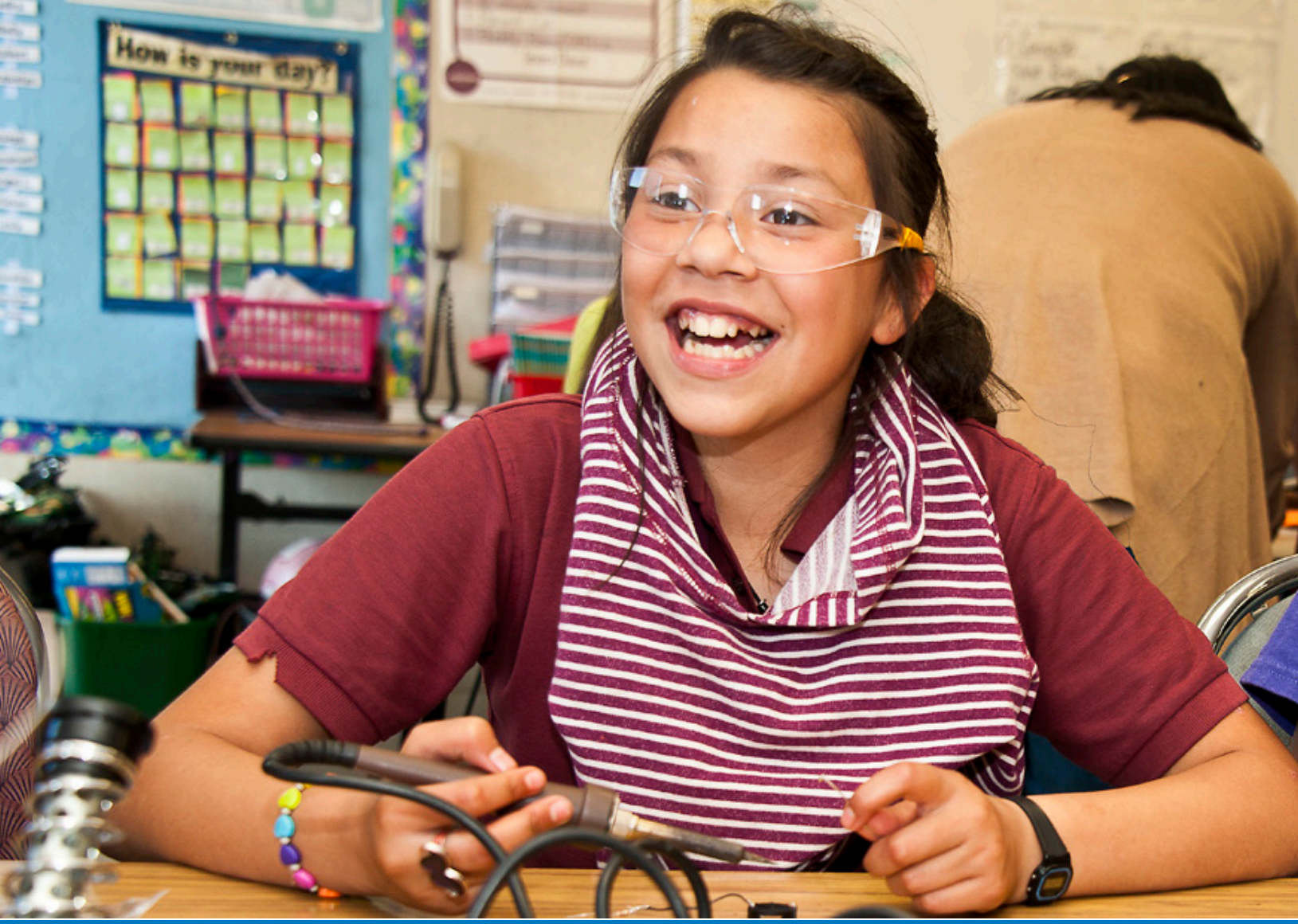

Changing The Game for Girls in STEM

Findings on High Impact Programs and System-Building Strategies

A WHITE PAPER ON BEST PRACTICES AND LEARNINGS FROM LEADERS IN THE FIELD

April 2016

techbridge

Inspire a girl to change the world

in partnership with Chevron

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Quick Facts

Diversity Numbers in the STEM Workforce

In 2014, women were:

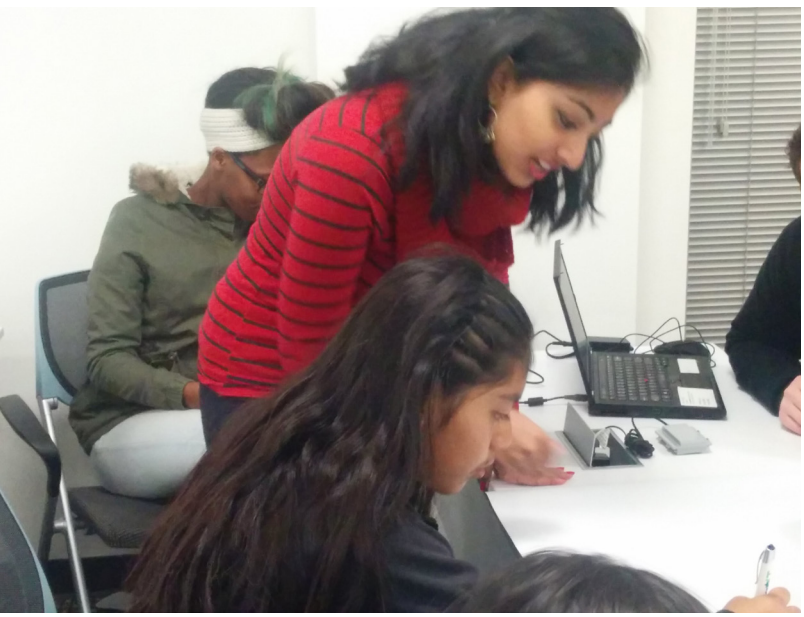
- 12% of the engineering workforce
- 26% of the computing workforce[8]

Within the 2014 computing workforce:

- 5% were Asian women
- 3% were African-American women
- 2% were Hispanic/Latina women[9]

U.S. workforce shortages:

- The U.S. expects 1.4 million computing-related job openings from 2010-2022.
- Only 32% of these jobs can be filled by U.S. computing graduates.[10]



Diversity Numbers in Education

Women earn only **18%** of bachelor's degrees awarded in engineering and computer science, and **19%** in physics.[5] Underrepresented minority women make up **16%** of the population, but only earn:

- **3%** of bachelor's degrees in engineering
- **5%** of bachelor's degrees in computer sciences
- **6%** of bachelor's degrees in physical sciences[6]

Percentage of computer science majors who are women is declining:

- **37%** in 1985
- **18%** in 2013[7]

Out-of-School Time STEM activities can make a difference.

STEM-focused organizations that work outside of school are uniquely positioned and effective at reducing STEM opportunity and achievement gaps.[11] By middle school, children from low-income communities typically have 6,000 fewer hours of enrichment activities compared with their middle-class peers. This means that by the first day of 6th grade, a girl attending a low-income school has likely never visited a science museum and has fewer resources for exposure to STEM experiences and instruction. Summer camps and after-school programs can open up opportunities that change the course of diverse girls' lives by complementing and addressing school day differences in girls' interests in STEM. Unfortunately, demand for out-of-school programs serving low-income African American and Latino families far exceeds available programming and program funding.[12] So although out-of-school time programs have the potential to help level the playing field and improve STEM workforce diversity, many girls do not have access to them.

Introduction

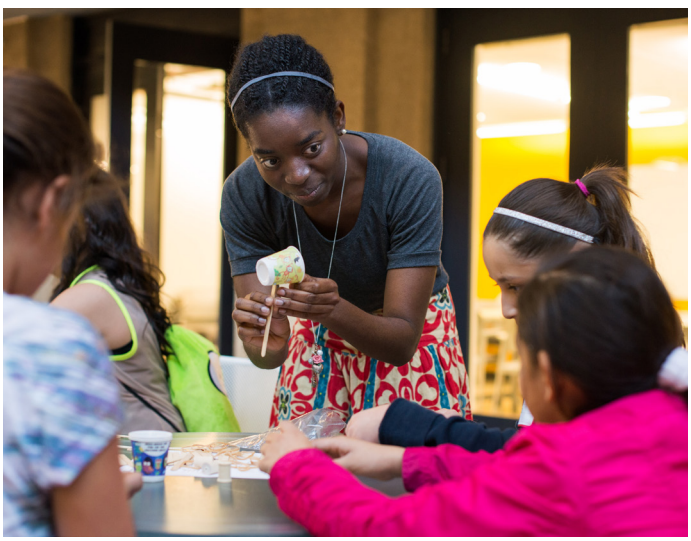
Diversity in STEM

The numbers are in and the gauntlet is down.

From Intel to Facebook, Google and Apple, technology companies are joining other science, technology, engineering, and mathematics (STEM) industry leaders in a grand challenge to diversify their workforce.[1] Finally, two sides of the diversity message can be heard simultaneously: expanding opportunities for women and girls is not just the right thing to do, investing in diversity is also a smart business opportunity.[2] To meet workforce supply demands, improve innovation, and ensure social equity, STEM professions need the imaginations and talents of girls and underrepresented communities of color. Diversifying the workforce is a win-win goal.

Diversity goals face reality.

Efforts by major players in STEM industries to report and ramp up their diversity and inclusion strategies are important. Yet industry efforts alone are not going to be enough to meet labor supply needs or to respond successfully to public accountability demands for labor force diversification. Nor can any single company, program or funding source solve the problem of recruiting, hiring, or retaining women in STEM.[3]



The solution?

STEM workforce issues will only be solved by diverse partners collaborating to create disruptive solutions that promote equity for all girls and underrepresented racial minorities. We must co-create solutions with girls that positively impact their communities. We must introduce girls to STEM when they are very young, nurture their STEM interests, and support them to sustain STEM-related efforts through college. We need organizations to work on different parts of a girl-centric STEM ecosystem; a sector-wide infusion of patient capital with a long-term view of social return on investment; more extensive family engagement efforts; and strong coordination to track, evaluate and communicate what's working. It's going to take a collective effort to engineer a STEM learning ecosystem that can capture the minds and hearts of girls and inspire them to pursue and persist in STEM studies and careers.

Here, we offer effective and promising strategies for promoting diverse girls' opportunities in STEM, leveling the playing field for girls and addressing workforce shortages. These strategies were identified by a research team led by Techbridge who reviewed a wide array of published materials, interviewed leaders of nationally recognized STEM initiatives, and drew upon lessons learned from Techbridge's 16 year history supporting girls in STEM.

Our strategies include applying a girl-centric and culturally responsive design process for recruiting and retaining girls in STEM, and strengthening the STEM ecosystem. Throughout the paper we also highlight exemplary practices of girl-serving organizations that are putting these strategies into action. These organizations represent the cutting edge of engineering a revolution for girls in STEM.

Strategy #1:
Design With Diverse Girls and Communities In Mind.

Human-centered design and design thinking are powerful methodologies for creating products. As creative approaches to innovation, they combine methods from engineering, business, design, social science and the arts. Human-centered design and design thinking are also often used to solve social problems. However, without modification of their traditional use, they are insufficient for solving the complex problems such as diversifying STEM fields.

Culturally responsive program design expands older design frameworks by including a broader lens, one that incorporates culture, contexts of structural inequity and histories of marginalization.[13] It also incorporates the multiple selves — the intersectionality — of an individual's identity, including gender, race, and class.[14] To promote equity and increase gender and racial diversity in STEM, the approach to designing solutions must be girl-centric and culturally responsive.

Understand Your End User.

A culturally responsive design process begins with the premise that there are no homogeneous, gender-neutral, non-racially specified end users of STEM programs. This means that if you are trying to design a program or intervention to bring more diverse girls into STEM, do be explicit that your end users are girls, racially diverse, and from underserved and under-recruited communities. However, don't assume that all girls are alike or that all girls of color are alike; there are best practices, but there is no one-size fits all approach to inspiring diverse girls in STEM. Girls' experiences are shaped not only by gender, but also by race, socioeconomic status, home language, and the broader cultural context in which they live.

Statistics can help us think about expanding the pool of girls from which we recruit. For example, nationally representative surveys show that the number of girls who say they are very interested in a STEM career remains less than 25%.[15] It turns out, though, that girls' self-reported lack of interest is often due to lack of exposure to STEM.[16] Girls from different communities experience vastly inequitable access and experience to STEM related educational activities both in and out of school.[17] In California, 75% of high schools with the highest numbers of low-income students offer no computer science courses.[18]

Not all girls have family members or community members in STEM careers. We need to describe our end users, in part, as the 75% of girls with less expressed interest in STEM and with fewer STEM-related opportunities. If we design recruiting solutions with these girls in mind, we should see STEM numbers shift.

Customize Girl-Centric Designs.

There have always been amazing girls who succeed in male-dominated STEM fields without programs designed specifically to encourage their success. There are also some exciting STEM programs that attract a large number of females without being intentionally designed to do so.[19] These successes are laudable. They are also outliers that represent a fraction of all girls and STEM programs. How can we expand on their success? The answer is not more of the same, pretending that traditional computer science or entry-level physics courses are gender-neutral. Girl-centric design incorporates key findings from years of research, evaluation, and program iteration about what works for a variety of girls—not just for girls who are readily drawn to pre-existing STEM culture.

Start Early.

If we want to increase the number of candidates available to meet workforce demands, we need to kindle girls' interest early and work hard to keep it. Attracting students into STEM fields is best started in elementary and middle school.[20] By high school, gender and racial gaps in STEM interest and exam scores are pronounced, with many girls no longer considering STEM careers.[21] Among underrepresented students, Latinas continue to express the least interest in STEM careers.[22] Moreover, even a high level of general interest in STEM among teenage girls is not necessarily translating into an interest in STEM careers.

Market for Impact.

Girls and underrepresented youth feel strongly about creating impact to serve their communities and the wider world.[23] This means that recruiting should focus on marketing the impact that girls can have through STEM first, with less focus on gadgets and technical toys. Making STEM real, contextual, and relevant to their everyday experiences can support girls' interest and success in STEM. Curriculum that hooks girls with real world scenarios provides context that allows them to see the value in the work and can make STEM more vibrant. Girls engaged in scientific research describe the ways in which struggling with the current problems in STEM makes learning come to life for them. In turn this understanding bolsters their academic interest and achievement in the field.[24]

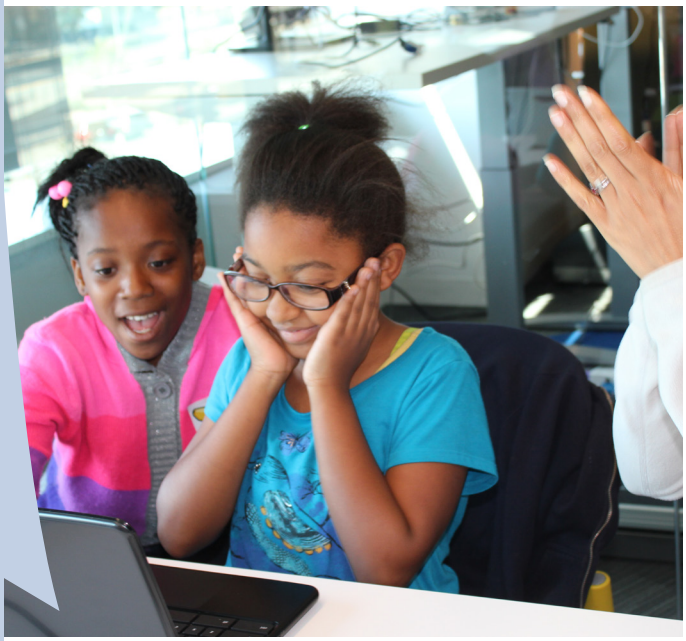
Safe spaces can foster supportive relationships and collaboration. Girls continue to have a confidence gap when they compare their own technical skills to their peers.

EXAMPLES OF DESIGNING FOR INCLUSION

Project Lead the Way

Project Lead the Way (PLTW) understands that early, positive exposure to STEM can play a critical role in recruiting and retaining girls and underrepresented minorities in STEM. Research shows students decide as early as second grade whether they are good at, and like, math and science. For these reasons, early exposure is critical to fighting stereotypes and engaging and inspiring all students -- and especially underrepresented minorities and young girls. As a result, they developed PLTW Launch, a program for kindergarten through fifth grade students.

PLTW Launch is intentionally designed to help girls and boys understand at a very young age that math and science are tools they can use to solve problems. In a second grade PLTW Launch module, for example, students are introduced to a gender-neutral design problem through a story in which female and male characters challenge the second graders to keep ice pops cold during a soccer game - without a cooler. Working in teams, students investigate and classify different kinds of materials by their observable properties. They also learn about states of matter and properties of materials, including insulators and conductors. Using their new knowledge and skills, they collaborate to determine the best material to solve the design problem and to evaluate how their designs might be improved. By solving problems and using their inherent curiosity and creativity, PLTW Launch engages young girls and helps them build a love of and confidence in STEM subjects.



Fab Lab

Fab Lab facilities vary in their designs, and some are thoughtfully set up in ways that look and feel inviting to a broad range of users. Amongst the more formal and typical lab equipment, there are often informal and inviting spaces that may include brightly colored couches, overstuffed chairs, coffee tables, and bookshelves. When placed near white boards, these spaces facilitate informal, collegial interactions for groups to generate design ideas together. The design of the space is important. Furniture that is less traditionally found in a lab can signal that the space is meant to feel more inviting, comfortable and relaxing, and can affect the learners that come to work there.

This may partially account for the far lower numbers of girls than boys who participate in high-profile, competitive STEM fairs. Safe spaces for girls new to STEM, or for girls who lack self-confidence, offer collaborative learning opportunities and opportunities to build trusting relationships. These safe spaces help empower girls to be able to brainstorm ideas and to fail in a first attempt at a design.[25]

In a well-designed girls-only space, opportunities for girls will be amplified. For example, in a girls-only space, girls are empowered to fill every role in an engineering design team. Observing, hypothesizing, creating, asking questions, and testing results are skills everyone needs for success in STEM. Girls new to STEM need environments where it's safe to hone these skills. Girls may not have experience leading their own work in this way—some sort of preparation and description of expectations may need to be negotiated before STEM investigations begin to ensure that all parties are comfortable with the problem-solving approach that is typical in the design process. Structuring interactions and creating supportive group norms that honor multiple perspectives and honest feedback helps girls learn to participate in an iterative design process that includes prototyping, testing, failure and redesign.

Design for Inclusion.

Inclusive environments will draw diverse girls in. Designing an inclusive environment may seem trivial when compared with designing technical content. However, what program designers may not realize is that objects in any given environment act as subtle social signals, providing clues about who belongs in that environment.

Tips for Designers:

- Think about what your work environment conveys about you.
- Ask yourself how a visitor would describe your work environment.
- Consider who might feel like an insider or an outsider in your work environment.

The same insider/outsider feelings translate into how girls new to STEM feel about the STEM learning environment and the people they encounter there. For girls who are just beginning to explore the world of STEM, the first STEM classrooms and people they encounter can be pivotal to drawing them in and making them feel like they belong. The opposite is also true: people and spaces can deter girls' interest. Both females and males express interest in computer science majors and classes that take place in work spaces with gender-neutral objects.[26] Gender-neutral objects in STEM spaces could include art or nature posters, water bottles, non-technical magazines, or plants. Females (but not males) are less interested in computer science when the learning environment includes stereotypical STEM objects, such as Star Trek posters, video game boxes, computer parts and electronics. Even though these stereotypical items may seem harmless, they evoke a masculine stereotype that makes females (but not males) feel like they don't belong in that environment—even if everyone else working in that environment is female!

Consider Community Assets and Constraints.

STEM program designers who are culturally responsive intentionally design recruiting, curricular and retention efforts to build on the assets of diverse communities. They also strive to understand constraints, such as the structural inequalities faced by communities.

Practice Cultural Humility.

Designers who are not from the communities they are designing for can't presume to know what girls from these communities want and need. In addition to reviewing best practices and current literature, designers must listen to voices from the communities they are serving in order to learn more about how to build better programs. Methods for listening range from community-based observations, to interviews and focus groups.

Similarly, just because a company is an industry leader, it shouldn't expect to know how to spark and maintain diverse girls' interests in related STEM careers. Instead, industry can partner with programs that are already embedded in and trusted by diverse communities. Let existing programs broker relationships in communities and advise on program design.

EXAMPLES OF DESIGNING FOR CULTURALLY RESPONSIVE IMPACT

GET City

Green Energy Technologies in the City (GET City) is a community-school-business partnership that supports youth to investigate issues in green energy that are important in local communities and the broader world. Through the practices of defining problems and designing solutions, girls ask questions about whose knowledge counts, whose voices belong in defining the problem space, and who should have a stake in constraining the problem. Multiple perspectives -- including scientific, technological, community and cultural -- are incorporated as a part of these practices.

One GET City engineering design challenge unit focused on safety in the community. Girls designed and administered surveys, and analyzed data from a wide range of community stakeholders in order to gather input on safety concerns within their community. One group designed a light up, heated jacket to help them stay safe and warm as they commute in the darkness of winter to school in Michigan. Another group, after looking at rape statistics for their community, created a design solution for a rape alarm jacket.

Technovation

Technovation, a program of Iridescent, works to inspire and educate girls and women to solve real-world problems through technology. Their approach prioritizes girl-generated content and the usability of technology solutions in girls' own communities. Girls work in teams to develop mobile apps to solve problems in their communities. An example app created in 2015 by a team of U.S. high school girls is AMEKA, which tests for impaired driving. The girls' app scores users' responses to a variety of tests to determine if it is safe to drive. The app has built in text messages to be sent to pre-identified support contacts (parents, friend, etc.) in the event that the user is deemed unfit to drive.

Safe, trusted learning environments for diverse communities take time to develop and sustain.[27] Be aware of and honor cultural differences, including different prior experience with tools, STEM jargon, and access to technology. Unfamiliar STEM terms that come up in curricula or with role models may unintentionally signal to girls that they don't belong in STEM.[28] It's especially important to provide dual language learners with scaffolded opportunities to hear and use technical terminology in ways that support conceptual understanding.[29] Role models, for instance, should try out descriptions of their careers on non-technical audiences from a variety of age groups to decide what terms to share with youth and how to present them clearly.

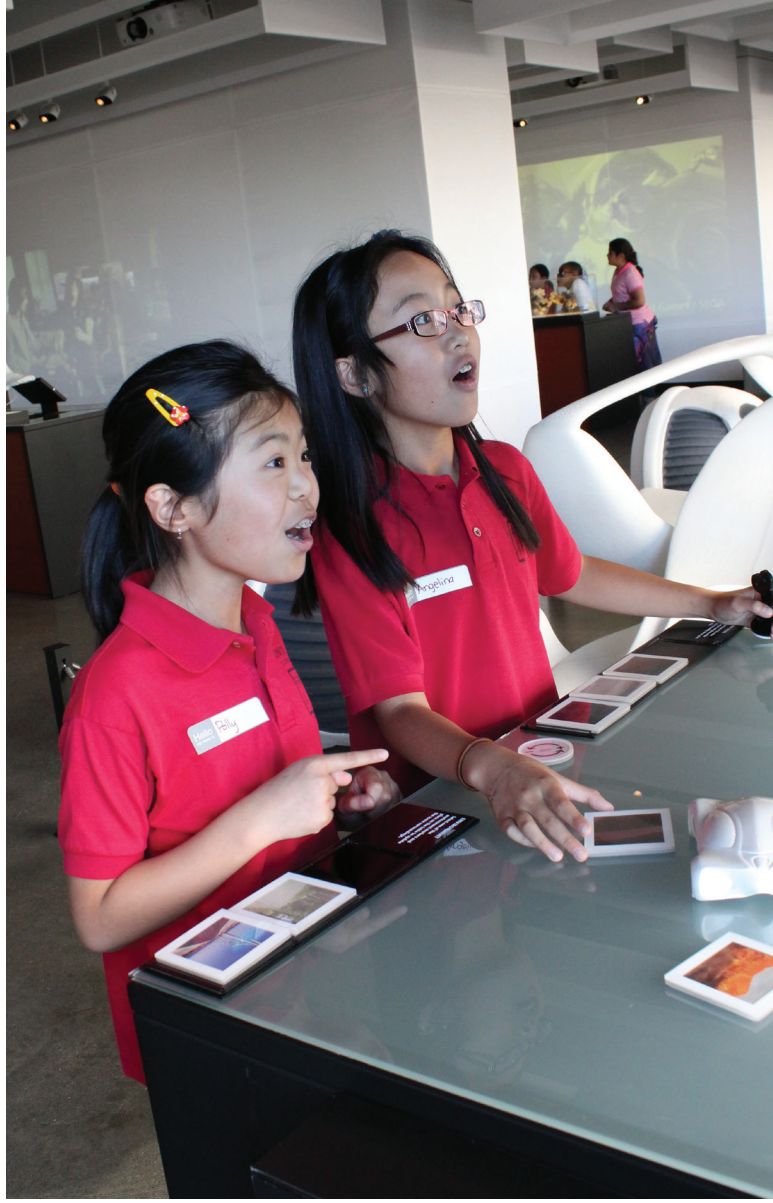
Ask Lots of Questions.

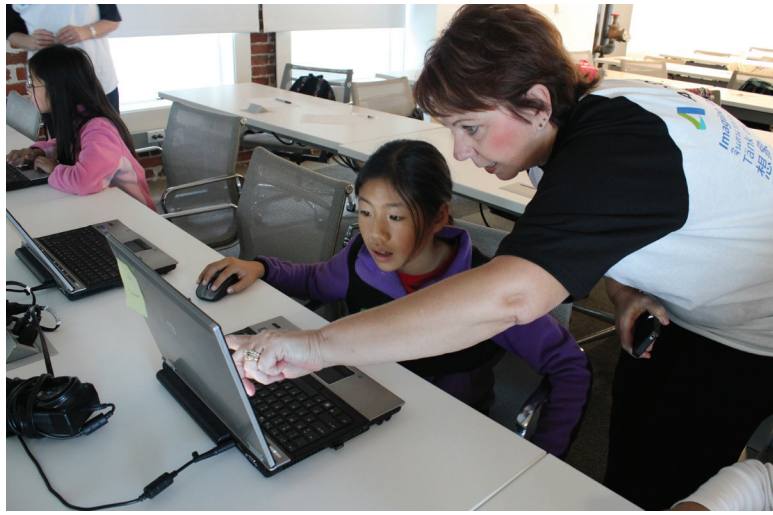
How do you know if a space feels safe and empowering for girls? How do you know if your curriculum is keeping up with girls' interests and challenging them enough but not too much? How do we know what barriers families face in accessing STEM opportunities? Don't wait for end-of-year surveys to understand what girls and parents think of your STEM program. Ask girls and their families at regular intervals about what is working and why. This allows for rapid-cycle program revision and refinement.

Culturally responsive design requires that programs test any assumptions with actual users or beneficiaries and iterate.

More Tips for Designers:

- Tap into girls' reactions on a regular basis through observations, reflections, and embedded assessments. Ask girls to keep video diaries of their experiences and have educators review them regularly. Have girls interview each other about their projects and teach them to use rubrics to assess their own learning.
- Host family nights and community-based focus groups where you can hear about the experiences of people using your services.
- These types of culturally responsive user-experience research ultimately benefits girls and communities by helping designers use real-time data to refine and optimize STEM-focused initiatives.





Girl Game Company

In ETR's Diversity in STEM work, they use pair programming as a tool for creating safe spaces that foster supportive relationships and collaboration while teaching information technology (IT) to middle school girls.

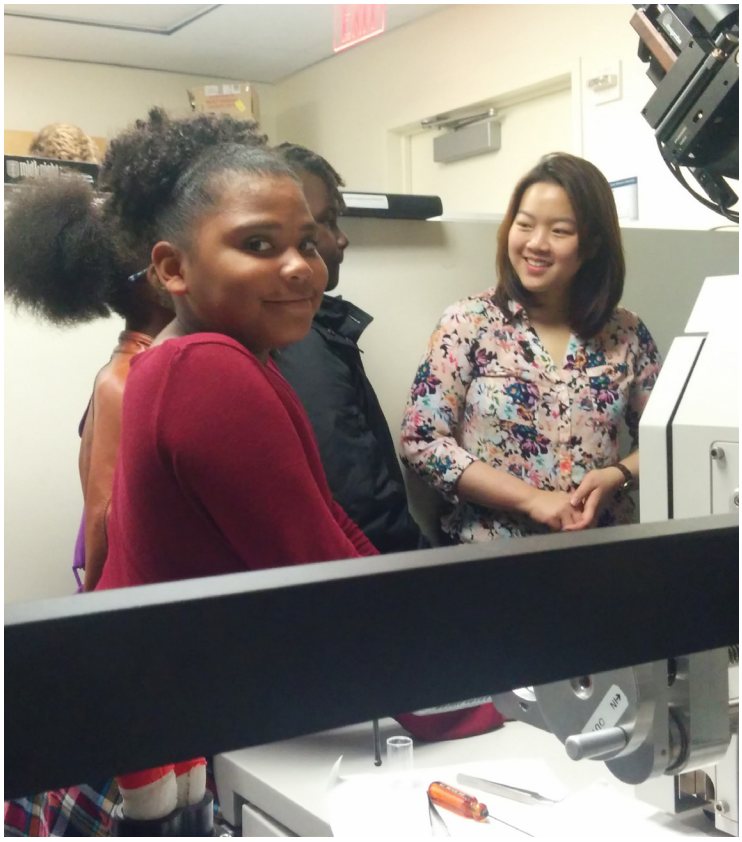
For example, in their Girl Game Company (GGC) program, two girls work collaboratively on a single computer in a way that gives both a critical role in completing their project. This GGC technique was designed based on research showing that girls prefer to work together and that pair programming in universities has resulted in higher confidence, enjoyment and persistence for students than solo IT training, particularly for women.

However, simply letting two girls work together on an IT project is not enough to ensure positive results. Good coaching from a supportive and competent adult is essential. Setting up pairs must be done very thoughtfully, with instructors and students both contributing to selection of partners who can work well together. Friendship pairings are not always the best choice, for instance, if friends with large ability gaps are paired together or if one friend is more dominating in decision-making. Good coaches also pay attention to pairing issues that may affect retention, such as when a shy or less-confident girl is unwilling to stay in the course unless she is partnered with a friend.

Additional positive, collaborative culture-building activities in GGC include private, partner-to-partner appreciations, anonymous peer appreciations that are written then shared publicly in the group, pair of the week awards, pair work showcases, and graduation events with families.

TechHive

The Lawrence Hall of Science's TechHive program and their partners developed a mechatronics education kit, which involved combining mechanical cardboard systems with electronics and programming to design and engineer "pets." Teen participants in the program were challenged to create an animal which would delight a young child, utilizing an empathetic design challenge approach. This aspect of creating a product for the audience to enjoy is often missing from robotics competitions and science fairs, where student projects are either displayed for judging or pitted against one another in competition. Instead the Robot Petting Zoo theme was intentionally designed to focus on collaboration, which helps especially girls and first-time participants feel welcome.



Strategy #2: Strengthen the Girl-Centric Ecosystem.

In this section we highlight the need to shift our attention in STEM diversity work from the pipeline to the STEM learning ecosystem, and we share three recommendations for building coordinated, cross-sector partnerships across a girl-centric ecosystem.

Embrace an Ecosystem Approach.

The STEM learning ecosystem model is a relatively new and nuanced metaphor. The ecosystem in this context emphasizes evolving systems of interaction between individual girls, their families, communities, informal and formal learning environments, and culture.[30] In a girl-centric STEM learning ecosystem, girls are agents of their own lives and also members of a larger system that acts on them. Information and resources link individuals and organizations together in the ecosystem.

Historically, a leaking pipeline metaphor has been used to describe the underrepresentation of women and people of color in STEM.[31] The pipeline imagery points to structural inequalities in the system: either blockages in the line that prevent females from advancing or holes in the line that allow females to drain away. In this leaking pipeline, girls who no longer persist are "drips."[32]

Among its limitations as a metaphor, the pipeline is a deficit model that looks back and highlights failure overtime.

The primary benefit of the pipeline metaphor is as an accountability tool. Recent revelations about lack of workforce diversity in the tech industry, for instance, are a public relations concern, prompting new promises for improved recruiting and retention. Documenting under-representation remains important but, by itself, is not solution-oriented. The pipeline still serves a purpose though, in continuing to reveal where the STEM education and professional workforce systems fail or fall short.

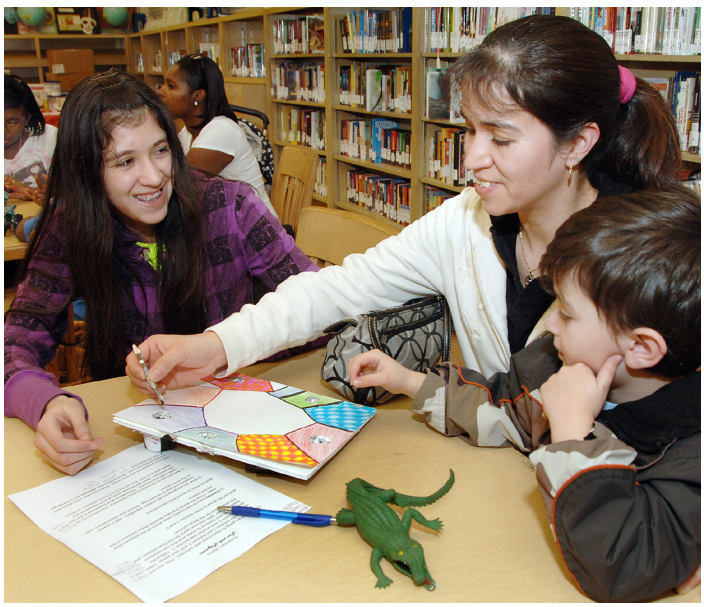
In contrast, a STEM ecosystem model highlights various points of opportunity for girls to move into STEM education and careers. The ecosystem evolves over time. Along various pathways in the ecosystem, girls may encounter both gendered barriers and engaging opportunities that can inhibit or inspire their persistence in STEM.[33]

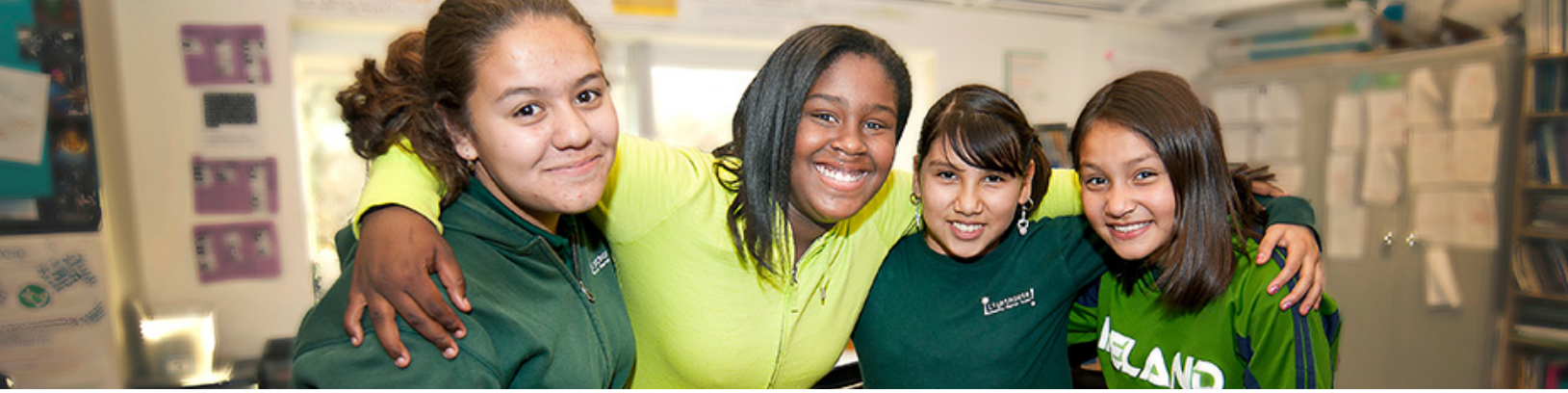
Why does the STEM metaphor matter? Metaphors help simplify complex concepts. The stronger our conceptual understandings, the better we can focus our resources to create solutions to complex problems. An ecosystem approach is forward looking. By embracing an ecosystem approach, we are better situated to look for opportunities to strengthen and diversify the STEM system.

Build Partnerships Between Programs and Families.

Within the ecosystem, it's important to consider the ways families and peers influence girls. Girls are twice as likely as boys to look to their parents for college and career advice over any other resource.[34] Parents are also girls' primary roles models. Encouragement from family, regardless of their technical expertise, can foster and reinforce girls' interest in STEM.[35] Yet girls' social networks are one of the most underutilized resources within the STEM ecosystem. Because of parents' and peers' strong influence, building partnerships with them will strengthen the STEM learning ecosystem.

Programs that are successful in engaging families meet parents where the parents feel comfortable. We want all parents to feel capable of supporting their daughters in STEM. A venue that provides families with a safe space to interact together around STEM projects can spark interest in a new STEM-related hobby and can connect STEM with the home. STEM programs can also offer family events that provide the opportunity for parents to celebrate their daughters' accomplishments and discover how they can support their daughters' interests in STEM. By seeing their daughters engaged and excited about learning, parents discover that engineering and technology are fields of study in which their daughters can thrive.





EXAMPLES OF FAMILY-FRIENDLY RECRUITING

CompuGirls

CompuGirls recruits girls in a variety of ways, including hosting pizza lunches, presenting videos of past projects, inviting program graduates to talk about their experience and disseminating CompuGirls brochures that highlight pictures of girls working collaboratively with laptops.

At CompuGirls, culturally responsive practices — including asset building, reflection, and connectedness — are embedded within the curriculum. Working in small groups, girls use technology to address issues of social injustice and utilize multimedia to suggest innovative solutions for community advancement. Girls create projects that can cause social change on a topic of their choosing. One 15-year old participant wanted to research sexual harassment within Latino families but she also realized that respondents would likely be reluctant to participate. Her CompuGirls teacher encouraged her to pursue the topic using culturally responsive methods. This led to many of her interviews being conducted in Spanish, which capitalized on her bilingualism. After gathering and analyzing her data she created a video documentary with English subtitles, and learned how to maintain confidentiality of respondents by blocking their faces in the video. She seamlessly integrated national statistics, peer-reviewed articles, and personal narratives to demonstrate how the dominant society attempts to depict sexual harassment as an issue more prevalent in urban settings than in white, middle-class contexts. The CompuGirls program proves to girls that even if they are 14 or 15, they have the means to make global change.

Girlstart

Girlstart begins its recruiting process by retaining local teacher liaisons at partner schools where afterschool programs will take place. These liaisons are the primary Girlstart program advocates and recruiters. Liaisons conduct most of the communication with parents and principals, and try to do so in a way that is intentionally respectful and appropriate for each unique school community. Because the advocates come from girls' communities, those communities trust them in a way they might not trust outside organizations or industries.

Girlstart then works carefully with liaisons to identify and recruit girls that are "the right fit." For Girlstart, this means finding girls who are "in the middle." Their end user profile is a girl who is not already interested and confident in STEM. Since Girlstart has more demand for programs than funding, they also try to select girls who are less likely to need remediation that will pull them away from in-demand program time. Approximately 80% of the girls Girlstart reaches are from racial minority communities that are underrepresented in STEM. Many of the girls are dual language learners and most have low socioeconomic status.

To be inclusive, it is important to address barriers to access and create bridges for girls to participate. Families are girls' most trusted resources and role models; family engagement and partnership are critical to opening STEM doors for girls. To successfully engage all families, programs need to meet girls and their parents where they feel comfortable. For instance, programs may have more success at recruiting girls at locations that are convenient and familiar to their families, such as churches, mosques, community centers, grocery stores, and libraries. Families may benefit from help filling out program applications through workshops, one-on-one advising and phone calls. Potential participants may be more interested in opportunities and feel safe enough to register if they hear about them in their own language, and from girls and members of their own community. Covering the costs of classes and materials is important but not enough. Programs may need to provide other services to families such as transportation, childcare and food.

When providing families with information about STEM educational opportunities and careers, programs need to make resources accessible to families from diverse linguistic and educational backgrounds. Listen to family voices to confirm family knowledge and resources that can support girls' success in higher education. Parents of first-generation college students may or may not have the resources and background knowledge to facilitate college preparation, enrollment, and perseverance.[36] Parental encouragement is necessary but not sufficient for promoting college success—families also need guidance about how to help girls succeed in post-secondary education, including college requirements for entry, loan and grant applications, as well as information about employment and housing opportunities for students in college. Connect families to educational advisors and programs who can help clarify college pathways, particularly for first-generation prospective college students.

The most important suggestion we can offer in partnering with families is to invite families from under-served communities to the program design table. Work with allies from within girls' communities to broker introductions. Leverage the unique assets of each community. Ask families what they want, what they need, and how to best collaborate with them to support their daughters. Do not assume that a STEM-oriented opportunity that works well for families from one community will be an effective approach for families in all communities.

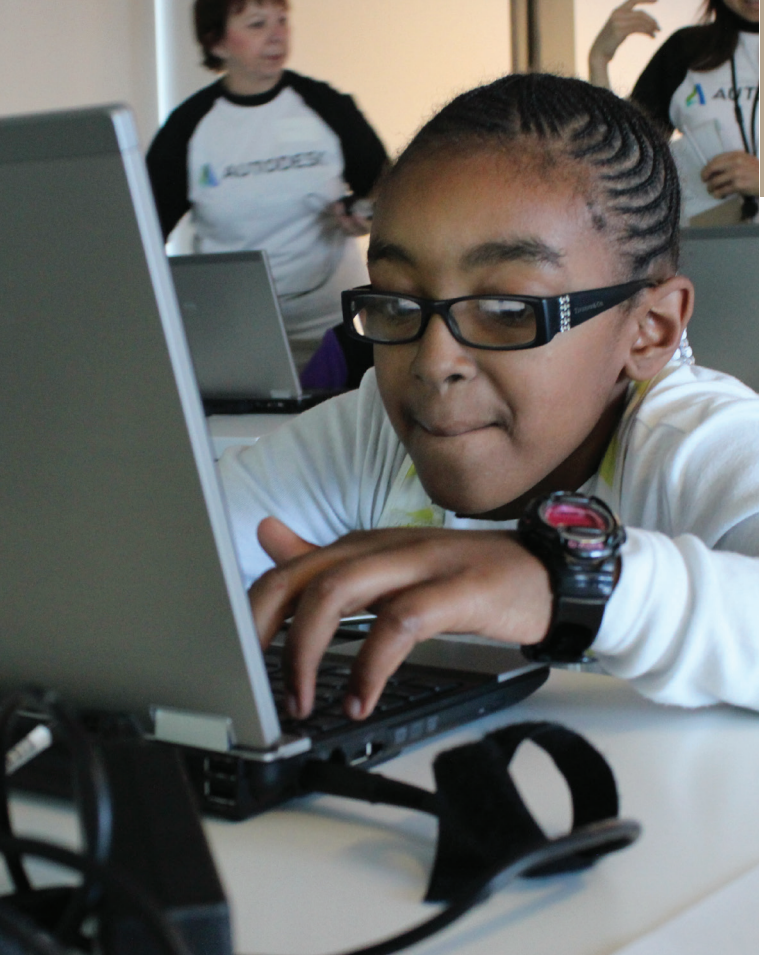
Build Partnerships Between Programs and STEM Industries To Train Role Models.

Within the STEM ecosystem, exposure to industry role models can help shape girls' life choices. Girl-serving programs frequently partner with industry-based role models to help girls see someone in the field with whom they can identify and potentially emulate. Strong role models can enhance STEM visibility, counter girls' misconceptions and expose girls to a wide range of career possibilities. Even brief interactions with someone from a STEM field can shape student beliefs about their potential for success in that field. Yet girls from low-income communities are unlikely to know a woman working in STEM. Girls need engagement with more expert practitioners, as well as access to the language, values, and norms of diverse STEM professional communities.[37]

However, just because a woman is actively involved in engineering or technology doesn't automatically ensure that girls will see her as a role model. Female students (but not male) are less drawn to STEM careers when they are introduced to the field by role models –whether the role models are male or female—who embody STEM stereotypes.[38] The more dissimilar girls are from potential role models who embody persistent STEM stereotypes, the less girls are able to see themselves succeeding in STEM.

The problem now is not that girls need more role models; many women and men in the STEM fields are incredibly generous of their time and ready to give more. The issue is that we need more effective role models. To be effective, role models need training to learn how to appeal to diverse youth. Organizations like Techbridge know how to do this training and are leading the way in providing professional development to potential role models.

The key message Techbridge conveys during role model training is that personal stories help students relate to role models and see STEM in a favorable light. Girls are interested in what makes role models unique outside of the professional sphere, and how that relates to girls' own experiences. Girls also want to hear about how a role model's career helps make her community or the world a better place. Girls benefit from hearing about challenges that role models faced along the way and strategies that role models have used to overcome hurdles.



EXAMPLES OF FAMILY PARTNERSHIPS

Girls Who Code

Girls Who Code utilizes multiple strategies to actively engage families to support the girls in their programs. For example in advance of their intensive summer camp programs, Girls Who Code offers application support at local libraries and community centers. This allows girls and parents to seek help with completing the application and to ask questions about the summer program. Before girls commit to participating in the summer intensive, families are invited to join a conference call that details the required commitment and provides another opportunity for families to ask questions. Program materials for families are distributed in multiple languages, and parents are also invited to an open house at the beginning of the summer to meet the staff, ask questions, and see the program's site. With this intentional outreach to parents, Girls Who Code's intensive summer program seeks to enable as many girls as possible to have access to its programs.

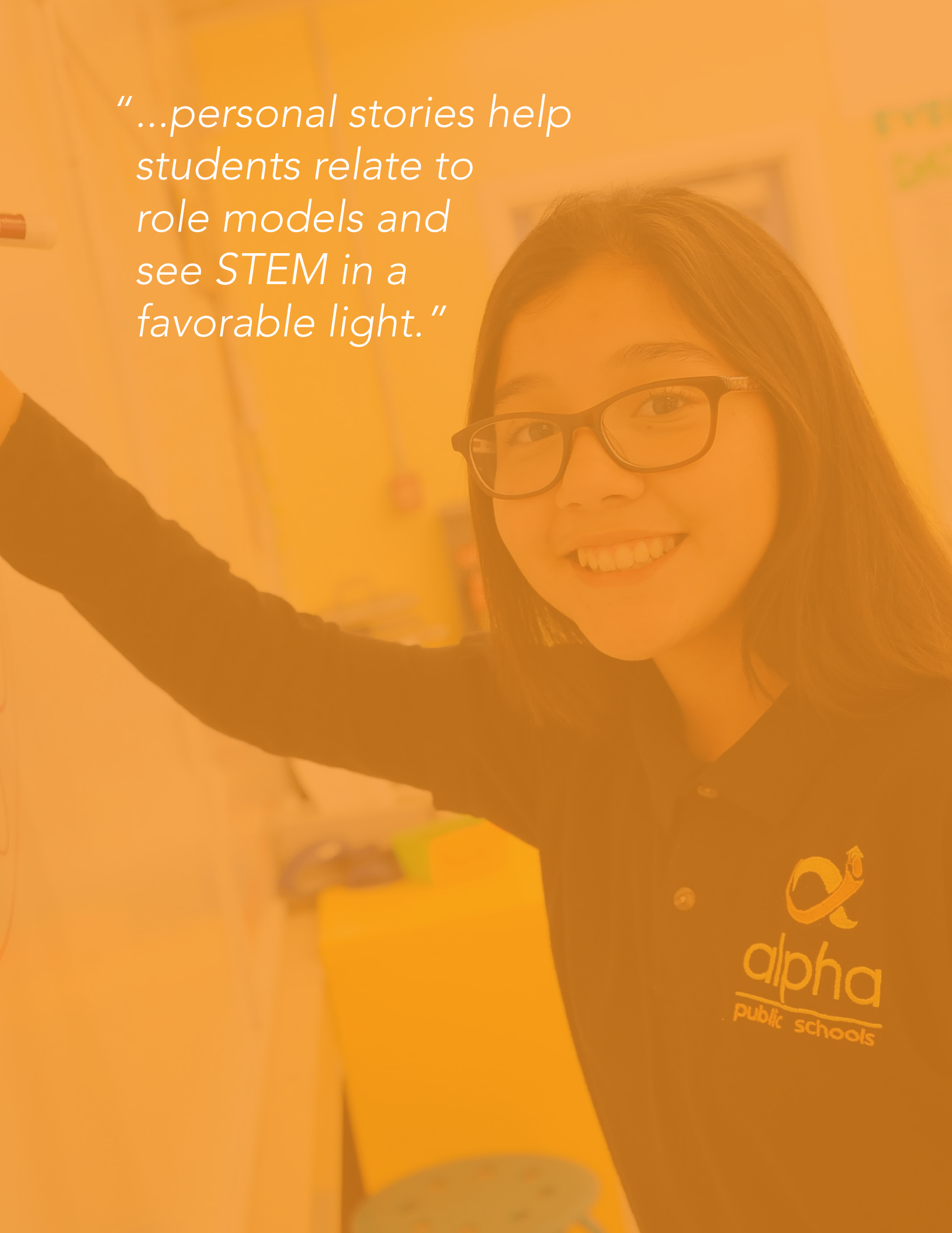
Techbridge

When creating new family engagement programs at Techbridge, parents and girls collaborate with program staff to define problems, brainstorm potential solutions, and test prototypes. Families partner with Techbridge to iterate and develop best practices that balance family needs with organizational resources. Techbridge is also creating a formal Girls Advisory Council, made up of recent Techbridge Alumni, to contribute to program refinement, near-peer activities, and fundraising.

Black Girls Code

At Black Girls Code (BGC), near-peer mentorships have grown organically out of programming as a way for graduates to "pay it forward" to current students. This relationship is rich for both mentor and mentee. Near-peer mentoring extends the learning experience of the program to older girls by giving them the ability to teach the curriculum to younger girls. This teaching process helps to build leadership skills and solidify the knowledge they gained at BGC. For current, younger BGC girls, near-peer mentoring provides them with a role model who has the same background - someone who is from their culture and who looks like them. These near-peer mentors help fill a gap in STEM pathways from high school to college and career. College students or upper level high school students can easily create a shared language with younger girls. This shared language gives them the ability to connect with younger girls in a way that can be challenging for mentors who are further along in their career.

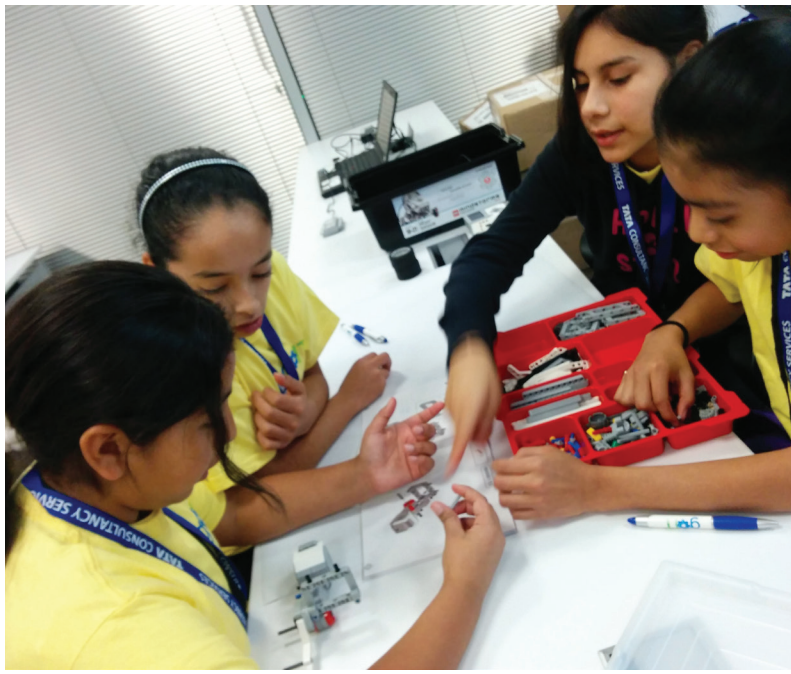
Near-peer mentoring at BGC is often informal, and includes having recent program graduates attend a workshop for current girls, speak on a panel or take part in a Q&A session. However, BGC is also creating more formal mentorship opportunities, such as a junior assistant position for girls near college. By building in clear, institutionalized pathways as part of their program structure, BCG provides older girls who are still in BGC with formal, resume-building opportunities.


"...personal stories help students relate to role models and see STEM in a favorable light."
alpha
public schools

Selecting and training appropriate role models for interacting with girls is important. Knowing how to lead an activity or talk about careers in a relevant way for students is not something that scientists or engineers learn in college or on the job. For instance, role models may need to practice taking about what they do in language that a 10-year-old girl can understand. This means avoiding acronyms and insider technical jargon.

Without support, well-intentioned role models and mentors may fail to connect with students because they do not know how to communicate their passion for their work or how to make a presentation that is appropriate for their audience. Training and practice allays fears and sets role models and mentors up for success. Role models who connect personally with a youth audience can show a "new face of STEM," one that may counteract stereotypes youth hold about the fields. Role models have valuable opportunities to craft new, positive, welcoming messages about STEM.

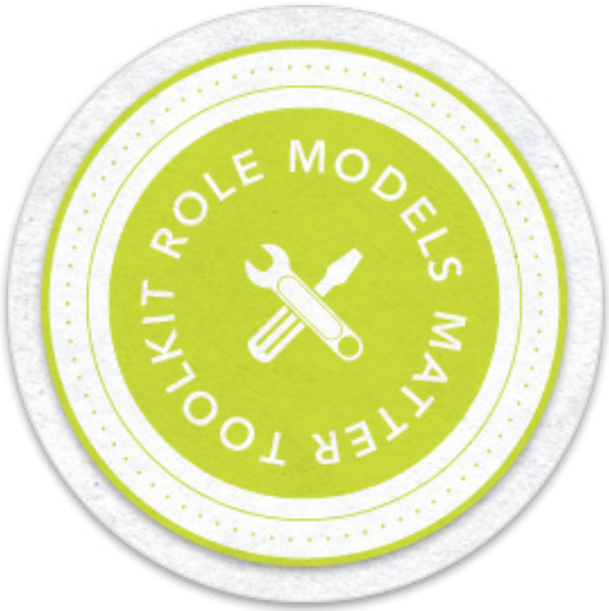
"Without support, well-intentioned role models and mentors may fail to connect with students because they do not know how to communicate their passion for their work..."



Techbridge

Techbridge has sixteen years of experience training role models and corporate partners to successfully interact with girls on field trips. Techbridge has identified the following elements to bolster role models' success engaging girls:

- Be personal and passionate when sharing career stories
- Dispel stereotypes by sharing information about hobbies and out-of-work activities
- Explain why your STEM-related career matters for local and global communities
- Before interacting with girls, practice speaking using age-appropriate, non-jargonistic language. (It's harder than you might think!)



Next Steps

Media stories about the alarming status of women in STEM are grounded in statistics like the ones presented in Quick Facts at the beginning of this paper. In college, women earn 6% or fewer of the undergraduate degrees in the physical sciences, computer sciences and engineering. In 2014, women represented only 12% of the engineering workforce. Women represented 26% of the computing workforce; African-American women accounted for only 3% and Hispanic/Latina women, 2%. Clearly, recruiting and retaining diverse girls in STEM has to start earlier than college and career entry.

This paper recommends two broad strategies to engineer a revolution in STEM diversity: design girl-centric, culturally responsive out-of-school time STEM opportunities and strengthen the STEM learning ecosystem. Girl-serving organizations that represent the leading edge of this revolution include Techbridge, Iridescent, CompuGirls, Girls Who Code, Black Girls Code, Girls Inc., Girlstart, and Girl Scouts, as well as alliance leaders like the National Girls Collaborative Project and the National Council for Women and Information in Technology.

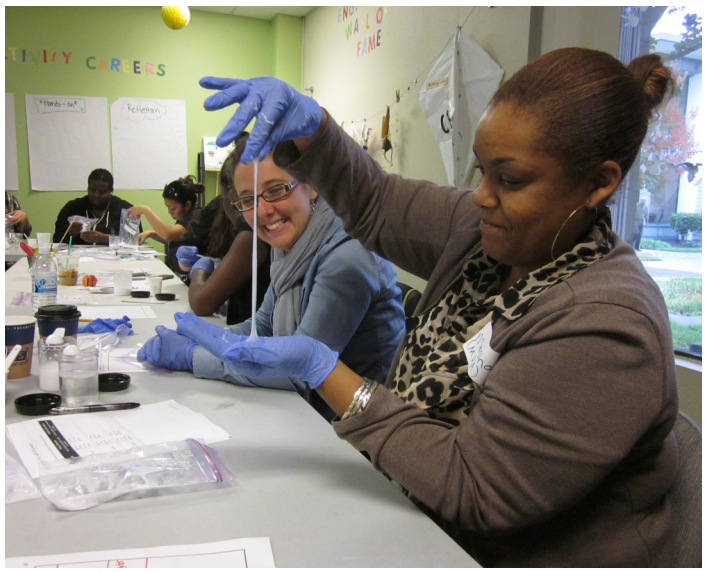
Big impact requires bold action from STEM education funders, including from industry, philanthropy and government sources. Our next steps offer a call to action for funders about spaces within the STEM landscape that have potential to be overlooked or underfunded.

1. Shift the funding model. Engineering design principles--design, prototype, test, fail and reiterate--that work so well for industry leaders would be a boon if applied to the creation of out-of-school programming. Non-profits in the out-of-school STEM space can only afford to do this, though, if their funding is flexible enough to allow for uncertainty about the outcome of their design process.

Unfortunately, most current grant opportunities run counter to engineering design principles by asking non-profit providers to promise pre-determined solutions and outcomes in grant applications.

When nonprofit organizations are secure in funding for this type of flexible development cycle, they are likely to iterate more quickly and creatively.

2. Foster collective impact. To reach the level of impact necessary to diversify the workforce, we need to work together using a dedicated collective impact approach. Collective impact efforts involve five conditions that must be implemented with an eye toward equity: a common agenda, a shared measurement system, mutually reinforcing activities, continuous communication and backbone support organizations.[39]



A collective impact approach means partnering deeply over extended periods of time. Talking at conferences is important, but isn't enough to achieve broader collective impact. To be successful, collective impact initiatives to support girls in STEM require committed leadership, dedicated funding and time, and personnel for backbone organizations.

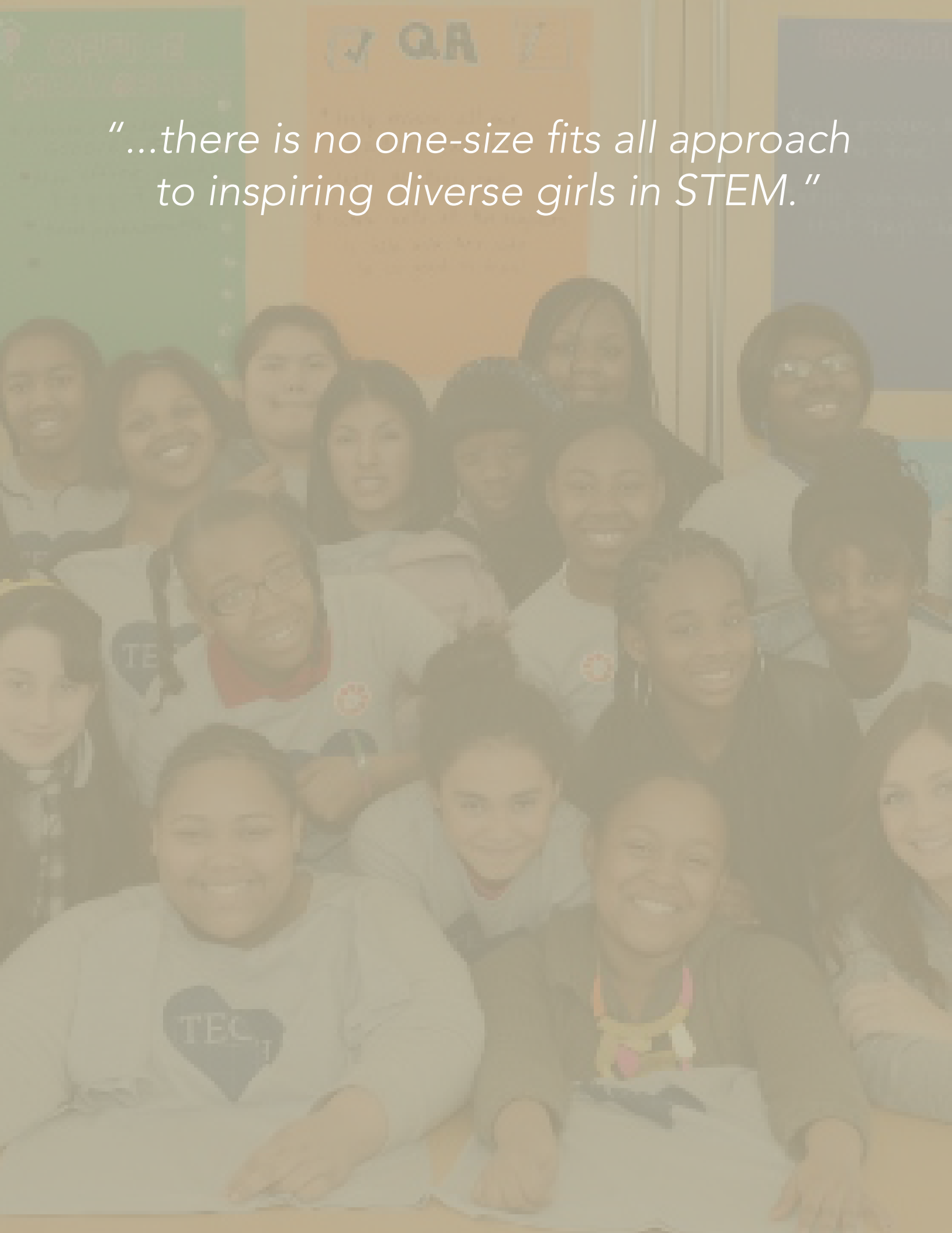
3. Empower organizations to conduct rigorous, longitudinal, culturally responsive evaluation & research. High-quality evaluation and research increases our knowledge of evidence-based practices and informs continuous program improvement. A generally accepted guideline for evaluation is that 5-10% of programmatic budgets should be allocated to evaluation.

Funders should also consider investing in alumni systems and other mechanisms for capturing long-term persistence and related outcomes. If we want to know if today's programs work to make a lasting impact, we are talking about a long-term investment of decades.

4. Invest in communities. The economic, political and social imperatives to diversify are undeniable, and it's understood that corporations need to brand their efforts to move the needle. However, diversity challenges will not be solved by each corporation starting a new, siloed STEM initiative and running it in isolation.

For higher leverage, corporations could coordinate efforts using existing networks and organizations as a vehicle for change. We urge forward-looking funders to help scale solutions by connecting into the ecosystem and supporting non-profit partners with a track record of impact for girls in STEM.

"...there is no one-size fits all approach to inspiring diverse girls in STEM."



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Associate Professor
Arizona State University

in partnership with Chevron

"To be effective, role models need training to learn how to appeal to diverse youth."

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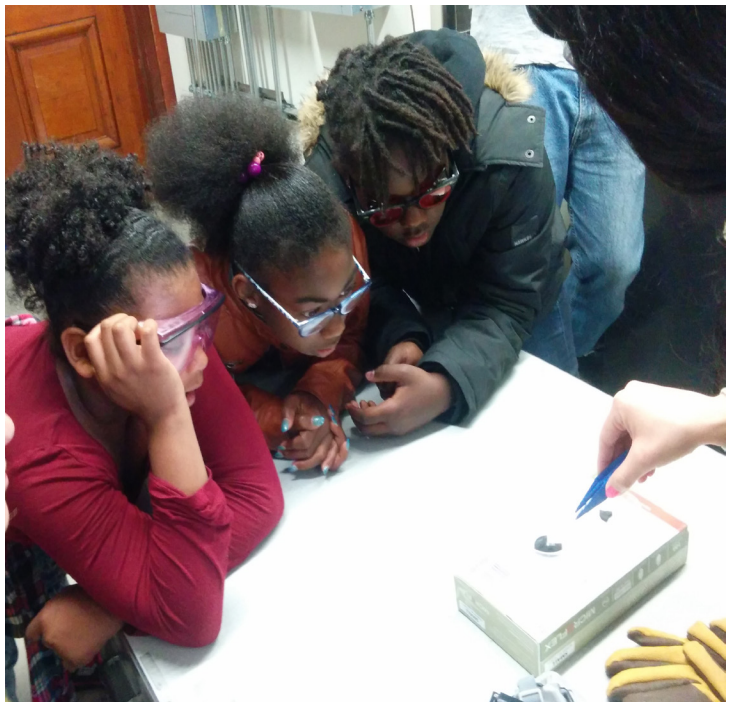

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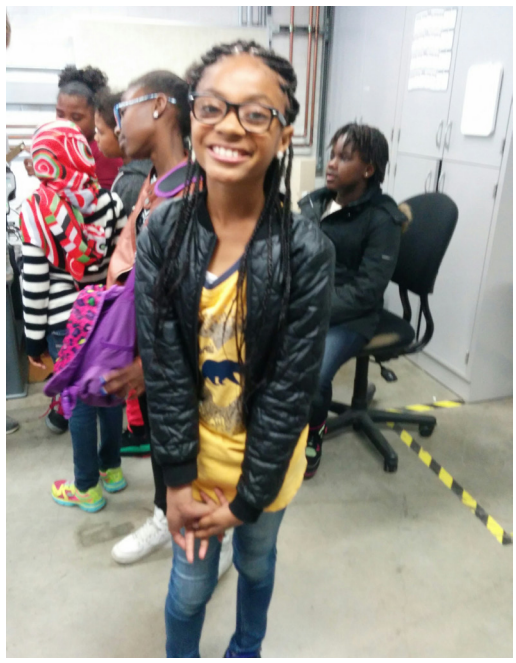

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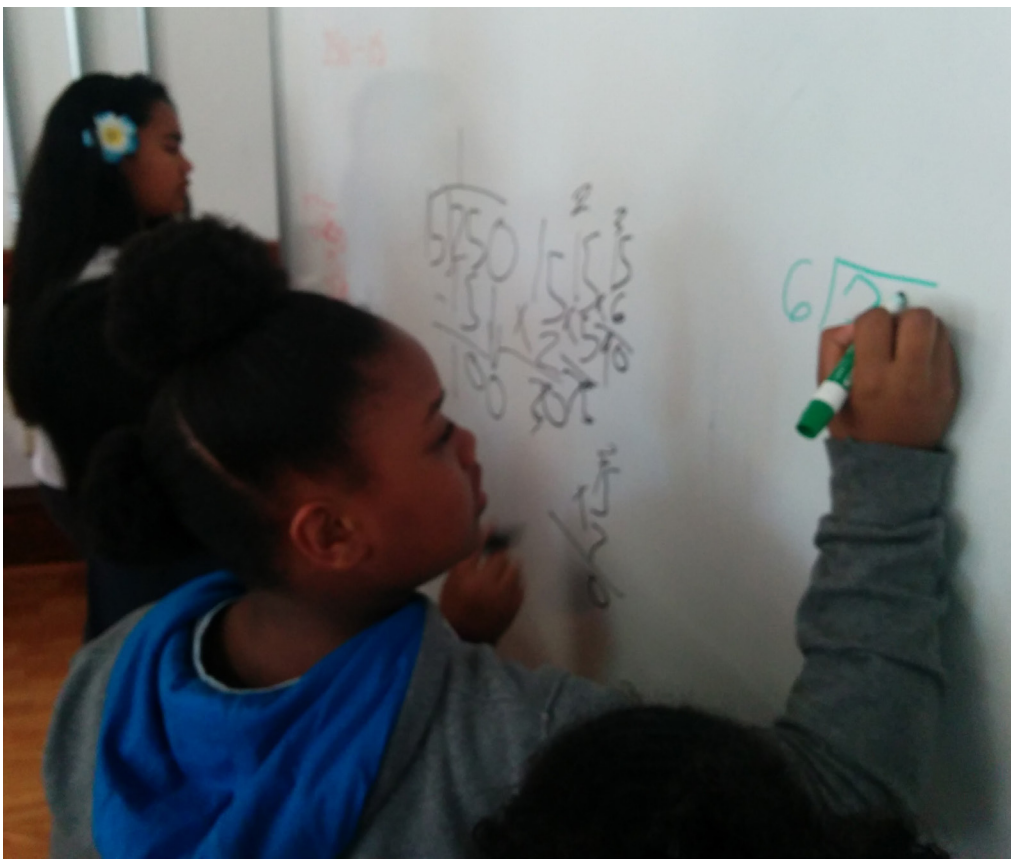

About Techbridge

Techbridge is an award-winning national nonprofit devoted to inspiring girls to change the world through science, technology, engineering and math ("STEM"). Our renowned after-school programs empower girls in grades 4-12 at public schools in low-income communities in Oakland, San Jose, Greater Seattle and Washington DC. We introduce girls to a new world of skills, confidence and careers through fun hands-on STEM activities in a girl-friendly environment, STEM professionals serving as role models, field trips to local employers, and family events. Through our programs, we engage girls in a year of scientific discovery that transforms their attitude towards mistakes, builds a whole new set of job-ready skills, and prepares girls for making big decisions that shape their careers and the future workforce. In tandem, Techbridge strengthens the ecosystem around girls by providing training and resources for role models and families, and builds the capacity of teachers to better engage girls in their classrooms.

OVER THE PAST 16 YEARS TECHBRIDGE INTRODUCED OVER

66,000

GIRLS AND BOYS TO THE WONDERS OF SCIENCE, TECHNOLOGY & ENGINEERING

A LONGITUDINAL STUDY HAS SHOWN THAT GIRLS WHO PARTICIPATE IN TECHBRIDGE...

Are twice as likely as the national average to choose a STEM major in college

Graduate from high school at higher rates

Earn higher GPAs

Take AP Calculus at higher rates and earn a higher average grade in the class

Score higher on state STEM exams

LAST YEAR, WE ENGAGED OVER

600

girls in our after-school programs in Oakland, San Jose, Greater Seattle & Washington DC.

techbridge

Inspire a girl to change the world

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Inspire a girl to change the world

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