Roadmap to Results

A Framework for Selecting and Executing STEM Talent Solutions

STEMconnector

CONTENTS

About This Report

This report sets out to answer some of the practical questions around how employers can approach choosing and executing solutions to address the STEM talent crisis, both for their own talent needs and for society at large. This paper builds on two prior pieces, *State of STEM: Defining the Landscape to Determine High-Impact Pathways for the Future Workforce* and *Input to Impact: A Framework for Measuring Success Across the STEM Ecosystem*. Unlike those pieces, *Roadmap to Results* is written to be most applicable to an employer audience, though it has implications for how employers partner with others across sectors to implement solutions.

About STEMconnector

A research-driven professional services organization, STEMconnector provides corporate, postsecondary, K-12, nonprofit, and government members with enterprise-wide support to meaningfully develop, execute, and scale their STEM talent strategies across business functions and company-wide priorities. For more information on STEMconnector membership, please email info@stemconnector.com.

AUTHOR

Erin S. White

1 Introduction

Questions are an integral part of the scientific method, from the time children complete a simple experiment in their kitchens to the most cutting-edge research in an advanced laboratory.

These questions evolve over the course of an inquiry.

They start at the fundamentals -

How does it work?

Then move to the aspirational -

Can it work, better?

Then, finally, the questions get practical -

How can I make it happen?

The process of answering these questions is the source of innovation—and at times, frustration—for both the scientist and those who may benefit from his or her answers.

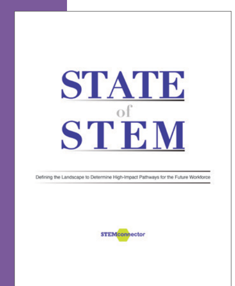
The pursuit of solutions to the STEM[1] talent crisis is no different. We continue to ask questions to understand the problem and pursue the solution. We assess our progress along the way. Then, we start the inquiry all over again. This process must be iterative because the demands of modern work continue to change at a breathtaking pace, and the next generations face new challenges in learning and working in STEM.

STEMconnector's research is focused on answering a range of questions—fundamental, aspirational, and practical—both for our members and the field. This paper sets out to answer some of the practical questions around how employers can approach selecting and executing solutions to the STEM talent crisis, both for their own needs and for society at large.

THE COMPLEXITY OF THE STEM TALENT CRISIS

Approaching solutions to the STEM talent crisis requires us to have a full and nuanced understanding of the fundamental, complex nature of the problem. Below is a summary of the fundamental questions and answers we need to embrace before turning to discussion of the solutions.

For further exploration of the fundamental questions around STEM talent, including the ecosystem, gaps, and more, see STEMconnector's *State of STEM* report.



What is the definition of STEM?

STEM is not simply a collection of disciplines.
While STEMconnector recognizes that STEM stands for "Science, Technology, Engineering, and Math," we seek to expand our understanding of the definition beyond the acronym to include the set of knowledge, skills, and mindsets that all students and workers need to succeed in both middle- and high-skill jobs in the modern economy.

Who influences STEM talent?

STEM talent outcomes at every stage of learning and working are influenced by an entire STEM talent ecosystem, which includes the set of systems, organizations, actors, and forces that shape the experience of those who interact with them. This ecosystem is illustrated in Figure 1.

An ecosystem encompasses those components as well as their connections to each other. This system is dynamic, reacting to forces outside as well as to changes inside.

At the center of this ecosystem are individuals. Those individuals are students learning STEM skills, undergraduates earning STEM degrees, and members of the STEM workforce from all ages and stages. They also include those who may yet enter into STEM pathways through education or work experience.

What is the gap in STEM talent?

There are five critical gaps in STEM talent that resonate across the entire ecosystem, cutting across sectors. The gaps produce an overall loss of opportunity for students, jobseekers, and employees, as well as lost opportunity for the companies seeking to hire talent, innovate their product sets, and grow their businesses.

These STEM talent gaps are representative of the complexity of the problem but are not mutually exclusive nor independent. As such, employers face challenges in hiring and retaining talent because of a confluence of the gaps rather than because of a single gap. Figure 2 summarizes these gaps.

FIGURE 1. THE STEM TALENT ECOSYSTEM

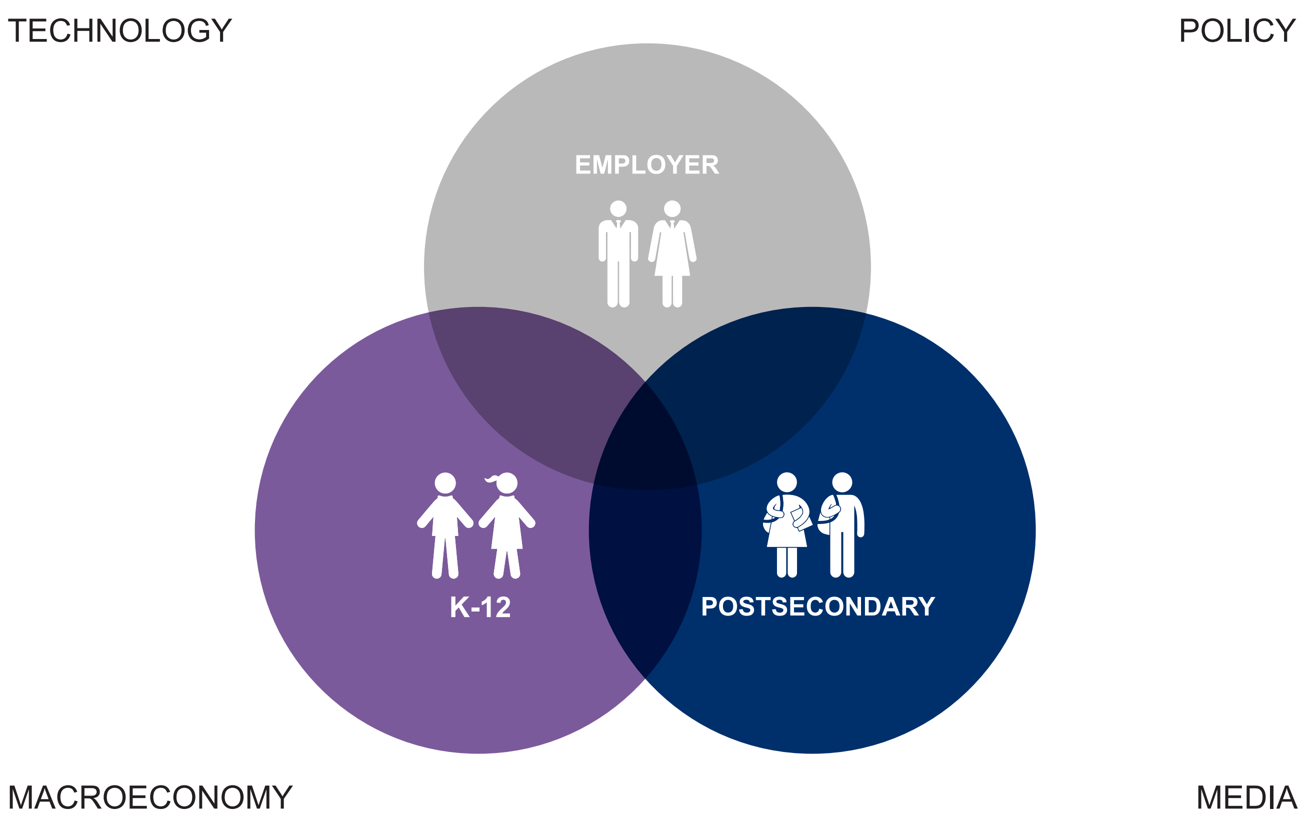


FIGURE 2. THE FIVE STEM TALENT GAPS

1. FUNDAMENTAL SKILLS GAP
- Average STEM competency is insufficient for modern work
- The new “STEM skills” (employability skills, 21st century skills) are hard to build in traditional education models
- Employers do not always clearly or appropriately define the skills they need

2. BELIEF GAP
- Students hold incorrect beliefs about their own STEM ability
- Students and others feel they do not “belong” in STEM
- Students believe only certain industries offer STEM jobs
- Employers hold incorrect beliefs about how academic performance and credentials relate to job success

3. POSTSECONDARY EDUCATION GAP
- Not enough people hold credentials beyond high school, but most STEM jobs require postsecondary credentials
- Credentials are misaligned with employer needs
- Jobseekers and employees face challenges engaging in lifelong learning

4. GEOGRAPHIC GAP
- In some regions, the number of jobs is declining, leaving people out of work and with outdated skillsets
- In some regions, there is a booming STEM economy, but companies must import talent as locals are not equipped to compete for those jobs

5. DEMOGRAPHIC GAP
- Lack of access to resources drives achievement gaps in STEM education from early years
- Bias and historic inequity remain embedded in education and employment systems

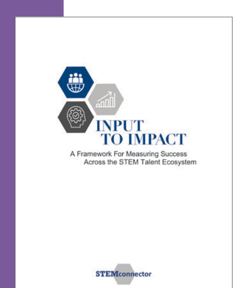
What does success look like?

The aspirational question, “What does success look like?” has many answers. STEMconnector’s definition of success for our collective STEM talent efforts acknowledges the systemic nature of STEM talent, as well as the integral role of diversity in achieving these goals.

Success is a diverse and STEM-ready talent pool with the knowledge, skills, and mindsets needed to secure and succeed in careers today and in the future.

An individual student, jobseeker, or employee in STEM cannot succeed in isolation. Systems—and the people within them—must be aligned, equipped, and focused in supporting STEM talent pathways.

For further exploration of the aspirational questions around STEM talent, including a definition for success, theory of change, and framework for decision-making, see STEMconnector’s *Input to Impact* report.



IMPLICATIONS FOR STEM TALENT SOLUTIONS

The complex nature of the STEM talent crisis demands we take a different approach to solving it than we would other types of challenges. This complexity has implications for:

The substance of the solutions.

- **There is more than one solution.** No one solution will close a single talent gap. Quite simply, we need many solutions across all ages and stages of STEM talent and across the ecosystem.
- **Solutions are required at the level of the individual and the system(s).** Some solutions, such as exposing a child to STEM career pathways, are targeted at the individual. Others, such as changing policies and practices that govern education, are systemic. Both are necessary to achieve overall success.

The timeframe over which solutions unfold.

- **We must work across multiple time horizons, simultaneously.** At any given moment, we must address the short-term needs to attract and retain students and employees to STEM pathways, while building a longer-term STEM-ready talent pool.
- **The process of solving must be iterative.** Solutions must adapt along with the dynamic nature of the STEM talent crisis. Our solutions must change as new technologies emerge, environments change, and the ecosystem shifts.

The people involved in enacting the solutions.

- **More than one actor, organization, or sector is responsible for solutions.** It takes an ecosystem to fuel the gaps. It will take the entire ecosystem to close those gaps, improving practices within each organization and working in closer coordination and alignment
across systems.
- **Learning and success will be shared, not isolated.** While a given organization can pursue a single solution, it is increasingly unlikely that the organization can isolate its impact. The problem is the result of many actors and forces, and so will be the solution.

Quite simply, the STEM talent crisis requires us to adopt a new approach to solutions that reflects our understanding of the fundamental complexity of the problem and embraces the aspirations for shared success.

2 An Employer's Approach to Solving for STEM Talent Complexity

Employers can adopt a familiar strategic approach to determining which STEM talent solutions to fund or employ: Identify challenges, define the desired return, determine capital available to deploy against that return, and choose an evidence-informed solution. What is different about this compared to other strategic decisions? Complexity, namely, a dynamic problem involving multiple actors, time horizons, and solutions. Below are the major elements of a strategic approach to selecting solutions that account for this complexity.

DEFINING RETURN

Employers should start with the end in mind. That is, employers must first determine the types of return they seek over multiple time horizons and stages of STEM talent pathways.

Figure 3 is a framework that employers can use when making decisions about where to invest in the STEM talent ecosystem. Ideally, an employer can chart investment and activity across the entire pipeline, including philanthropic, employee volunteering, and traditional talent lifecycle activity. Each activity has a different type of return on investment, and the desired return should be defined first before investing in a group of students and/or a program.

R = Short-Term Talent Needs

This "R" refers to the talent needed to fill roles realized within the year, or even the next quarter. Improving the return on short-term talent is about starting with early career or entry-level recruiting (regardless of the level of education required), developing that talent, and then improving retention of existing staff. While all employers have short-term needs, it is important to better refine those needs and narrow in on specific skillsets required. Programs in the K-12 years will generally not produce a short-term return, unless the company is interested in recent high school graduates as part of their hiring pool, or in developing apprenticeship programs.

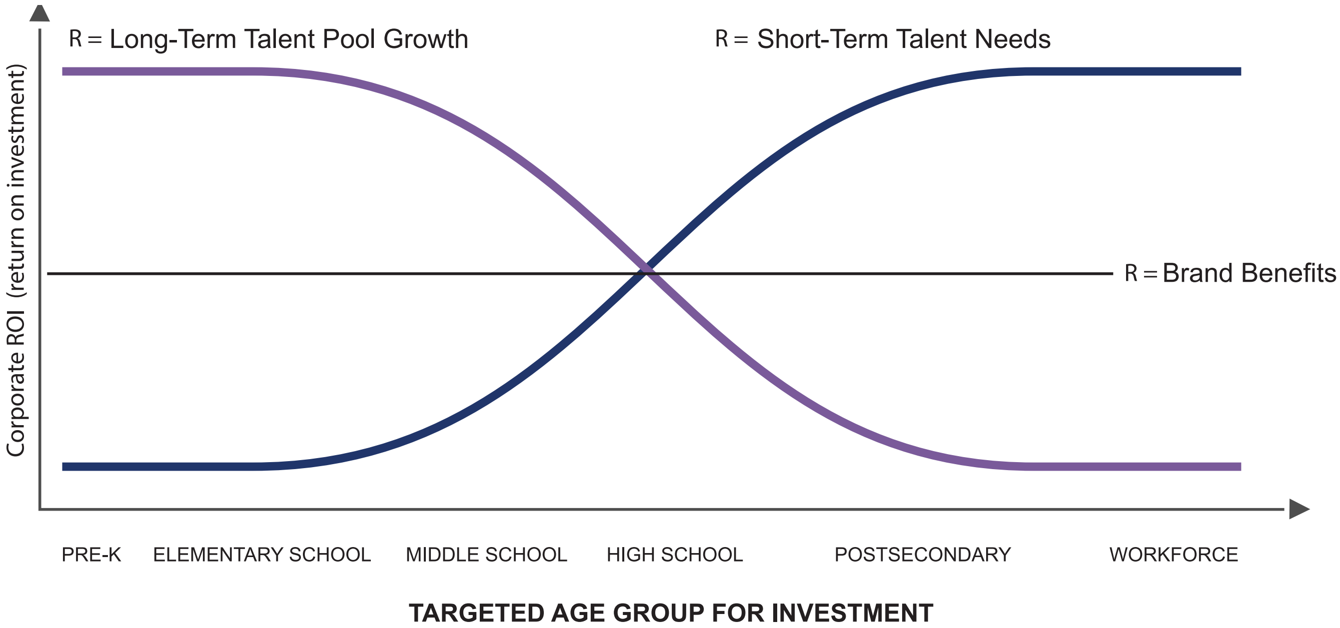
R = Long-Term Talent Pool Growth

This "R" refers to outcomes expected many years in the future, including a greater quantity, quality, and diversity of the future workforce. This potential future talent may or may not work for an employer who invests in them. Rather, the investment is in the overall STEM-readiness of the future workforce. A desired long-term return naturally invites focus on the K-12 years, and partnership with educational, nonprofit, philanthropic, and community organizations, as well as other businesses looking to make similar contributions. Corporate foundations and other purely philanthropic entities are well-positioned to focus on this type of return given their social impact imperative and often a long-term time horizon.

R = Brand Benefits

Regardless of how a company defines its talent-related return on STEM investments (short-term or long-term) it can receive positive corporate brand and strategic positioning benefits at any stage of STEM talent activity. Corporations may seek improved brand awareness and affinity among consumers or community members. Corporations may also seek community goodwill, including a community's willingness to welcome them as an employer for years to come. Additionally, many corporations seek to differentiate themselves as an employer of choice for diverse STEM talent. The nature of brand return differs by industry and company. For example, consumer product goods corporations may want to focus on activities that enhance the affinity among current or future consumers. Business to Business (B-to-B) companies find that their brand reputation in the marketplace is directly linked to their employment brand.

FIGURE 3. FRAMEWORK FOR DECISION MAKING ON STEM TALENT STRATEGY



Tip for maximizing impact: Engage in a cross-enterprise process of setting goals and defining return. This will ensure all desired return is captured, from both business and social impact perspectives, as well as short- and long-term time horizons.

DEPLOYING CAPITAL

Employers have a range of different types of capital available to deploy against STEM talent solutions to meet their desired return. Figure 4 below summarizes the types of capital available to employers. These categories of capital are not mutually exclusive, and the lines may blur. Taken together, they are a relatively exhaustive list of the resources employers have at their disposal.

FIGURE 4. CAPITAL AVAILABLE TO EMPLOYERS

Financial Capital

- Write checks to nonprofits or schools
- Donate in-kind
- Offer scholarships

Human Capital

- Mentor students
- Participate in career day
- Host field trips
- Teach classes

Intellectual Capital

- Create curriculum
- Advise on curriculum
- Share industry insights or labor needs

Programmatic Capital

- Internship
- Apprenticeship
- Externship
- Co-op Program
- Student challenge/ competition
- Fellowship
- Upskilling or reskilling
- Normal activity (e.g., campus recruiting)

Social or Political Capital

- Policy advocacy
- Join or launch cradle to career efforts
- Marketing campaigns

Often, we think about financial or human capital. But employers invest a tremendous amount of time, money, and energy in programmatic capital—the ongoing activity of attracting, recruiting, developing, and retaining talent. The "normal activity" of programming encompasses all the standard practices of the talent lifecycle. Figure 5 below includes guidance on deploying each type of capital.

FIGURE 5. FOCUS FOR CAPITAL

Type of Capital	Suggested Focus on:
Programmatic Capital	• Areas that connect the investment of time and resources to short term talent returns, such as postsecondary internships. • Areas where you can shape your own practices and control variables within your own business operations, such as employee development and retention.
Financial Capital	• Areas far from or outside of your core expertise as a business. • Areas where the direct infusion of philanthropic dollars contributes more to social impact than investments of time or programming.
Human Capital	• Areas where employees have passion and natural affinities, such as sharing career advice, direct STEM tutoring, or others. • Areas that enhance community visibility and brand benefit in geographies of importance to the company.
Intellectual Capital	• Areas where you can fill a unique role in shaping the skills of the future workforce based on your knowledge of industry needs. • Areas of natural partnerships with educators, particularly in geographies where employers anticipate long-term talent needs.
Social or Political Capital	• Areas that leverage your existing formal or informal relationships with community and policy leaders across sectors, such as cradle to career efforts and business coalitions. • Areas that enhance the overall environment, and forces that shape the STEM talent ecosystem, such as education policy.

Tip for maximizing impact: Work to bundle multiple types of capital for high-value and high-profile solutions, such as a scholarship program (financial capital) that includes mentoring (human capital) with an internship (programmatic capital).

CHOOSING AN EVIDENCE-INFORMED SOLUTION

There are many lengthy reports by leading researchers that outline various solutions to the STEM talent crisis. Summarizing those reports, and listing every potential solution therein, would take many more pages. This list of all possible solutions would not only be long, but also not particularly useful for employers. Why? Specific solutions depend on specific context, challenges, goals, expertise, partnerships, and interest. As stated previously, there is no single solution that will solve the challenges within the STEM talent crisis.

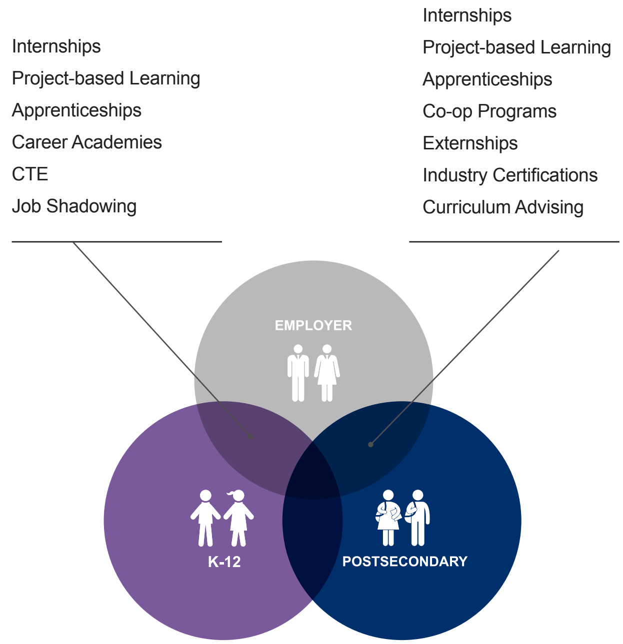
Every actor within the STEM talent ecosystem needs knowledge, skills, confidence, resources, access, and opportunity to enact the most positive impact on STEM talent outcomes. Those actors include a parent of a young child in STEM, a high school guidance counselor, an after-school STEM program leader, a math professor at a community college, a frontline hiring manager, or the chief technology officer of a multinational enterprise. The universe of solutions and those with the potential to enact them is, in a word, overwhelming.

Narrowing in on solutions available to employers, we find three overarching categories:

1. **Solutions that impact the business operations solely in your control**. This is the ongoing work of attracting, recruiting, hiring, developing, and retaining STEM talent. Within that category are solutions around assessing and changing credential requirements in job descriptions, formalizing mentorship and sponsorship programs for STEM talent, targeting different types of institutions for postsecondary recruiting, etc.

2. **Solutions that focus on the natural intersection between employers and other sectors**. Figure 6 below illustrates this approach. For example, employers can partner closely with local high schools to shape and offer internships. These solutions include your own business operations and require close partnerships with others. Leaning toward the partners' knowledge and expertise will be valuable here.

FIGURE 6. AREAS OF INTERSECTION



3. **Solutions that do not directly involve an employer but are an important part of building the future STEM workforce**. For example, research shows parents play a critical role in influencing STEM outcomes for their children, and that students who have access to after-school STEM programs are more interested in STEM than are other students.[2] Employers could fund programs that focus on those areas, and perhaps deploy human capital there in the form of volunteers.

> **Tip for maximizing impact:** Before choosing a solution, engage with trusted partners, community leaders, and even other employers/competitors in your field and region to better understand the needs of your focus communities and solutions already at work.

3 Executing STEM Talent Solutions for Greater Success

Many millions of dollars and countless hours of time have been invested in efforts to improve STEM outcomes from K-12 into the workforce. However, we have not seen significant progress at scale. Part of that disconnect is how the solutions are executed. It is not enough to do them—we must execute them with greater intentionality and alignment to best practice. Three considerations for employers are outlined below: (1) Dosage of intervention (2) Depth of outcomes vs. breadth of reach (3) Equity embedded at the center, not as an afterthought.

DOSAGE

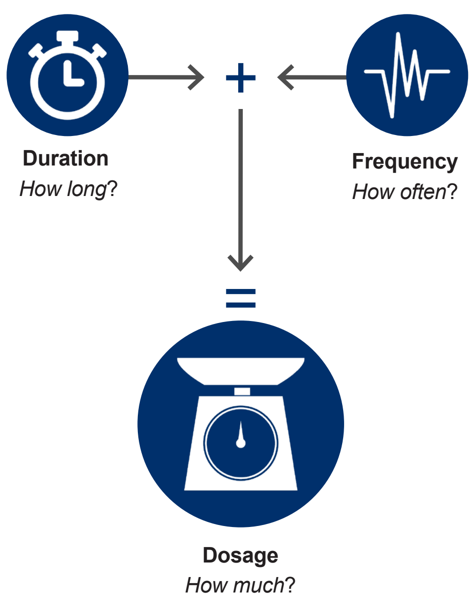
Public health literature has long revealed the importance of attending to the dosage or intensity of a given solution. Dosage is a combination of duration (how long) and frequency (how often).[3] Researchers studying STEM outcomes, particularly in education and learning in the K-12 years, have highlighted dosage as a consideration.[4] Higher dosage typically, although not always, yields greater impact. However, there is no "formula" that links the two.

Duration

Duration refers to either how long a specific solution lasts, or how long the end user is exposed to a related set of solutions. In general, longer duration yields greater impact. For example, a study of youth in after-school STEM programming found the largest increases in "STEM engagement, identity, career interest, career knowledge, relationships, critical thinking, and perseverance" after four weeks or more of STEM activities.[5] Other studies point to more positive outcomes for students after "greater longevity of experience with activities."[6]

Frequency

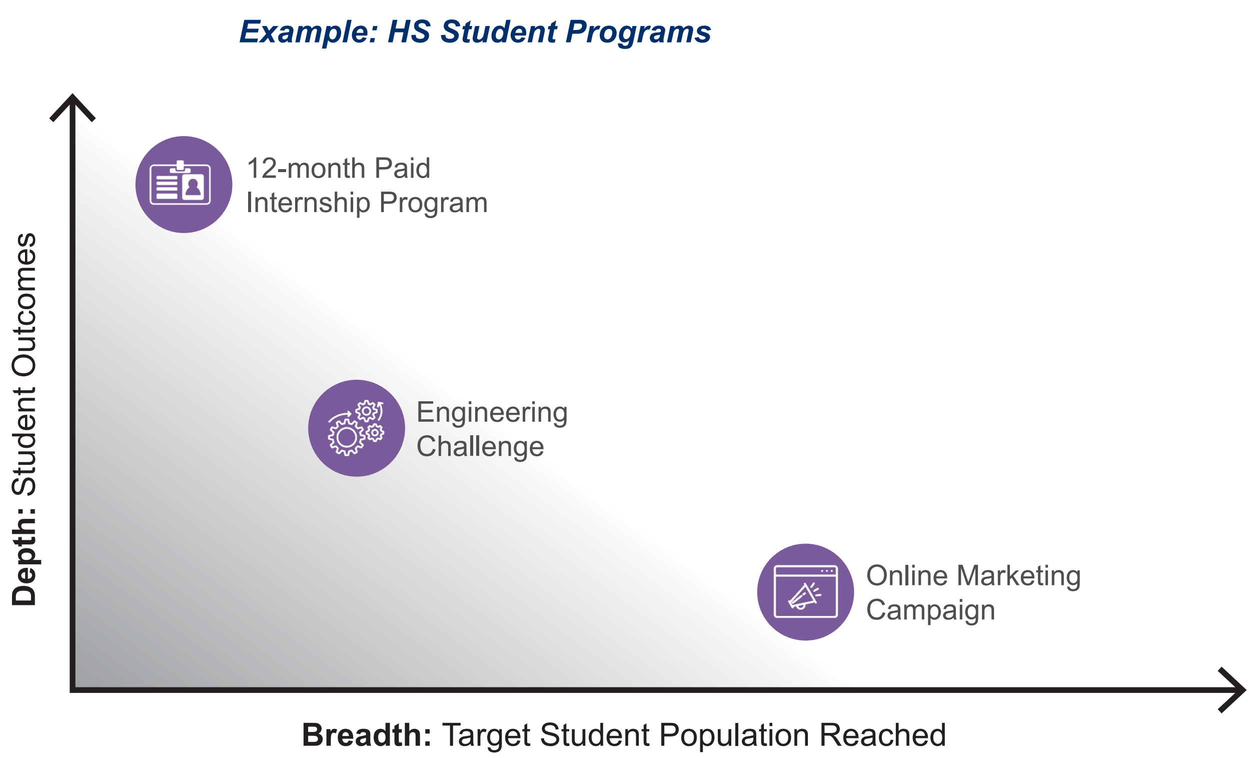
Learning and building knowledge, skills, mindsets, beliefs, and behaviors that shape STEM talent outcomes is a process. It happens over time, and over many repeated (frequent) instances of exposure and different types of experience for both young children and adult learners. For example, college students need exposure to math concepts more frequently over a given duration to develop mastery.[7]



DEPTH VS. BREADTH

Solutions can yield deep, lasting outcomes or reach many individuals, but usually cannot do both at once. Often, but not always, attaining positive outcomes requires greater resource investment, including investment in measuring those outcomes. This may come at the expense of reaching more individuals—students, workers, members of the community, etc.—with the solution. Employers taking a portfolio approach to their STEM talent solutions should balance solutions with deeper outcomes and those with broader reach. Figure 7 illustrates this trade off using programs that target high school students as an example.

FIGURE 7. DEPTH OF OUTCOMES VS. BREADTH OF REACH FRAMEWORK



EMBEDDED EQUITY

The challenges of racial, ethnic, gender, geographic, and other diversity within STEM fields are well documented. Without intentionality around equity and inclusion for all current and prospective STEM talent, we will never achieve our collective talent goals. Equity is not an extra solution, but rather a mindset, approach, and set of specific actions taken within each solution. Employers should assess barriers to awareness, access, participation, and success within each solution and address both on their own and with partners. The challenges facing women in STEM are related yet different from those facing individuals from racial and ethnic minority groups.

Some solutions are universal, such as creating a workplace free of discrimination and harassment. Others are more specific, such as paying student interns to promote participation of those from low-income backgrounds. While there is research around specific strategies to improve outcomes for diverse groups[8], many solutions simply require a willingness to both acknowledge barriers and change practices to overcome them. Nearly every solution available to employers can enhance diversity, equity, and inclusion of the STEM workforce—but only if an inclusive outcome is intentional and embedded.

4 Conclusion

Scientific inquiry requires asking questions, seeking the answers, learning from failures, and trying again. This is the same approach needed to solve for the complexity of the STEM talent crisis. We must continually ask questions to unpack the foundational nature of the problem, to set aspirational goals, and to tackle the practical implementation of solutions.

We will be more successful in answering those questions if we recognize the interconnected nature of the STEM talent ecosystem, and that credit cannot be easily isolated and awarded to any one member of that ecosystem. We must embrace the frustrating reality that there is no single solution to the challenges we face. Most of all we must be willing to call into question longstanding norms and approaches to achieving our shared goals of a robust, diverse, sustainable STEM workforce now and in the future.

5 Appendix

APPRECIATION

Special thanks to those STEMconnector members who have provided valuable thought partnership around how corporate employers approach STEM talent solutions, specifically:

- Abbott
- Cargill
- CME Group Foundation
- Ford (Next Gen Learning Communities)
- Micron Foundation
- Linde plc
- Lockheed Martin
- Smiths Group plc
- Walmart

METHODOLOGY

This paper builds on two years of research across disciplines, among the STEMconnector network, and in the broader STEM talent field.

Secondary research: Literature review across the fields of K-12 STEM education (in school, out of school, and in the home), postsecondary STEM pathways (two year, four year, other), diversity, equity, and inclusion in STEM across ages, and STEM workforce development.

Interviews: Themes from 200+ interviews over a two-year period on a variety of best practice solutions in STEM talent. Interviewees include leaders in corporations, nonprofits, government, foundations, K-12 school districts, postsecondary institutions, and academic researchers.

Pre-Release Attendees: The following is a list of all individuals who graciously gave their time in a research review session to test early hypotheses and shape this final report, in alphabetical order of their organization and then their last name.

Cora Buckner, Abbott

Chris Neitzey, Afterschool Alliance

Megan Ely, American Heart Association

Caroline Solazzo, American Heart Association

Crispin Taylor, American Society of Plant Biologists (ASPB)

Ingrid Ellerbe, Base 11

Demetha Sanders, Cargill

Cynthia Murphy-Ortega, Chevron

Kassie Davis, CME Group Foundation

Ronda Hamm, Corteva Agriscience

Randolph Guschl, Delaware Foundation for Science and Math Education (DFSME)

Kathy Renzetti, DiscoverE

Sarah Currid, Discovery Education

Sarah Fountain, Discovery Education

Deborah Santiago, Excelencia in Education

Ivana Jackson, Fund II Foundation

Dana Pawinski, Imagine Learning

Tameka Roebuck, JPMorgan Chase & Co.

Russell Heater, Linde plc

Kirsten Cordes, Lockheed Martin

Margaret Ardillo, Lockheed Martin

Rick Gilmore, NASA

Kerry Brenner, National Academies of Sciences (NASEM)

Amy Rivera, Noblis Inc.

Susan Everhart, Revature

Jay Flores, Rockwell Automation Inc

Jorge Pacheco, Smiths Group plc

Rachel Alper, Society for Science & the Public

Aditi Trehan, Tata Consultancy Services

Balaji Ganapathy, Tata Consultancy Services

Abby Daniels, TGR Foundation

Rick Singer, TGR Foundation

Aaron Mertz, The Aspen Institute

Casey Satell, The Franklin Institute

Dane Boyington, Thinking Media

Sunji Jangha, University of Maryland, Baltimore County (UMBC)

Deepa Shankar, Underwriters Laboratories

Beth Broome, University of California - Davis

Sarah Davis, Walmart

Jane Oates, WorkingNation

Gay Stewart, Center for Excellence in STEM Education, West Virginia University

REFERENCES

In this paper, “STEM” stands for Science, Technology, Engineering, Mathematics

[1]STEM Next Opportunity Fund. (2019). *Changing the Game in STEM With Family Engagement*. Retrieved from https://stemnext.org/changing-the-game-in-stem-with-family-engagement/.

[2]Krishnamurthi, A., Ballard, M., & Noam, G. (2014). *Examining the impact of afterschool STEM programs, A paper commissioned by the Noyce Foundation*. Retrieved from http://www.afterschoolalliance.org/ExaminingtheImpactofAfterschoolSTEMPrograms.pdf.

[3]Collie-Akers, V. L., Fawcett, S. B., & Schultz, J. A. (2013). Measuring progress of collaborative action in a community health effort. *Revista panamericana de salud publica = Pan American journal of public health*, 34(6), 422–428.

[4]Bohnert, A., Fredricks, J., and Randall, E. (2010). Capturing unique dimensions of youth organized activity involvement: Theoretical and methodological considerations. *Review of Educational Research, 80*(4), 576–610.

[5]Allen, P.J., Chang, R., Gorrall, B.K. et al. (2019) From quality to outcomes: a national study of afterschool STEM programming. *International Journal of STEM Education 6*, 37. https://doi.org/10.1186/s40594-019-0191-2.

[6]Roberts, T., Jackson, C., Mohr-Schroeder, M. J., Bush, S. B., Maiorca, C., Cavalcanti, M., Craig Schroeder, D., Delaney, A., Putnam, L., & Cremeans, C. (2018). Students’ perceptions of STEM learning after participating in a summer informal learning experience. *International Journal of STEM education, 5*(1), 35. https://doi.org/10.1186/s40594-018-0133-4.

[7]Duhon, G.J., Mesmer, E.M., Atkins, M.E. et al. (2009). Quantifying Intervention Intensity: A Systematic Approach to Evaluating Student Response to Increasing Intervention Frequency. J*ournal of Behavioral Education 18*, 101–118. https://doi.org/10.1007/s10864-009-9086-5.

[8]National Academies of Sciences, Engineering, and Medicine. (2019). *Minority Serving Institutions: America’s Underutilized Resource for Strengthening the STEM Workforce*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25257.

STEMconnector©

1200 New Hampshire Ave NW
Suite 820
Washington, DC 20036

stemconnector.com