron Technologies - Job Shadow	Micron offers virtual job shadow experiences for high school students in grades 11 and 12. Students spend a half-day learning about the semiconductor industry, interacting with employees in selected careers and finding out what it takes to pursue a career in the high-tech world of semiconductors.	https://www.micron.com/gives/students/k12-student-resources/job-shadow

Intel - Skills for Innovation	The Intel® Skills for Innovation (Intel® SFI) framework envisions a world in which students learn the skills necessary to traverse the shifting landscape of the Fourth Industrial Revolution. Here, they are empowered to be innovators as they prepare for, imagine, and create the jobs of the future.	https://www.intel.com/content/www/us/en/education/intel-education.html
NASA - High School Aerospace Scholars	Texas High School Aerospace Scholars is an authentic STEM learning experience for Texas high school juniors to engage with NASA's missions and become the next generation of explorers. HAS is a year-long commitment for Texas high school juniors which starts in the fall with a four-month online learning experience related to space exploration, Earth science, technology, and aeronautics.	https://www.nasa.gov/centers/johnson/stem/student-activities/index.html
USDA – National Institute of Food and Agriculture - Grants Promoting K-12 Education	These grants target teachers from primary grades to high school. They help educators give students a foundation in math and science relating to agriculture. Grants include: Ag In the Classroom; Secondary Education, Two-Year Postsecondary Education, and Agriculture in the K-12 Classroom Challenge Grants Program (SPECAs); and National Awards Program for Excellence in College and University Teaching in the Food and Agricultural Sciences	https://www.nifa.usda.gov/grants/programs/k-12-higher-education-programs
STEM Next Opportunity Fund - Million Girl Moonshot	The Million Girls Moonshot seeks to re-imagine who can engineer, who can build, who can make. It will inspire and prepare the next generation of innovators by engaging one million more girls in STEM learning opportunities through afterschool and summer programs over the next 5 years. The Moonshot will be active in out-of-school programs in all 50 states, leveraging the Mott-funded 50 State Afterschool Network, which has access to more than 10 million youth and 100,000 afterschool programs across the country.	https://milliongirlsmoonshot.org/
Corteva Agriscience - Corteva Grows	The Corteva Grows Science Outreach program supports projects and programs that aid in educational achievement and development, fueling a knowledgeable and diverse agricultural workforce in communities around the world.	https://www.corteva.com/our-impact/communities/corteva-grows-science-outreach.html
Northwestern Mutual - Quality Early Childhood Education	Quality education provides students the foundation to become future leaders, and research has shown that an education foundation is built strongest during the preschool years. Northwestern Mutual's investment in high-quality early childhood education, focuses on expanding options for residents in our three Milwaukee neighborhoods of Amani, Metcalfe Park, and Muskego Way.	https://northwesternmutual-foundation.com/education/
Thinking Media - Learning Blade	Learning Blade sends students on engaging missions that both interest and excite them. Within each mission you will find a wide variety of lessons, each one tied back to a career, tool or technology of a STEM related field. As they progress, students can earn points as they complete their lessons and practice their skills. This type of multi-sensual approach helps to foster interest and encourage students to pursue a STEM related career path.	https://learningblade.com/
STEM2Hub	STEM2 Hub seeks to assure that all student have the opportunity to engage in high quality experiences that will open doors to the future STEM2 careers. STEM2 Hub works to assure that all students have access to experiences in computer science, coding, high-quality mathematics instruction, and experiences that are problem-based and interdisciplinary in nature, such as those experienced by programming a robot.	https://stem2hub.org/stem2/

Arlington Independent School District	Arlington ISD offers two STEM labs at every elementary school, certified Career Tech courses are offered to all high school students, STEAM (science, technology, engineering, art, and math) starts in pre-k, and there are two NEW playgrounds at every elementary school campus. Furthermore, unique programs focus on world languages, fine arts, dual language, STEM, and leadership development starting in kindergarten, two early college high schools, four P-TECH options, and one STEM Academy allow students to earn up to 60 hours of FREE college credit beginning in ninth grade.	https://www.aisd.net/
EiE, Museum of Science, Boston	EiE offers curricula, training, and materials needed to implement engineering and computer science across schools or districts and to transform the teacher's role in the classroom. EiE can help by building a standards-aligned STEM foundation for the youngest learners, opening up exciting new career paths and possibilities to middle schoolers, implementing hands-on engineering across districts.	https://eie.org/
PAST Foundation - Linking Learning to Life	The PAST Student STEM Experiences team designs, tests and implements a variety of summer programs, after school programs, and community events. These programs and events engage students and link learning to life in a fun and unique manner in collaboration with professionals and community partners with real world issues. Throughout our programs participants are introduced and encouraged to apply skills that help make the transition from classroom to career seamless.	https://www.pastfoundation.org/student-experiences
Underwriters Laboratories- Xploralabs	UL Xploralabs is an educational platform designed to encourage students to "solve through science." Through interactive videos, instructional experiences, hands-on classroom activities, and creative classroom challenges, this free, STEM-focused experience builds scientific knowledge, passion, and commitment among students, teaches key concepts, makes it simple to implement hands-on exercises in the classroom, and shows students that by using scientific inquiry to ask why a phenomenon happens, that they can solve real problems and help create innovative solutions for a safer world.	https://ulxploralabs.org/
Val Verde Unified School District - Portrait of a Graduate	Val Verde Unified School District partnered with EdLeader21 to create Val Verde's Portrait of a Graduate as part of their commitment to Future Ready Students! The EdLeader21 Profile of a Graduate campaign seeks to energize communities of educators, students, and parents around a 21st-century definition of student success. The Portrait of a Graduate journey included collaborative conversations with all stakeholders including staff, students, and our community around the key attributes and characteristics our graduates will need to be College and Career Ready. As a district, Val Verde Unified School District is committed to supporting 21st Century learning for every student!	https://www.valverde.edu/district-office-99715fbe
National Renewable Energy Laboratory Education Center	The Energy Department's National Renewable Energy Laboratory (NREL) is home to world-renowned energy experts. NREL's Education Center offers a variety of program topics and experiences for student and adult groups addressing renewable energy and energy efficiency innovations and introducing the work of NREL to audiences.	https://www.nrel.gov/docs/fy15osti/62811.pdf
Amgen Foundation - Biotech Experience	Amgen Biotech Experience (ABE) is an innovative science education program that introduces students to the excitement of scientific discovery and builds bridges between school and the real-life biosciences. ABE prepares the next generation of scientists and innovators and provides access to cutting-edge science.	https://www.amgenbiotechexperience.com/get-involved

Illumina - DNA Day	Every year, Illumina celebrates DNA Day throughout the month of April. Together with schools, districts, and nonprofit partners, Illumina provides educational programs and activities for all grade levels.	https://www.illumina.com/company/about-us/corporate-social-responsibility/empower-communities/stem-education.html
Filament Games	Filament Games is an American educational video game developer based in Madison, Wisconsin. Filament Games is a design and production studio specializing in the creation of authentic gameplay mechanics that are also accurate representations of educational content. By actively embedding learning objectives within game activities, Filament's games help players transform their play experience into real-world knowledge.	https://www.filamentgames.com/
Stride Learning	Stride Learning has a mission to help learners of all ages reach their full potential through inspired teaching and personalized learning. Focused on PACT values, passion, accountability, courage, and trustworthiness.	https://www.stridelearning.com/
EducationWorks	EducationWorks is a nonprofit organization that provides academic support, career readiness, and enrichment programming throughout Greater Philadelphia. Focusing on topics like literacy, Science, Technology, Engineering, Art and Mathematics (STEAM), and social-emotional learning equips approximately 12,000 students annually with the tools needed to succeed in school and life.	https://educationworks.org/
Abbott - High School Internship Program	The Abbott High School STEM internship strives to harness the next generation of STEM leaders. Abbott started this program in part as passionate advocates for women joining STEM fields. Abbott targets students from diverse schools near areas where they operate, recruiting the best students for the job based on ability.	https://dam.abbott.com/en-us/homepage/international-womens-day/Abbott-STEM-Blueprint.pdf
Verizon - Innovative Learning	Verizon's Innovative Learning educational initiative is a transformative program that gives students the tools to succeed in the digital age. Verizon Innovative Learning is reimagining how students learn. We help bring your classroom to life with technology-based lesson plans & resources. Verizon Innovative Learning believes connectivity & technology can be available to all by providing resources to help both teachers and students thrive.	https://www.verizon.com/about/responsibility/digital-inclusion/verizon-innovative-learning
Utah STEM Action Center	The Utah STEM Action Center is a division of the Utah Department of Cultural & Community Engagement tasked with advancing STEM education best practices in Utah. It was created by a legislative directive in 2013 with a primary goal "to support teacher professional development and excite students with STEM opportunities by providing effective STEM education/digital learning tools to public K-12 classrooms." The center hopes to increase equity and access to all Utah students, including those in rural communities, while producing "a STEM-competitive workforce to ensure Utah's continued economic success in the global marketplace.	https://stem.utah.gov/
Microsoft - DigiGirlz	Microsoft offers girls* ages 11-18 opportunities to learn about careers in tech, connect with Microsoft employees, and participate in hands-on workshops. Programs include the DigiGirlz Hackathon, DigiGirlz High Tech Camp, and DigiGirlz Day.	https://www.microsoft.com/en-us/diversity/programs/digigirlz/default.aspx

Microsoft - Technology Education and Literacy in Schools	Technology Education and Learning Support (TEALS) is a Microsoft Philanthropies program that builds sustainable computer science programs in high schools. TEALS focuses on serving students excluded from learning CS because of race, gender, or geography. TEALS helps teachers learn to teach CS by pairing them with industry volunteers and proven curricula.	https://www.microsoft.com/en-us/teals
STEM Stars – Actuarial Scholars Program	The STEM Stars Actuarial Scholars Program identifies, recruits and supports skilled high school students interested in the field. We believe we can finally move the needle by providing help that starts in high school, extends into college and continues through a career. The new STEM Stars Actuarial Scholars Program offers high school seniors a scholarship of \$20,000 (\$5,000 annually for four years). Along with financial support, it includes mentoring, tutoring, immersion experiences and exposure to internships and job shadowing opportunities.	https://www.actuarialfoundation.org/scholarships/stem-stars/
NASA Internship Programs	NASA offers internships for high school, postsecondary, and international students, as well as Fellowships for graduate students.	https://intern.nasa.gov/
Department of Defense STEM Internships	DoD STEM has opportunities for students of all ages, educators, and professionals.	https://www.dodstem.us/participate/opportunities/?type=Internship+or+Apprenticeship
Department of Navy - Science and Engineering Apprenticeship Program (SEAP)	The Science and Engineering Apprenticeship Program (SEAP) provides an opportunity for high school students to participate in research at a Department of Navy (DoN) laboratory during the summer.	https://navalsteminterns.us/

Postsecondary Programs	Description	Link to Website
Army Educational Outreach Program - Undergraduate Apprenticeships	Undergraduate students have the unique opportunity to conduct real-world, U.S. Army-sponsored research alongside scientist and engineer mentors in world-class facilities at university labs or U.S. Army Research Laboratories and Centers.	https://www.usaeop.com/program/undergraduate-apprenticeships/
Department of Navy - Naval Research Enterprise Internship Program (NREIP)	The Naval Research Enterprise Internship Program (NREIP) provides an opportunity for college students to participate in research at a Department of Navy (DoN) laboratory during the summer.	https://navalsteminterns.us/
Department of Defense STEM Internships	DoD STEM has opportunities for students of all ages, educators, and professionals.	https://www.dodstem.us/participate/opportunities/?type=Internship+or+Apprenticeship
NASA Internship Programs	NASA offers internships for high school, postsecondary, and international students, as well as Fellowships for graduate students.	https://intern.nasa.gov/

Intel - Student Ambassador for oneAPI	The Intel Student Ambassador for oneAPI program is focused on undergraduate and graduate students who are passionate about technology and working with developer communities to promote learning, sharing, and collaboration. It provides opportunities for students to enhance their oneAPI skills, expand their network, and learn about the cutting-edge Intel® hardware and software products.	https://www.intel.com/content/www/us/en/developer/tools/oneapi/training/academic-program/student-ambassador.html
NASA - Minority University Research and Education Program (MUREP)	MUREP engages underrepresented populations through a wide variety of initiatives including multiyear grants, internships, fellowships, scholarships, and STEM activities.	https://www.nasa.gov/centers/johnson/stem/student-activities/index.html
University of California, Davis - STEM Strategies	By leveraging resources, driving program development, and encouraging collaboration the STEM Strategies Group is able to foster opportunities for prospective and current undergraduate and graduate students at UC Davis. Additionally the Group works regionally with partners to develop student pathway programs as well as increase the footprint of UC Davis as a premier STEM institution regionally and nationally through public partnerships.	https://stemstrategies.ucdavis.edu/
University of Maryland, Baltimore County - TRIO Upward Bound Math and Science Program	The University of Maryland, Baltimore County - TRIO Upward Bound Math and Science Program has a mission to prepare income-eligible students who aspire to be first-generation college graduates for academic programs that lead to STEM careers. Goals of the program are to instill confidence, engender self-esteem, increase motivation, encourage goal setting, facilitate goal-attainment, expand the intellect, promote acculturation, and broaden horizons.	https://ubms.umbc.edu/contact-us/vision-mission-and-goals/
Beba Foundation	Beba Innovation & Entrepreneurship Foundation creates passion, ignites enthusiasm and prepares mindsets of the innovative youth and female entrepreneurs by implementing continuous educational and training activities, mentorship and outreach programs. With a goal to assist innovative youth and aspiring women entrepreneurs to turn their ideas into applications, commercial products and/or services for global markets.	https://www.bebafoundation.org/
Tuskegee University - Ag Industries Study Tour	Tuskegee University's, Study Tour of Agricultural Industries, enhances students' knowledge of agriculture industries, provides exposure to internship and career opportunities, and learn about the skills and preparations needed to pursue said careers.	https://academic.oup.com/jas/article-abstract/94/suppl_1/64/4700412?redirectedFrom=fulltext
Dallas College - STEM Institute	The STEM Institute was established in 2009 to provide a transformative experience for scholars as they pursue their education with Dallas College, in preparation for university transfer and to fill a critical workforce need for prepared professionals in STEM fields. The Institute includes support for all areas of STEM, including computer science, construction, electronics, engineering, logistics, manufacturing, nanotechnology, renewable/sustainable energy and more.	https://www.dallascollege.edu/cd/schools/stem/institute/pages/default.aspx
Florida International University STEM Transformation Institute	The FIU STEM Transformation Institute is a multidisciplinary collaboration promoting active learning and supporting more than 12,500 undergraduate STEM majors across FIU's colleges and schools. FIU's experts develop research-based education practices to prepare students for successful careers in STEM teaching or fields. FIU's work makes the university a living laboratory for developing future STEM professionals, especially those from underrepresented groups.	https://stem.fiu.edu/

Science Undergraduate Laboratory Internship at National Labs	The Science Undergraduate Laboratory Internships (SULI) program encourages undergraduate students and recent graduates to pursue science, technology, engineering, and mathematics (STEM) careers by providing research experiences at the Department of Energy (DOE) laboratories. Selected students participate as interns appointed at one of 17 participating DOE laboratories/facilities. They perform research, under the guidance of laboratory staff scientists or engineers, on projects supporting the DOE mission.	https://science.osti.gov/wdts/suli
Florida International University Immersive Learning	The Immersive Learning in Extended Reality (ILXR) Lab is a multidisciplinary platform to explore the possibilities of student-designed immersive digital experiences that drive student success at FIU. Collaborating areas at the University include the Knight Foundation School of Computing and Information Sciences, the Division of Academic and Student Affairs, the Institute of Environment, and the College of Communication, Architecture + The Arts. Housed in FIU's Tech Station, the lab has been supported by a generous donation from HP.	https://ilxr.fiu.edu/
Micron - Data Science for Social Good	The Micron Data Science for Social Good program brings interdisciplinary teams of graduate students across the country together with in-house data scientists to tackle projects that can benefit society. The Advancing Curiosity Award, funded by the Micron Foundation, supports research institutions and nonprofits that are investigating how artificial intelligence, machine learning and deep learning will improve our lives while addressing ethical issues, security and privacy protocols. The funding provided financial support and stipends to eight Micron fellows and leadership from data scientists from the eScience Institute.	https://www.micron.com/gives/university-programs
University of Arkansas - Semiconductor Research Center	The Center for Manipulation of Atomic Ordering for Manufacturing Semiconductors at the University of Arkansas will be the first Energy Frontier Research Center in Arkansas. The four-year grant is part of the Energy Department's \$540 million in research funding to universities and national laboratories focused on clean energy technologies. The goal is to develop low-carbon manufacturing processes that will reduce greenhouse gas emissions, according to the university.	https://www.axios.com/local/nw-arkansas/2022/09/26/university-arkansas-semiconductor-research-center
Qualcomm - Semiconductor Mentorship Program	Qualcomm Semiconductor mentorship Program is a first-of-its-kind initiative for the semiconductor startups in India. The objective is to mentor semiconductor startups through their design phase towards commercialization. As part of the program, the startups get 1:1 mentorship from the Qualcomm senior leadership, masterclasses covering the semiconductor design topics, pitch clinic, IPR workshop, go-to-market, etc. Selected startups will be provided with industry and ecosystem connected with system integrators, potential customers, investors and VCs to further their business and sales prospects."	https://www.qualcomm.com/company/locations/india/design-in-india-program/qualcomm-semiconductor-mentorship-program
UC Davis - CUBES	The Center for the Utilization of Biological Engineering in Space (CUBES) will leverage partnerships between NASA, other federal agencies, industry, and academia to: 1. Support biomanufacturing for deep space exploration; 2. Advance the practicality of an integrated, multi-function, multi-organism biomanufacturing system on a Mars mission; and 3. Showcase a continuous and semiautonomous biomanufacturing of fuel, materials, pharmaceuticals, and food in Mars-like conditions.	https://cubes.space/

Bioscience Core Skills Institute	Bioscience Core Skills Institute provides workforce skills assessment and digital micro-credentialing that is valid, reliable, and trusted by the bioscience industry. Working with educational and industry partners, BCSI provides assessment opportunities and documentation of skills. BCSI knows that micro-credentials help people showcase and share skills with future employers. Get in touch to learn more.	https://www.coreskillsinstitute.com/
EducationWorks	EducationWorks is a nonprofit organization that provides academic support, career readiness, and enrichment programming throughout Greater Philadelphia. By focusing on topics like literacy, Science, Technology, Engineering, Art and Mathematics (STEAM), and social-emotional learning, equipping approximately 12,000 students annually with the tools needed to be successful in school and life. In the re-engage vertical, focusing on experiential, on-the-job training, shadowing and career exploration. EducationWorks creates Opportunities for Learning and Skills for Life.	https://educationworks.org/
Abbott - Development Programs	Abbott's rotational development programs are formally structured, two-to-three-year paid assignments designed to let recent college graduates explore new career opportunities and experiences based on specific functions or disciplines.	https://www.abbott.com/careers/students/development-programs.html
Tenneco - Garage Gurus	Garage Gurus eLearning online is a way for technicians to sharpen their skills, or pick up new ones. Designed as a convenient option for techs who cannot attend any of the Garage Gurus classroom training sessions, courses are available online 24 hours a day, seven days a week, so they can be accessed according to each tech's schedule and need. If a tech needs to sharpen his or her skills in preparation for an ASE-certification test, Garage Gurus has several courses that provide the relevant content for the test. Topics range from engine repair through transmissions, suspension and steering, brakes, and even electronics or heating and air conditioning.	https://www.tenneco.com/news/news-detail/2019/11/05/garage-gurus-expands-elearning-platform-for-technicians https://www.garagegurus.tech/
University of Central Missouri - Diversity to Go	Diversity to Go (D2GO) provides various educational opportunities for students, staff and faculty related to cultural awareness, brought and catered to their specific needs. Hosted by the Office of Student Activities, these programs, presentations, or referrals enhance further understanding of the multicultural nature of our campus community.	https://www.ucmo.edu/current-students/student-experience/office-of-student-activities/diversity-education/diversity-to-go/

Industry Resources	Description	Link to Website
STEM Next Opportunity Fund - The Family Engagement Project	The Family Engagement Project is a multi-year project leveraging research, convenings, publications and a national social media campaign. The ultimate goal is to empower families to support their children's engagement in STEM and to unleash the untapped talent of their children. The long-term success of this project will result in more parents understanding and communicating the promise of STEM to their children, and taking action to change their children's participation and persistence in STEM.	https://stemnext.org/engaging-families/

STEM Next Opportunity Fund - STEM Ready America	STEM Ready America is a compendium from 40 authors presenting bold and persuasive evidence—as well as real-world examples of effective practices, programs, and partnerships—on how science, technology, engineering and mathematics (STEM) knowledge and skills are preparing young people to be successful in school today and the workforce tomorrow.	http://stemreadyamerica.org/
Diversified Search Group	Diversified Search Group has led the shift to redefine success in executive search by building a more innovative and impactful business model. Diversified Search Group’s approach has earned the distinction, with recognition as a top-10 search firm and as the fastest-growing company in the executive search sector by Forbes magazine.	https://diversified-searchgroup.com/
Beba Foundation	Beba Innovation & Entrepreneurship Foundation creates passion, ignites enthusiasm and prepares mindsets of the innovative youth and female entrepreneurs by implementing continuous educational and training activities, mentorship and outreach programs. With a goal to assist innovative youth and aspiring women entrepreneurs to turn their ideas into applications, commercial products and/or services for global markets.	https://www.bebafoundation.org/
Abbott - Development Programs	Abbott’s rotational development programs are formally structured, two-to-three-year paid assignments designed to let recent college graduates explore new career opportunities and experiences based on specific functions or disciplines.	https://www.abbott.com/careers/students/development-programs.html
Northwestern Mutual - Women in Tech Conference	The conference is organized and hosted by the women in tech group at Northwestern Mutual. The conference is intended to deliver value for people of all backgrounds, experience levels, locations, and interests. The agenda is designed to support, motivate, and educate all who attend in their current position and in working toward future career aspirations.	https://news.northwesternmutual.com/2022-11-01-Uplift-and-Inspire-Northwestern-Mutual-to-Host-Third-Annual-Women-in-Tech-Conference
Diversity by Doing - Diversity, Equity, Inclusion, and Belonging Seminar Series	This series empowers and equips healthtech leaders to fully understand and then operationalize diversity, equity, inclusion and belonging — not only because it’s best for the company, but because it’s the right thing to do.	https://diversitybydoing.org/deib/
STEM Next Opportunity Fund - STEM Next Opportunities Fellows	The STEM Next Opportunity Fellowships provide opportunities for STEM Education experts to contribute their knowledge, skills and expertise to support Federal agencies to expand access to STEM education. STEM Next Opportunity Fellows experience first-hand working in a Federal agency to ensure that more students access great STEM learning in and out of school. Fellowships range from 1-4 years depending on agency needs and funding.	https://stemnext.org/fellows/

Grants and Funding	Description	Link to Website
Tennessee STEM Innovation Network - Classroom Opportunities	TSIN provides several opportunities for educators to engage their students through STEM. Each of these programs encourages critical thinking and problem solving skills to ignite a passion for STEM in the workforce of tomorrow. Opportunities include Statewide Design Challenge, STEM Classroom Grants, and Defined Learning.	https://www.tsin.org/classroom-opportunities
Tennessee STEM Innovation Network - Professional Development	TSIN provides several professional development opportunities to share best practices in STEM. Ranging from year long cohort programs to hands-on training sessions, TSIN is committed to connecting educators, sharing best practices, and promoting professional learning and growth. Opportunities include a Professional Development Grant, Innovative Leaders Institutes, TN Rural STEM Collaborative, CTE STEM New Teacher Training, and Professional Learning Series.	https://www.tsin.org/professional-development
NASA - Minority University Research and Education Program (MUREP)	MUREP engages underrepresented populations through a wide variety of initiatives including multiyear grants, internships, fellowships, scholarships, and STEM activities.	https://www.nasa.gov/centers/johnson/stem/student-activities/index.html
USDA – National Institute of Food and Agriculture - Grants Promoting K-12 Education	These grants target teachers from primary grades to high school. They help educators give students a foundation in math and science relating to agriculture. Grants include: Ag In the Classroom; Secondary Education, Two-Year Postsecondary Education, and Agriculture in the K-12 Classroom Challenge Grants Program (SPECA); and National Awards Program for Excellence in College and University Teaching in the Food and Agricultural Sciences.	https://www.nifa.usda.gov/grants/programs/k-12-higher-education-programs
USDA – National Institute of Food and Agriculture - Grants Promoting University Education	These grants allow faculty members to give their students the best education possible in agri-science. Grants include: Higher Education Challenge (HEC) Grants Program; Capacity Building Grants for Non-Land-Grant Colleges of Agriculture Program.	https://www.nifa.usda.gov/grants/programs/k-12-higher-education-programs
STEM Next Opportunity Fund - STEM Next Opportunities Fellows	The STEM Next Opportunity Fellowships provide opportunities for STEM Education experts to contribute their knowledge, skills and expertise to support Federal agencies to expand access to STEM education. STEM Next Opportunity Fellows experience first-hand working in a Federal agency to ensure that more students access great STEM learning in and out of school. Fellowships range from 1-4 years depending on agency needs and funding.	https://stemnext.org/fellows/
3M Foundation	3M Foundation forms lasting partnerships with communities worldwide and provides resources to help them succeed and grow—ensuring a more interconnected and thriving world. 3M Foundation enhances community vibrancy by improving standards of living, preparing youth for life-long success, increasing access to quality and diverse arts opportunities and contributing to global humanitarian relief efforts.	https://www.3m.com/3M/en_US/gives-us/

3M Gives	3M provides cash and product investments, along with the engagement of our people, to maximize our social impact. Our focus areas include supporting underrepresented and underserved individuals to advance in STEM and skilled trades and addressing environmental challenges such as climate change and the need for a circular economy. These challenges align to significant needs in our communities and allow 3M to leverage our core competencies for social good.	https://www.3m.com/3M/en_US/gives-us/
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Teacher Professional Development	Description	Link to Website
Department of Defense STEM Internships	DoD STEM has opportunities for students of all ages, educators, and professionals.	https://www.dodstem.us/participate/opportunities/?type=Internship+or+Apprenticeship
Army Educational Outreach Program - STEM Enrichment Activities	STEM Enrichment activities spark student interest in STEM from the earliest grades through high school. They also provide experiential learning opportunities for educators. These programs are great for students and teachers from all backgrounds and interests, and are designed to complement classroom learning and teaching by providing exciting, engaging, hands-on experiences.	https://www.usaeop.com/type/stem-enrichment-activities/
Tennessee STEM Innovation Network - Classroom Opportunities	“TSIN provides several opportunities for educators to engage their students through STEM. Each of these programs encourages critical thinking and problem solving skills to ignite a passion for STEM in the workforce of tomorrow. Opportunities include Statewide Design Challenge, STEM Classroom Grants, and Defined Learning”	https://www.tsin.org/classroom-opportunities
Tennessee STEM Innovation Network - Professional Development	TSIN provides several professional development opportunities to share best practices in STEM. Ranging from year long cohort programs to hands-on training sessions, TSIN is committed to connecting educators, sharing best practices, and promoting professional learning and growth. Opportunities include a Professional Development Grant, Innovative Leaders Institutes, TN Rural STEM Collaborative, CTE STEM New Teacher Training, and Professional Learning Series	https://www.tsin.org/professional-development
Tennessee STEM Innovation Network - STEM Workforce Fellowship	The STEM Workforce Fellowship seeks to equip Tennessee educators to develop future ready talent. SWF seeks to address the growing STEM skills gap in STEM industry sectors by engaging K-12 Tennessee educators in paid winter externships with local companies in STEM industries.	https://www.tsin.org/SWF
Alabama STEM Council - STEM Industry Externship Program	Provides educators with externship experiences in STEM-based public and private industries, deepening the connection between STEM workplaces and the classroom.	https://stemcouncil.alabama.gov/externship-program/

Microsoft - Learn for Educators Program	Microsoft Learn for Educators enables you to bring Microsoft Official Curriculum and the instructor-led training materials into your classroom to build your students' technical skills for the future. Eligible educators and faculty members at higher education institutions that offer accredited degree, diploma, certificate, or continuing or further education programs, such as colleges, universities, community colleges, polytechnics, and secondary schools with STEM focused curriculum, can access Microsoft ready-to-teach curriculum and teaching materials aligned to industry-recognized Microsoft Certifications.	https://learn.microsoft.com/en-us/training/educator-center/programs/msle/
Intel - Teach Elements	Intel® Teach helps K–12 teachers of all subjects engage students with digital learning, including digital content, Web 2.0, social networking, and online tools and resources. Intel Teach professional development empowers teachers to integrate technology effectively into their existing curriculum, focusing on their students' problem-solving, critical thinking, and collaboration, which are precisely the skills required in the high-tech, networked society in which we live.	https://www.intel.com/content/www/us/en/education/k12/teach-elements.html
"USDA – National Institute of Food and Agriculture - Grants Promoting University Education"	"These grants allow faculty members to give their students the best education possible in agri-science. Grants include: Higher Education Challenge (HEC) Grants Program; Capacity Building Grants for Non-Land-Grant Colleges of Agriculture Program"	https://www.nifa.usda.gov/grants/programs/k12-higher-education-programs
EducationProjects.org	EducationProjects.org was founded by two veteran teachers with a deep desire to inspire students. Working to drive industry workforce development while supporting teachers as they guide students' growth and career awareness. EducationProjects.org are teachers who love supporting teachers through industry partnerships.	educationprojects.org
Amgen Foundation - Biotech Experience	Amgen Biotech Experience (ABE) is an innovative science education program that introduces students to the excitement of scientific discovery and builds bridges between school and the real-life biosciences. ABE prepares the next generation of scientists and innovators and provides access to cutting-edge science through four key areas:	https://www.amgenbiotechexperience.com/get-involved
Association for Supervision and Curriculum Development (ASCD)	ASCD is a passionate community of life-changing educators. ASCD's community is empowered to be equity and instructional warriors who transform vision into practice. For 75 years ASCD has worked side by side with educators from every level in all 50 states and more than 200 countries to help them find their people and amplify their voice to reach many. ASCD's professional learning services let educators chart their own learning journey, as educators, as leaders, so they and their students can flourish.	https://www.ascd.org/
Infosys	The Pathfinders Institute is an intensive professional development experience for K-12 public school teachers in computer science and maker education. #InfyPathfinders pairs teachers from across the country with a diverse group of PDs for high-quality, hands-on training.	https://www.infosys.org/infosys-foundation-usa/pathfinders.html

STEM Ecosystems	Description	Link to Website
Battelle Memorial Institute - STEMX	The STEMx network was created on the premise that strength is based in numbers and diversity of thought. The network has grown into a multi-state national coalition that continues to advocate for STEM, amplifies “what works” in practice and grows a professional STEM community dedicated to the advancement of STEM education.	https://www.stemx.us/about
Tennessee STEM Innovation Network	TSIN supports the growth and quality of STEM education in Tennessee by: Connecting innovative schools, teachers, and administrators to one another and to national resources, Supporting schools and communities that want to create innovative schools and programs, Building community awareness and driving local school to industry partnerships	https://www.tsin.org/
Alabama STEM Council - STEM NEAR ME	STEM Near Me is a free resource and directory to help quickly find opportunities to engage in STEM events, projects, programs, and experiences, both in person and online, including: science projects, museum events, science festivals, out-of-school time programs, maker faires, public science policy forums, astronomy clubs, science cafes, and more.	https://stemcouncil.alabama.gov/stem-near-me/

Competitions	Description	Link to Website
Office of Science, U.S. Department of Energy - BioenergizeME Infographic Challenge	The U.S. Department of Energy’s (DOE) BioenergizeME Infographic Challenge is an engaging and fun way for students to use technology to learn about bioenergy in the classroom. In this activity, anyone can now explore one or more bioenergy research prompts and then communicate what they’ve learned in an infographic. BioenergizeME Infographic Challenge instructions, topic areas/prompts, print-ready tools, and activity ideas are provided.	https://www.energy.gov/eere/bioenergy/infographic-challenge
Office of Science, U.S. Department of Energy - National Science Bowl	The U.S. Department of Energy (DOE) National Science Bowl® is a nationwide academic competition that tests students’ knowledge in all areas of science and mathematics. Middle and high school student teams from diverse backgrounds are comprised of four students, one alternate, and a teacher who serves as an advisor and coach. These teams face-off in a fast-paced question-and-answer format, being tested on a range of science disciplines including biology, chemistry, Earth science, physics, energy, and math.	https://science.osti.gov/wdts/nsb
Office of Science, U.S. Department of Energy - Geothermal Design Challenge	Through the Geothermal Design Challenge™, the U.S. Department of Energy (DOE) Geothermal Technologies Office (GTO) inspires students to develop innovative solutions for geothermal energy application challenges. The competition also helps students develop career skills as they prepare to enter the clean energy workforce. Through engagement with students not traditionally involved with geothermal, GTO aims to raise awareness of geothermal resources to communities and the public, thereby broadening the geothermal stakeholder base.	https://www.energy.gov/eere/geothermal/geothermal-design-challenge

Micron - UV Robot Challenge	In light of COVID-19, Micron announced the UV Robot Design Challenge to address the growing need for reliable, low-cost ultraviolet-light robotic solutions that can help automate disinfection and potentially combat the spread of COVID-19 and other diseases. Micron's UV Robot Design Challenge is intended to produce innovative and highly cost-effective solutions that can have an impact against COVID-19 and other pathogen-borne diseases.	https://www.micron.com/About/Newsroom/Events/Micron-UV-Robot-Design-Challenge
FIRST® (For Inspiration and Recognition of Science and Technology) - Robotics Competition	The FIRST Robotics Competition is the ultimate Sport for the Mind, combining the excitement of sport with the rigors of science and technology. Under strict rules, limited time, and resources, teams of students are challenged to raise funds, design a team "brand," hone teamwork skills, and build and program industrial-size robots to play a difficult field game against like-minded competitors. Volunteer professional mentors lend their time and talents to guide each team.	https://www.firstinspires.org/robotics/frc
iGEM Competition	The iGEM Foundation is an independent, non-profit organization dedicated to the advancement of synthetic biology, education and competition, and the development of an open, collaborative, and cooperative community. Multidisciplinary student teams from all over the world compete for medals and awards by designing, building, and testing projects using cutting edge synthetic biology.	https://igem.org/
Thermo Fisher Scientific Junior Innovators Challenge	The Thermo Fisher Scientific Junior Innovators Challenge builds on the company's longstanding commitment to widespread and equitable access to STEM education through skills-based colleague engagement and a focus on outreach and equity programs—ensuring that students served, teachers reached and nominees converted to national competitors are more representative of the U.S. population.	https://www.societyforscience.org/press-release/2022-thermo-fisher-scientific-and-society-for-science-launch-junior-innovators-challenge/
Samsung - Solve for Tomorrow	Solve for Tomorrow is Samsung's global contest designed to boost interest and proficiency in Science, Technology, Engineering and Math (STEM), by challenging youth to demonstrate how STEM technological solutions can help improve their local community and impact their surroundings.	https://www.samsung.com/us/solvefortomorrow/