

Changing the Game in STEM with Family Engagement

A WHITE PAPER FOR PRACTITIONERS AND FIELD LEADERS
TO EMPOWER FAMILIES IN STEM

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Introduction



Photo Courtesy: Greene Scholars Program

We all lose when youth with potential don't have access to resources to realize their dreams.

Imagine Sofia, a middle school girl who lives in Queens, New York. A computer science program recently launched in her community by Google. Sofia was nominated for the afterschool program which will teach kids how to code and the fundamentals of computer science. It could be a life-changing opportunity for Sofia, introducing her to role models and career opportunities in technology. Sofia is both interested and hesitant; she isn't sure she wants to attend. None of her friends are interested and she didn't have a positive experience in the computer program she attended over the summer, where she was one of only a few girls. Her parents are concerned about Sofia's safety getting home after dark, and they worry about Sofia's use of computers and whom Sofia might meet online. In the end, Sofia lets the deadline pass on applying.

Now, imagine if Sofia had been encouraged by her parents to sign up for the program. Imagine that teachers at Sofia's school talked with them about the opportunity and how it was specially designed to encourage Sofia and other students in their community in computer science. They explained the skills she would learn from the projects, the role models and field trips that would spark new interests, and the academic and career opportunities that would help her in school. And, imagine that they listened to her parents' concerns and addressed their transportation and safety issues.



By not participating in the afterschool program, it's not just Sofia who misses out. We all lose when youth with potential don't have access to resources to realize their dreams. Kids like Sofia have passion, life experiences, talents, and perspectives that could help tackle today's challenges and design solutions for the future. How do we make sure that every girl and boy has the chance to engage in science, technology, engineering, and mathematics (STEM) and to explore their potential? Have mentors to guide their path to make these discoveries? Have the confidence needed to persevere through struggles to reach success?

Parents are vital players in raising youth's awareness of the value of STEM and in brokering their participation in activities that build STEM competencies. For youth like Sofia, family support plays a particularly important role in participation and retention in a STEM pathway.

STEM Next Opportunity Fund is committed to ensuring that *every child* – especially girls, youth of color, kids in low-income communities, and youth with disabilities – has access to STEM experiences and the social capital that lead to greater opportunities in academics and careers. STEM Next Opportunity Fund believes family engagement is a game changer and offers this white paper to raise awareness of its importance and amplify promising practices.

Rethinking assumptions about family engagement

Our strategic plan is to serve more youth. We need to devote resources to programs for kids, not to programs for parents who don't come.

We tried family engagement. We hosted a STEM Night, but families didn't come.

Our parents are busy, overwhelmed and under-resourced. We don't want to add to their responsibilities.

Our staff are maxed out delivering STEM programming. We can't ask them to do more.

These are comments we've heard from some educators and leaders about their unsuccessful attempts at family engagement, and assumptions that program designers make as to why their programming failed. We are sharing these research and program successes to dispel these assumptions.

Leaders of innovative STEM programs are showing how to bring parents to the table as key stakeholders, empower parents with resources, bridge research and practice, and implement family engagement at scale. With this white paper we want to raise awareness of innovative efforts and challenge program leaders, funders, corporate partners, and policy-makers to act on family engagement. While our primary focus is on family engagement in out-of-school settings, we believe it is essential to bridge family engagement strategies anytime, anywhere Pre-K through high school. Collectively, we can ensure that every family has access to resources that will enhance their child's success and engagement in STEM.

Family structures vary, and when we refer to parents, we mean to be inclusive and include all guardians and caregivers who help play an integral role in youth development and opportunities. Sometimes it is aunts, uncles, grandparents, godparents, or surrogate family members who take on the role of encourager, facilitator, mentor, and curator of opportunities.

Our approach: Listening and learning



Photo Courtesy: Iridescent

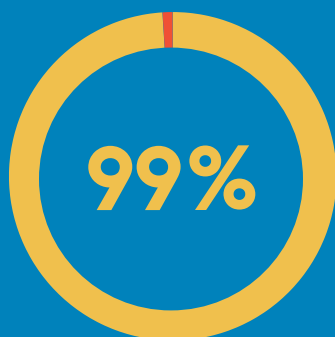
This white paper was developed over two years. Our work included a review of the research literature on family engagement, especially in STEM, as well as interviews with leaders and educators across the country who are deeply engaged in family engagement, and field observations of STEM programs for families. We looked for examples of promising practices as well as lessons learned from which to understand challenges and ways to make the work accessible across diverse organizations and communities. Equity and access were essential considerations guiding the research and discovery. We looked for programs that support children and families who are often missing from STEM opportunities and what can be done to be more inclusive.



Evidence of impact of family engagement on learning outcomes

Photo Courtesy: Oregon After School for Kids

There is extensive research going back 50+ years on the effects of parent influence and outcomes in educational, career, and general life trajectories. Cumulatively, the research shows that parents have a profound impact on children's learning, development, interests and aspirations, and educational and career outcomes.¹ Longitudinal studies confirm the return on investment; sustained family engagement from early childhood through high school is associated with higher graduation rates and college attainment.² Much of this research has focused on literacy, language, and social-emotional development where parents feel some sense of competence in the subject matter.



*In a national survey, 99% of parents said they **want** to be involved in their child's education; however, they don't understand the role they can play in their child's learning.*

While parents want to be supportive, when it comes to STEM many parents feel anxious and unqualified to do so. In a survey by Bayer, nearly one-third of parents reported that they didn't feel confident enough in their scientific knowledge to help their child engage in hands-on science activities.³ Parents with less formal education are less confident.⁴ In a national survey about young children and science by EDC and SRI, 99 percent of parents wanted to be involved in their child's education; however, they don't understand the role they can play in their child's learning. The researchers attribute this confidence gap to how parents view their role in STEM learning—needing to have the right answer and communicate information appropriately rather than supporting their child's exploration.

There is a disconnect between what parents think they need to do and what really matters in their child's STEM journey. Within STEM, parental influence is related to improving or increasing children's interest, academic persistence and success, standardized test outcomes, and career choice.⁵ Family support plays a particularly important role in participation and retention in a STEM pathway. Parents are vital players in raising youth's awareness of the value in STEM and brokering their participation in activities that build STEM competencies.

Family engagement can be a game changer for expanding and diversifying the world of STEM and expanding the options for all youth.



Photo Courtesy: Remake Learning

Collectively, the research studies highlighted below - along with other programs and studies - show the return on investment that family engagement can have. Family engagement can be a game changer for expanding and diversifying the world of STEM and expanding the options for all youth. Each of these focus on different areas of STEM and within different communities, showing innovative ways of supporting youth along the STEM pathway from Pre-K through high school.



Encouragement matters for computer science

While parents may think that it's their expertise, experience, or knowledge that makes for their child's success in computer science, research shows otherwise. **Google** conducted research to determine factors that influenced young women's decision to pursue computer science. They interviewed 1,000 women and 600 men with a survey built upon research factors from existing studies. What matters? Encouragement by parents and exposure to out-of-school computer science activities arose as key factors in females' persistence in computer science.⁶ The gender gap in tech can be tackled with deliberate and directed action focused on encouragement and exposure. Google has developed resources to support family engagement in computer science across home, school, and library settings.



Math competence starts early and starts at home

Bedtime Math offers playful math problems for families with kids ages 3-9. These problems can be completed in just 5 minutes and fit into nighttime (or anytime) routines. Parents can sign up for the daily email, download the free app, or read one from their children's books. Evaluation with a control group documents program benefits for kids and parents. Bedtime Math helps kids do better in math.⁷ Using Bedtime Math as little as once a week over a year improves kids' math skills by 3 months. For kids whose parents have math anxiety the results are even more positive—gains of half a school year. New research shows kids were still ahead two years later, even after they stopped using the app. The program boosts parents' confidence and helps overcome their own fear of math, thereby empowering them to engage in math activities with their child.⁸



The importance of talking science for STEM identity

A national survey of college students looked at the relationship between STEM identity, interest in STEM careers, and informal STEM experiences during the K-4 school years.⁹ Talking with friends or family about science, as well as reading or watching science, had significant influences on STEM identity. The authors note the importance of these results—that everyday experiences, like talking science and engaging in science through books and television make it possible for youth in families with fewer economic resources to develop STEM identities. These experiences do not require material resources and supporting those activities do not require great financial investment. Given that STEM identity is associated with STEM career interest, supporting parents in talking about science, and promoting science reading and media holds promise for family engagement supporting a pathway in STEM.



Remake Learning for a more inclusive and equitable society

Remake Learning, which began as an experiment in collaboration in Pittsburgh, has grown into a cross sector regional network igniting engaging, equitable learning and impacting thousands of practitioners in southwestern Pennsylvania and West Virginia.¹⁰ One aspect of Remake Learning is **Remake Learning Days**, a multi-day celebration that offers thousands of families hundreds of free hands-on events at schools, museums, parks, libraries, makerspaces, centers of faith, community centers, and businesses. Remake Learning Days takes a big, bold approach to family engagement to address the challenge, “How do we make sure the benefits of innovation reach all children, especially those in greatest need?” Commitment to equity is a priority; results from 2018 document that the programs continues to overrepresent chronically marginalized racial populations.¹¹ In addition, Remake Learning Days increases parent familiarity with science, technology, engineering, art, and math (STEAM), showing progress towards the goal of increasing parent and caregiver awareness and understanding of what the future of learning looks and feels like in practice. Due to its success, Remake Learning is sharing its resources, lessons learned, and expertise. Other regions across the country are now producing Remake Learning Days in ways that are contextually relevant for the organizations and families in their communities.

These are just a few of the many research studies and programs that demonstrate the impact of family engagement in STEM. Collectively, they highlight the importance of including families in STEM outreach with children.

Promising practices



Photo Courtesy: New York Hall of Science

Next, we offer promising practices for promoting family engagement that empower parents to support their children's participation and persistence in STEM. We also highlight case studies of organizations that are putting these practices into action.

- 1** Listen, learn, and build relationships with families
- 2** Empower parents with research and resources
- 3** Prioritize access and inclusion
- 4** Provide professional development for impactful family engagement
- 5** Evaluate impact

Practice 1: Listen, learn, and build relationships with families

Family engagement starts with listening. This approach moves “from research and practice on families... to research and practice with families, that builds from their knowledge, experiences, and priorities for change.”¹² By inviting families to “the table” to listen and work together we can better understand what parents want and need as well as consider what are potential barriers and how they can be addressed. While organizations may take different approaches to listening to families, those that are most impactful share a deep commitment to this work, which is done over time and within the context of relationships.

The human-centered design process, made popular by IDEO, puts listening and learning with people at the center to create products and services that are relevant and impactful.¹³ This process can be a powerful approach for family engagement because it raises up families’ voices and needs and builds relationships between families and program providers. The results can lead to more effective family engagement practices, strategies, and programs.¹⁴ The Global Family Research Project and IDEO offer free resources on human-centered design that can help in work to promote family engagement.¹⁵

PRACTICE IN ACTION

For many parents, a welcoming STEM program needs to begin with an invitation to come and just try or observe the first time. The program team at the Center for Mathematics Excellence and Equity at the **Lawrence Hall of Science**, learned that starting with STEM activities may be intimidating for families if they think that correct thinking or answers are expected of them. The program staff learned by listening that some parents prefer a chance to first get to know one another before they jump into hands-on STEM experiences. This is important to note, especially if your program has had trouble attracting parents. Could it be that parents are intimidated by what is offered, and not that they are too busy or not interested?

While families liked engaging in math activities at the museum, not all felt confident that they could do the activities at home. Parents want to help their children at home, but they are often intimidated by the complexity of the concepts their children are learning in school. Just by observing the families engaged in the activities, staff would never have known this. But, by listening to parents, staff gained insights that helped them rethink the kinds of activities they were using in their programs. Math projects with everyday materials in everyday routines became favored over those that were less accessible.

PRACTICE IN ACTION

Making can mean different things to different communities. For some families, robots, flame throwers, and 3D printing might be their inspiration for making, while for others it may be cardboard and duct tape, or a loom and dyed wool.¹⁶ A team at the Science Museum of Minnesota, launched the **Making Connections Project** which seeks to better understand different making practices that may be embedded within different communities that are traditionally underrepresented in the making community.¹⁷ The Museum team learned from families and community members through a series of listening sessions, which generated insights into a range of making activities that were personally and culturally relevant. These included cooking, gardening, making doll clothes, and creating obstacle courses for toys. Repair projects were also quite common, in addition to creating new things from scratch. In addition, Museum staff learned that the concept of "thrift" was important for several of the families engaging in hands-on activities, motivating families to be creative and innovative while using everyday materials for their designs. By listening to families, the Science Museum of Minnesota expanded the definition of making to be more inclusive and designed its making program through a lens of cultural relevance and equity.

Photo Courtesy: Making Connections Project





Invest resources in relationships

While organizations may take different approaches to listening to families, those that are most impactful share a deep commitment to this work, which is done over time and within the context of relationships. Below are examples of how different organizations invest in these relationships for greatest impact.

PRACTICE IN ACTION

For the **YMCA of the USA (Y)**, family engagement is an essential element across the organization and fundamental to their youth development work. Leadership at the Y recognizes that developing meaningful relationships takes time and resources. For the Y, family engagement is about how staff and volunteers relate with families on an everyday basis. This work is supported by four principles: welcome, connect, support, and invite families to engage. How are these principles put into action? Staff are purposely trained to welcome families with a smile, greet them by name, introduce themselves, ask open-ended questions, and reaffirm what they're hearing. By engaging in these strategies, staff get to know parents and caregivers and their needs. This enables staff to connect parents to other Y programs, members at the Y, and relevant opportunities in the community. The Y demonstrates its commitment to strengthening relationships with families by engaging parents and caregivers in simple, realistic strategies.

PRACTICE IN ACTION

The **Family Creative Learning Project** host workshop series that engage children and families from non-dominant groups in computing. The project's director, Ricarose Roque, understands that building relationships is as important as building projects. Roque and her team learned from families that they were attracted by the possibility of family time, sharing food together, and having fun while learning more about technology. In response, the team sets aside time and space for families to get to know one another and for facilitators to get to know families. The workshops are structured in 4 parts: Eat, Meet, Make, and Share. Roque shares that “food is non-negotiable” as it communicates that program staff care about families. The meals are not just about eating, but also about building relationships, which are enhanced with thoughtful practices. Meals support families, providing an activity that they are familiar with—eating together—before they jump into a new and potentially intimidating activity with technology. As families eat during their first meeting, they fill out “About Me, About Us” cards. With this activity family members share their names, a drawing of themselves, something they like to do, and something they like about themselves. This activity serves many purposes: It reinforces relationships and signals that the program is not just about technology, and allows all families to share who they are and see who else is present.¹⁸



Photo Courtesy: Family Creative Learning Project

MAKING THE CASE

How the New York Hall of Science listens to and learns with families



Photo Courtesy: New York Hall of Science

The **New York Hall of Science (NYSCI)** has a longstanding commitment to family engagement and learning through various family programs that were built on initial feedback received from members of the community.¹⁹ The Museum started its community initiative, NYSCI Neighbors, which focuses on bringing STEM family engagement and learning to families in Corona, Queens. This neighborhood in Queens is composed primarily by immigrant families and first-generation families. By listening to families via interviews and focus groups, NYSCI heard parents express interest in programs for the entire family, in opportunities to interact with others in their native language, and for a safe learning environment where they could feel comfortable and not out of their depth.

With support from the Carnegie Corporation of New York and the Deutsche Bank Americas Foundation, NYSCI developed **Parent University**, a parent empowerment program that builds upon parents' perspectives about their needs and interests in order to become advocates for their children's education and future.²⁰ When youth visit museums, they typically design, play, and make things, but the adults who bring children don't always understand how these activities connect to learning or how they may be important to their child's future. At NYSCI, museum staff help both youth and adults understand the value of STEM activities as well as understand the innovative ways of learning at cultural institutions.

NYSCI has developed STEM pathways for local families by inviting them to quarterly STEM workshops—STEM Nights—with local businesses where youth and their families learn about academic coursework, internship opportunities, paid summer programs, and career options in STEM in New York City. Exposing local families to different fields within STEM and making connections to design-based learning makes STEM opportunities more explicit and less of a mystery.

Embedded in all parent empowerment workshops is skill building, such as problem solving, teamwork, and critical thinking, which are important within the STEM fields. In family workshops, both children and adults work on building these skills together. NYSCI empowers caregivers to be STEM learners and champions through hands-on experiences. NYSCI tailors other programs to youth, such as Science Ambassadors, that supports academic success through its Homework Zone and allows time for families to explore and engage with the hands-on exhibits NYSCI has to offer. High visitation during Science Ambassadors demonstrates the value families have to the different community work found at NYSCI.

Practice 2: Empower parents with research and resources

There is often a disconnect between research and practice in family engagement; programs can change that. In this section, we highlight the success of programs in applying lessons from a variety of research resources to design and implement cutting-edge programs that maximize impact. This research informs both what gets communicated with parents and how it is communicated.

Many parents report that they don't feel confident enough in their scientific knowledge to help their child engage in hands-on science activities.²¹ For math, many parents have anxiety about the subject which can influence their child's comfort level and confidence.²² While parents may think that STEM experience or knowledge is needed, research shows otherwise. Parents don't need to be the experts or have the answers; it's their encouragement that matters. The following practices reflect how research-backed messages along with resources can empower parents.

PRACTICE IN ACTION

The words caregivers use to talk about success and effort influence how children approach learning and work through challenges. Consider the following messages.

Great job on your book report. You are so smart.

I know that you put a lot of effort into your science report.

I like how you didn't give up.

The first set of comments reinforces a fixed mindset and intelligence as innate talent while the second set supports a growth mindset and encourages effort. Research reveals that a growth mindset promotes not only higher achievement but increased persistence in STEM fields.²³ In contrast, a fixed mindset is threatened by challenges, effort, and mistakes which are common in STEM courses and work. While mindset research has implications for learning, it isn't readily accessible to most parents.

In its family programs with engineering and artificial intelligence, **Iridescent** instructs parents on growth mindset, knowing that this is critical to staying engaged in STEM. The program offers parents both in-person and online training on growth mindset (belief that success is a function of hard work) versus fixed mindset (belief in innate abilities). Iridescent also developed a family workbook and video, which are available in English and Spanish, to help families understand their own mindset and put growth mindset into practice during interactions with their children.²⁴

“Parents don't need to be the experts or have the answers; it's their encouragement that matters.”



Photo Courtesy: PowerMyLearning

PRACTICE IN ACTION

Girl Scouts invests in original research to inform program design and empower parents and volunteers with research-based strategies. Relevant to digital technology, The Girl Scout Research Institute went to girls to find out what they were thinking and what adults could do to sustain girls' interest and confidence in technology. Results are presented in *Decoding the Digital Girl. Defining and Supporting Girls' Digital Leadership*.²⁵ Here are findings and actionable takeaways to empower girls as digital leaders who improve their own lives and the world through their digital experiences and use of technology. The parents of daughters tend to treat them differently than they do their sons, such as turning to boys for technical assistance. Girls' interest in STEM and in tech careers decline at the start of high school. Girls in lower-income households and girls in rural areas tend to be less familiar with tech skills like coding and robotics. Girl Scouts offers adults ideas to counteract these findings like treating girls and boys as equally capable in technology and supporting girls' engagement in technology opportunities during the transition from middle school into high school. Girl Scouts also provides online STEM resources for parents to extend the benefits of the Girl Scouts Leadership experience at home.²⁶



Photo Courtesy: Girl Scouts of the USA



Research can inform *how* to share resources with families

More research and resources don't ensure more access. So, how do we share research and resources in ways that are equitable and inclusive? There are many ways to communicate with parents: emails, in-person interactions, written materials sent home in backpacks, texts, phone calls, and parent workshops. The good news is that there's research to help inform our choices.

PRACTICE IN ACTION

Ready4K is a family engagement program for birth through Grade 3 that is delivered via text message. Ready4K uses texts to build upon everyday family routines and learning opportunities that are easy and fun to support literacy, math, and social and emotional skills.²⁷ Weekly texts provide action tips and encourage family engagement. Studies show that these texting-based interventions can produce educational benefits in children across a range of ages and increase parental involvement at home and school. For example, randomized-controlled trials show positive outcomes of literacy-focused texts with parents reporting more parent involvement and kids making early gains. Family engagement through text messages, which have a high open rate, is relatively easy to implement and scale.

How Digital Youth Divas bridges research and practice to empower parents

Digital Youth Divas is an out-of-school program that takes an aspirational approach to sharing research and designing communication and social practices with parents. Based in the Chicagoland area, the program engages middle school girls, particularly those from underrepresented populations, in computer science and engineering projects that are technically challenging and appealing to girls, such as computational circuitry and programming through fabrication. The program aims to support the creation of STEM families by involving parents and other caring adults in the girls' lives (e.g., grandparents, adult siblings, aunts) as learning partners to support the girls' STEM knowledge and confidence and to connect them with resources in the community. Family engagement has evolved in Digital Youth Divas, moving from basic communication practices supported by an online platform and in-person showcases to an in-depth workshop series. These workshops address a variety of parent needs such as providing additional information on future informal learning opportunities for the girls, better equipping parents with the skills needed to support the girls' participation during the program, and demonstrating how parents can help sustain their girl's engagement in technology upon completion of the program.

Building on the Digital Youth Network model developed by Nichole Pinkard²⁸ and research on parents as learning partners led by Brigid Barron,²⁹ the team at Digital Youth Divas focused on several roles through which parents support their children in STEM. These include teaching skills like how to use a power tool or sewing machine, working and learning alongside their child, sharing resources like library books, finding and enrolling their child in STEM afterschool and summer programs, and learning from their child. The team at Digital Youth Divas intentionally decided not to present this research as top-down information from experts, but instead they allowed the research to catalyze active discussions among families and Digital Youth Divas staff, including researchers and educators. For example, after learning about the various roles that parents play in supporting youth learning, parents break up into small groups and share examples of the roles they play. The group also discuss roles for which they need additional help in developing and strengthening. This active approach to engaging with research helps parents affirm all the work they are already doing to support their daughters and validate the roles played by other people including grandmothers, teachers, and coaches. The use of a self-affirmation approach can be especially encouraging for parents without a STEM background who are unsure of what they need to do to best support their daughters, validating that they are on the right track and are learning how to better support their girls' STEM education.

By providing time and a variety of ways for parents to learn together, Digital Youth Divas creates social networks in which parents become resources for one another. Research is foundational in this work that resonates with the design principles for the programs hosted by the Digital Youth Network—an appreciation of learning ecologies and desire to help connect experiences across time and place for more powerful learning.

Photo Courtesy: Digital Youth Divas



The use of a self-affirmation approach can be especially encouraging for parents without a STEM background, who are unsure of what they need to do to best support their daughters, validating that they are on the right track.



How programs engage in a growth mindset and keep up-to-date with research

It takes an investment by leadership to share research with staff and put research into action. Consider designating a team “research officer” responsible for staying up-to-date on research and discussing it with program staff to support their work. Discussions can occur in a variety of formats including an occasional book club where staff read chapters from a book on a topic of current relevance or review research at team meetings.

Setting a Google Alert for topics of interest and following leaders in the field are helpful ways to monitor trends, as are following relevant organizations via social media or newsletters. Here’s our short list of favorite go-to resources for the latest in family engagement research and practice to help energize staff with new ideas.

Global Family Research Project is a national platform on family and community engagement research, practices, policies, and strategies.

Be a Learning Hero provides information, resources, and actions to help parents support their child's academic, social, and emotional learning.

The **National Association for Family, School, and Community Engagement** advances high-impact policies and practices of family, school, and community engagement.

STEM Next is a national leader in increasing opportunities in STEM learning for youth across communities both in and out of school. Of relevance is ***The Family Engagement Project***.

National PTA’s STEM + Families shares effective ways to engage families in STEM and works with partners to improve access to STEM, especially among underrepresented youth.

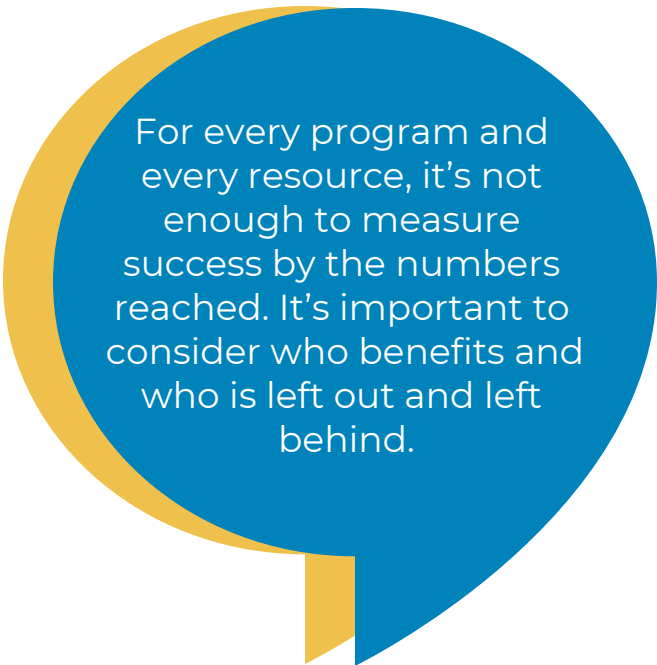
The Afterschool Alliance provides research on afterschool programs and resources to ensure that all youth have access to affordable, quality afterschool programs.

Practice 3: Prioritize access and inclusion

Family engagement holds promise for changing the game for youth in STEM. However, it's important to keep in mind that families bring different levels of knowledge and experience in STEM, as well as social capital for accessing resources for their children. For every program and every resource, it's not enough to measure success by the numbers reached. It's important to consider who benefits and who is left out and left behind.

The problem isn't simply that there aren't enough STEM resources for families, but that they aren't evenly distributed and accessible.³⁰ There are lots of online resources, but often, parents can't find them.³¹ Inequalities exist in how information is generated and distributed among social groups which impact the ability to access and take advantage of information and resources.³²

For example, parenting information that is delivered via the internet, is more difficult to access for some parents, including linguistic minorities, families in rural areas, and parents with less education. There are also barriers in participating in programs for some parents that are practical, such as not having transportation, child care, inadequate accommodations for a disability, and work schedule conflicts. The marketing and registration for programs also affect who knows about upcoming opportunities and who can register in time and online. By attending to these factors, we can make STEM programs more accessible.



For every program and every resource, it's not enough to measure success by the numbers reached. It's important to consider who benefits and who is left out and left behind.

PRACTICE IN ACTION

EdNavigator hacked the usual barriers and flipped its model for parent engagement. Instead of requiring parents to come to them, they go to parents where they work. Advisors—called Navigators, who have deep roots in the community—go to the workplace and support parents with academic guidance for their children from preschool through college. EdNavigator began with hotels and has expanded to new sectors including university and manufacturing partners. Advisors share research and practical strategies with parents. For example, they highlight summer learning loss and offer accessible ideas like free summer reading programs at the library, free apps like Bedtime Math, and online coding lessons from Code.org. While not STEM-focused, EdNavigator presents an innovative way of rethinking parent engagement that can be applied to STEM work. Noteworthy is that EdNavigator not only benefits families, it also improves workplace outcomes by increasing productivity and reducing turnover.³³

PRACTICE IN ACTION

PowerMyLearning flips the traditional roles and lets parents learn from their child at home. The nonprofit organization created **Family Playlists** for youth in Grades 3-8. Kids complete activities at school and teach what they learned to a family partner, who may be a parent or other significant adult. Afterwards, family partners provide feedback to teachers on how confident their child was teaching the material. This approach removes barriers especially for parents who don't feel confident in their STEM skills. Parents don't need to know the answers. In fact, they just need to show interest and willingness to learn from their child. Participation has been extremely high and results positive. Students improved in math proficiency and parents became more confident that they could help their child learn.

While Family Playlists were developed to help families and classroom teachers partner more effectively and support student learning in school, we see promise for the model in afterschool STEM programs.



Photo Courtesy: PowerMyLearning

PRACTICE IN ACTION

Deaf Kids Code isn't just another organization with programs to learn coding languages. Founder, Shireen Hafeez, aims for life-changing impact by changing attitudes of youth who are hearing impaired and their parents. The program builds upon lessons in coding and presents job possibilities in technology with job shadows, field trips, and internships. At workshops that are free to participants, Hafeez explains to parents their children's potential to impact the world through STEM; they are innovative and problem-solvers in a world that doesn't lean towards natural accessibility. Kids walk away from Deaf Kids Code inspired and more confident. Parents see new possibilities for their child.

There is great demand for programs like Deaf Kids Code and everyone benefits when people with different abilities are engaged in STEM. Instead of leaving it up to parents of children with disabilities to advocate for access, STEM programs can actively ensure that children with disabilities and their parents are welcomed and supported in afterschool and summer STEM programs.³⁴



Photo Courtesy: Deaf Kids Code



Culturally responsive programming

Broadening participation in STEM goes beyond trying to increase the number of youth and families served. To get to #STEM4All we need to uphold practices and programs that maximize the unique strengths, interests, needs, and complexities of communities who are underrepresented in STEM. As an approach to equitable and inclusive programs, culturally responsive STEM is sensitive to the historical disparity of power and privilege between providers and program participants, particularly with respect to cultural differences across race, language, religion, geography, language, and nationality. Non-dominant communities have traditionally been expected to assimilate and respond to the cultures of schools and informal STEM learning centers, such as museums or afterschool clubs. In contrast, culturally responsive family engagement intentionally taps into family culture and history to develop curriculum and approaches that are engaging and meaningful.

A key to culturally responsive practice is self-reflection and a willingness to acknowledge what we don't know about another community's languages, values, customs, local history, ways of knowing, and ways of communicating. By engaging in research and practice with families, we can develop culturally responsive programs that acknowledge our limitations and build from families' knowledge, experiences, and priorities for change.³⁵

Photo Courtesy: Iridescent



PRACTICE IN ACTION

The Exploratorium takes an equity-oriented approach to its **tinkering after-school programs**.³⁶ Rather than setting goals to increase participation they begin with the examination of cultural, political, and economic factors and consider how to account for these in the design of activities and teaching practices. Rather than beginning with the question of who has access to making, they start with the assumption that making practices are present in diverse forms in all communities. They select projects that honor the cultures and experiences of families. Instead of introducing making with 3D projects, robots, and rocket launchers, they support activities like home electronics repair and intergenerational use of sewing machines. Projects like these are responsive to the experiences of their culturally diverse families and serve community needs and interests. Along with engaging in making activities, families are invited to share stories about STEM practices within their homes—like the intergenerational use of sewing machines and kite making, allowing them to draw upon personal resources and experiences and gain new ways of noticing STEM and art activities in their everyday activities.

PRACTICE IN ACTION

The K^wul 'l'tkin Maker Truck project brought together members of the Flathead Reservation and research team from the University of Montana to co-create a mobile makerspace. Named for the Salish and Kootenai words for “to make” the truck brings making activities to schools, powwows, and community events on the reservation.³⁷ Members of the tribes identified cultural making practices—including basket-weaving, drum-making, and beading—as well as other cultural practices that they considered sacred or inappropriate for this project. They provided feedback on each iteration of the making activities. Findings from the project’s pilot research indicate that making activities that are culturally responsive and locally relevant spark greater engagement. For example, in the informal setting of powwows, children spent an average of 29 minutes at cultural STEM making experiences versus seven minutes at non-cultural activities, with equal participation by both boys and girls. Additionally, adults were engaged with their children at the beading and drum stations to a greater extent than in community events. This program’s innovative approach to engaging rural, tribal youth and their families in making and career pathways indicates culture is a powerful entry point into STEM in and out of school. Although the project’s making activities are unique to the tribal community it serves, the program’s culturally responsive, community-based approach offers a promising model for partnerships among tribes and museum, informal science education, and higher education.

PRACTICE IN ACTION

Among the 50 Mott-funded Statewide Afterschool Networks partners is Oregon After School for Kids (**OregonASK**), which supports quality out-of-school time programs for children, youth, and families throughout Oregon. OregonASK offers trainings on curriculum content and technical assistance to front line staff. Family engagement is a key value that ensures that every student has access to learning opportunities. While having had success making connections between in school and out of school, leadership at OregonASK recognized that not all families were as engaged. Equity and access are hallmarks of the Mott Statewide Networks and OregonASK looked for ways to better support families engaged in agriculture-based work and with low rates of educational attainment. In order to better support these families, partners knocked on doors at farmworkers' housing and held dinners to listen and learn from families, and they responded by supporting the hosting of afterschool programs within the housing units and holding conversations to make real connections with families. These lessons went into their "secret sauce" for more inclusive STEM programs, meeting families where they are and creating caring relationships. Lessons like these from OregonASK can help local, state, and national programs be proactive in identifying barriers and finding their own secret sauce for creative and accessible STEM programs for youth and their families.

Photo Courtesy: Oregon After School for Kids



Techbridge Girls realizes cultural responsiveness with the right partner

Techbridge Girls is a national non-profit organization that delivers high quality STEM enrichment programming to girls from low-income communities, who are often girls of color. Since its founding in 2000, Techbridge Girls has prioritized family engagement to support girls' interest in STEM. Among its family engagement efforts are events for girls to showcase their projects to their families, as well as ongoing outreach to families through newsletters, emails, text messages, and handouts.

More recently, Techbridge Girls wanted to expand its capacity to engage with the Somali immigrant population in the Greater Seattle Area. Despite low enrollment from the community, Techbridge Girls leadership was careful not to assume that Somali families were uninterested. Rather, they approached the Somali community with sincere curiosity about why more Somali girls weren't participating and worked toward a more culturally responsive approach to recruiting girls and engaging with families.³⁸ Techbridge Girls recognized that although they were experts in STEM for girls, they knew very little about Somali culture. They addressed this deficit through a partnership with the Somali Youth and Family Club, a community-based organization in Greater Seattle that serves East African refugee and immigrant families. Over time and through numerous in-person conversations, the two organizations built a shared vision for a partnership that addresses mutual needs and strengths.

The partnership led to the development of a workshop series with STEM content that was culturally meaningful for the interests and needs of the Somali families. The workshops addressed significant barriers to participation by taking place at the apartment complex where the women lived and including free child care. Techbridge Girls and the Somali Youth and Family Club connected activities to the participants' lived experiences. For instance, some of the women had been nomadic when they lived in Somalia and built and rebuilt their family dwellings. When they learned the terminology and concepts around the engineering design process, they made the connection to their own efforts designing, building, and improving the homes they created for their families. This connection validated the families' knowledge, enabled the mothers to develop a positive STEM identity, and improved their confidence in being STEM advocates for their girls' futures. Throughout the workshops, participants took part in hands-on activities like what Somali girls do in Techbridge Girls programs. They learned concrete strategies to support their children during STEM activities. They also talked about research on growth mindset, grit, and the engineering design process. Families learned about the rapidly growing number of STEM jobs in the Greater Seattle region and discussed how to encourage their children through various pathways to careers in the engineering and technology sectors.

When Techbridge Girls and the Somali Youth and Family Club launched the project, they didn't know exactly what the program would look like or what the outcomes would be. However, they were committed to two outcomes: (1) that each organization would build its capacity to serve recently immigrated Somali parents better going forward and (2) that they would iterate and revise program content and delivery based on continuous feedback from parents about what was interesting and helpful, and what was not. This work, which relied upon their partnership, took considerable time and proved well worth the investment.



Photo Courtesy: Techbridge Girls

Practice 4: Provide professional development for impactful family engagement

It is common for STEM programs—for both kids and families—to focus more on activities and less on facilitation. As a result, there are missed opportunities for empowering parents. Staff sometimes step in and take over an interaction to assist kids and parents who are struggling through a STEM activity. In other instances, staff may hold back when an interaction is off track, like when a parent tries to get to the “right answer” or “end product” at the expense of their child’s exploration and enjoyment. Staff may be unsure of how to adapt STEM activities for families with children who are disabled.

Impactful family engagement with all children relies upon professional development. With training, staff can support joint engagement between children and parents in STEM programs and sustain discovery at home. In addition, program staff are more confident and comfortable serving students of all abilities and their families when they have training. For professional development to be most helpful, it is important to involve staff by surveying their needs and investing in training and resources to help them support families.

Photo Courtesy: STEM Learning Ecosystems



PRACTICE IN ACTION

STEM Learning Ecosystems offer a means for bringing professional development for family engagement to scale through cross-sector collaborations. This Community of Practice supports national and regional peer-to-peer learning through monthly web-based meetings, technical assistance, and coaching. Family engagement was identified by Ecosystem members as both a priority and a challenge for providing STEM-rich learning environments to all youth. Through surveys and focus group meetings, a steering committee gathered detailed information on these challenges and the support needed by Ecosystems. This input informed a national convening which took a deep dive into family engagement with workshops led by Ecosystems for peer-to-peer learning. What works in an urban community with an abundance of STEM museums and corporations may not be viable for a rural community where STEM-rich institutions are scarce. Workshops address these differences as well as identify shared approaches and resources for family engagement.

PRACTICE IN ACTION

Libraries help play an important role in reducing the opportunity gap in STEM. Libraries exist in almost every community in the country and hold promise for making STEM accessible through free programs that are less structured and less intimidating for inter-generational participation. They offer experiences for youth in under-resourced communities to expand the STEM capital that their peers from more affluent homes gain in afterschool and summer programs. These are particularly important in rural communities where there may be fewer STEM institutions like museums and zoos that are available in larger cities.³⁹

The **STAR Library Network** supports STEM in libraries through partnerships that offer quality curriculum and professional development. Most library staff are not STEM experts, so training in STEM content and facilitation helps develop STEM skills and build confidence. These partnerships co-design professional development that also address family engagement in STEM.⁴⁰ STAR Net uses community dialogues that raise up parent and community voices to ensure that professional development addresses challenges and aspirations for better engaging with ethnically, economically, and geographically underserved and underrepresented audiences.⁴¹ These dialogues have uncovered important insights – such as barriers migrant families face to accessing library resources, and important community venues for promoting STEM programs in libraries. STAR Net offers a series of resources and makes them accessible for the professional development of partners.

Imagine Science invests in professional development

Imagine Science of Orange County is a partnership across Boys & Girls Clubs of Garden Grove, Boys & Girls Clubs of Huntington Valley, Anaheim Family YMCA, 4-H of Orange County, and Girls Inc. of Orange County. This partnership is advancing each organization's support for families of historically underrepresented youth in STEM.

Partners began by brainstorming ideas for deeper family engagement beyond one-time showcase events.

By understanding that family engagement doesn't have to be just what's done in programs, the Imagine Science team expanded its support for families at home. They developed a plan for parents that included question-of-the-day prompts, take-home projects, and resources that included STEM events in the community. This partnership across organizations resulted in several successes and lessons learned about engaging families.

From the program's evaluation, Imagine Science learned that parents were very positive about the program. The summer program offered the first opportunity for many parents to participate in their child's STEM experience. However, parents also shared that participation could have been bolstered by providing advanced notice of program activities and more opportunities for parent involvement.

The take-home family projects and questions of the day were inconsistently utilized, mainly because parents were not aware of them. The experiences of Imagine Science helped surface the challenges of putting resources and research into action. Professional development is critical for optimal use of these resources by families.

Lessons learned from this pilot include start small with modest goals that don't require too much staff time or funding, develop take-home activities to connect families' funds of knowledge with camp activities and, most importantly, support staff to support families. The journey continues for Imagine Science as they take the lessons learned from last year and plan for next summer, with professional development at the center of this work.

Photo Courtesy: Boys and Girls Clubs of Garden Grove



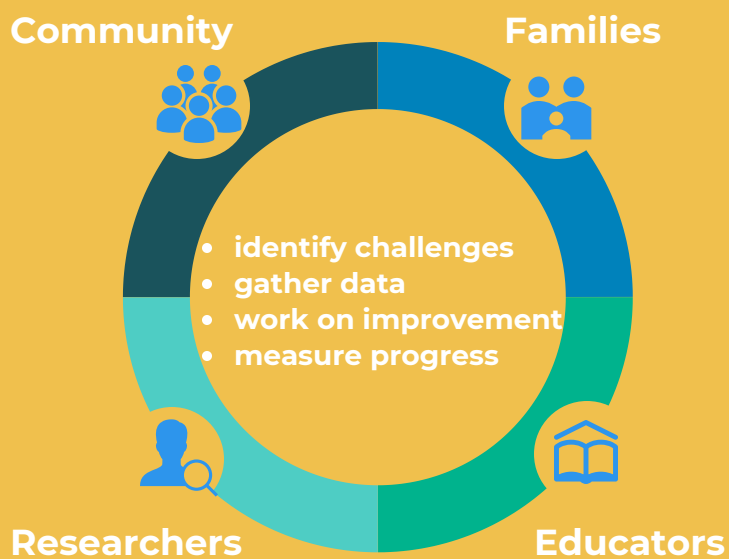
Practice 5: Evaluate impact

Does family engagement amplify program goals and youth outcomes for STEM interest and learning? Are the resources that are developed for families reducing or increasing the STEM divide? How can data improve programs for families? There isn't one resource tool to answer these questions and measure the impact of family engagement as it's more complicated.

The report by the Global Family Research Project proposes “when it comes to family engagement, research is often more complicated than simply isolating effects and practices. Family engagement is a dynamic process existing across time and space.”⁴² As a promising practice, the authors suggest looking to evaluation methods used for Network Improvement Communities.⁴³ With this approach, families, researchers, community, and educators work in partnership to identify challenges, gather data, work on improvement, and measure progress. The work is done through rapid prototyping to learn, revise, and retry quickly.

Evaluation of family engagement does not have to be separate or different from how organizations already evaluate their programs. Guidelines for evaluating out-of-school STEM programs can be applied to family engagement work.⁴⁴ For example, Wilkerson and Haden suggest prioritizing program outcomes that are most important based on the phase of program development and funder needs, creating a long-term evaluation plan that can be revised over time, using less expensive data collection methods like online surveys and social media, keeping survey instruments brief, and learning from evaluations of similar programs. We recognize that evaluation requires resources that tax programs with limited budgets. Research-practice partnerships are a means of handling this challenge and leveraging assets by bringing together organizations doing family engagement and universities and organizations with expertise in research and evaluation.⁴⁵

Family engagement is a dynamic process





Thank you for the feedback: Encouraging parents to speak up

It's important to get input from families, particularly the families you most want to support. Parent feedback can generate innovative program ideas and solutions to overcome challenges. There are a variety of approaches to get input. These include using web surveys and working with a partner that has a trusted relationship with parents.⁴⁶ Inform parents why their feedback matters and how it will be used for program design and improvement.⁴⁷ Also, communicate evaluation results with families.⁴⁸ The next practices in action describe different approaches to encourage feedback from families.

PRACTICE IN ACTION



Photo Courtesy: Scientific Adventures for Girls

Scientific Adventures for Girls keeps kids engaged in STEM through girls-only programs and co-educational classes in schools, libraries, and camps. Staff work hard to engage parents and support their critical role in encouraging future scientists. Feedback from parents is highly valued and is gathered in a variety of ways—both formal and informal. Staff offer incentives for completion of surveys at their Science Family Nights. When parents complete their surveys, they receive a raffle ticket for prizes that are given out at the end of events, which helps encourage parents to stay for all activities and complete their survey.

Survey results reveal that parents understand that it's not just simply knowing science facts that is important, but skills such as hard work, creativity, and teamwork are just as important in science and math. Parents report that these science events are the first for their entire family, and that they are interested in more STEM opportunities as a family unit. In addition, staff encourage feedback in one-on-one conversations at programs. These personal exchanges generate insights into program impact and valuable ideas for program enhancement. Parent feedback has been especially helpful in evaluating the weekly emails sent by instructors about the STEM activities completed at each session. Feedback shows that these updates are very effective; the majority of parents read the emails and report that these messages help them discuss program activities with their daughters and engage in additional STEM activities at home.

PRACTICE IN ACTION

By inviting feedback through surveys, **Digital Youth Divas** discovered ways to support families, especially those who had difficulty participating in the program. For example, they found that child care was a major hardship for many families participating in the workshops. Though Digital Youth Divas hadn't budgeted for child care of extra siblings, they made the need a priority, which positively impacted family turnout. This example of parent feedback leading to child care shows parents that leadership is listening and receptive to their input. Lead Researcher, Caitlin Martin, acknowledges that it can be hard to elicit feedback from families. Most parents are grateful for the program and express appreciation in parent surveys. It requires a concerted effort to get at what parents think, especially when it comes to the shortcomings of a program. The team has added a research component that includes parent focus groups, design workshops, and interviews in order to open a communication channel where parents can talk more deeply about what's working and what's not.



Photo Courtesy: Digital Youth Divas

The Greene Scholars Program evaluates impact with a multifaceted approach

The Greene Scholars Program supports African American youth in Grades 3-12 from dozens of San Francisco Bay Area school districts. It offers youth hands-on learning, leadership training, academic planning, and career exploration. From its beginning 19 years ago, parent engagement has remained a core component of the program model and quite an aspirational one. Parents in the Greene Scholars Program are responsible for every aspect of the program's operations. They help develop curriculum, run an annual science fair and awards event, chaperone events, supervise a summer camp, and write grants. Whether a parent has a background in STEM or not, Executive Director, Dr. Ayodele Thomas, notes, "Everyone has something to give." This model allows the program to do much with limited funding and has the added side benefit of presenting parents with opportunities to develop their own leadership skills along the way. By deeply engaging parents, the program successfully supports students' success in school and in life. The program's evaluation results show that these intensive efforts payoff—100 percent of Scholars who successfully complete the program graduate from high school and continue their education, primarily through 4-year universities and 60 percent major in STEM at college.

For Thomas, learning from parents is critical to the success of the program. She wants to make certain that parents are getting the information and resources they need, and that the program remains relevant during these rapidly changing times. She creates multiple opportunities to really listen and engage parents in program design and evaluation. During informal conversations, Thomas notes helpful feedback and ideas, and reflects these points back to parents. She elicits parent input in surveys upon completion of the program. Within this formal survey, parents are asked to give specific feedback on new program elements, possible programmatic changes for future years, impressions of program impact, and future changes they'd recommend. Thomas then does her best to incorporate their ideas into the program. For example, when a previous parent cohort expressed interest in academic guidance about STEM pathways and how they could help their child be "college ready," the program developed courses and presentations to help parents take a deep dive and support their children from elementary through middle and high school. In addition to the formal parent survey, parents are encouraged to provide informal input on the program through various opportunities.

It can be challenging to get feedback from parents, and Thomas reflects on how parents vary in their willingness to share input. Some are very vocal and share at every meeting while others are more reserved. To address this dynamic, the program dedicates time for parents to give feedback in small groups. Sometimes feedback initiates with casual conversations. In committees, members share what they've heard from parents in informal conversations, and how those points can help improve Greene Scholars' curriculum and parent workshops. These examples illustrate the diverse ways in which feedback is encouraged and family input is incorporated throughout every program element of the Greene Scholars Program.



Photo Courtesy: Greene Scholars Program

Call to action



Photo Courtesy: PowerMyLearning

Family engagement is a game changer

Family engagement is a game changer. Families may bring different levels of knowledge and experience in STEM but they all deserve the educational capital and support for accessing resources for their children. Research and promising practices from innovators in the field like those highlighted in this white paper offer a roadmap for the journey. At the destination, the STEM opportunity gap is reduced.

We can get to #STEM4All with a big, bold approach to family engagement. This will take all of us working together.

Below are six strategies to empower families and unleash the untapped STEM

talent of their children. Whether you have tried family engagement in the past or are exploring family engagement for the first time, we urge you to select a strategy that is most aligned with your local context, organizational goals, and available resources and commit to implementing it in the coming year.



Put parents at the center; listen and learn from families. Create authentic opportunities for parents to inform decision making, exercise leadership, and provide feedback on programs and resources.



Make equity and inclusion primary considerations in family engagement. Strive to reduce opportunity gaps by starting with the needs of families in communities that have historically received the fewest STEM resources. This includes families with girls, from under-resourced communities, in rural settings, and those with children who are disabled.



Support a STEM ecosystem that begins and ends with the needs of families. Every player in the STEM ecosystem – including philanthropic and corporate funders, policy makers, and practitioners – needs to support a pathway for anytime, anywhere STEM engagement of families.



Commit resources to support staff, particularly those working in under-resourced communities. Prioritize funding for professional development not just to enhance STEM expertise but also promote family engagement. And, provide time for staff to build relationships with families.



Evaluate impact on youth and parents to advance #STEM4All. Measure the impact of family engagement on youth outcomes. Build the field with innovative research-practice partnerships and longitudinal studies.



Go bold and big. Scale programs that have successful track records in supporting innovative approaches, particularly with families who have been underrepresented in STEM. Support innovative efforts that push the envelope and take risks to rapidly prototype new approaches to attain #STEM4All.

Embracing family engagement will make it possible for all children—regardless of their background—to engage in STEM. The vision, leadership, and support of policymakers, administrators, educators, and families is critical to doing this work well. In partnership we can elevate family engagement and support students like Sophia introduced at the beginning of this white paper to realize their talent and potential and reimagine a brighter future through STEM.

In Closing

When it comes to family engagement, there is no one-size-fits-all. Family-centered design can help in this work—listen and partner with families, learn from research, and aspire to new approaches. Then, review efforts and redesign for greater impact. Through mindful design with families, you will do more and better to empower families. We encourage you to envision family engagement as a journey and not a destination. Be bold, aspire, innovate, iterate, and evaluate.

- ✓ Be Bold
- ✓ Aspire
- ✓ Innovate
- ✓ Iterate
- ✓ Evaluate

Acknowledgments

We honor the organizations involved in research and programs that have elevated the importance of families in STEM education. Oftentimes with limited resources, they have found creative ways to support families in STEM in out-of-school time. With hands-on experiences, knowledge sharing, and community resources they validate what parents are already doing to support their children and enhance the STEM capital of families. Together, they are helping broaden the participation of youth and families in STEM.

We thank the many individuals who were interviewed for this white paper and those who opened their program doors so we could see their work in action. They were generous in sharing their successes and challenges and helping inform the promising practices and case studies in this white paper.

About the authors

Parent engagement has been part of Dr. Linda Kekelis' life's work. As the Founder and former CEO of Techbridge Girls, Dr. Kekelis made family engagement one of the vital elements of the program and throughout her tenure committed resources to measure impact and better understand how to serve the needs of families. Dr. Kekelis is an advisor on The Family Engagement Project for STEM Next, consults with informal STEM providers and STEM Ecosystem leaders, and chairs the EngineerGirl Steering Committee for the National Academy of Engineering. She received her doctorate in Special Education from the University of California, Berkeley. Her personal lessons about family engagement came from supporting her son's lifelong interest in tinkering and engineering.

Dr. Kara Sammet is a gender equity strategist, corporate trainer, and keynote speaker. She advises changemakers in start-ups, philanthropy, and corporate social responsibility on strategies to create inclusive cultures, combat gender bias, and inspire females to pursue and persist in technology careers. Dr. Sammet is the founder of **Gender Lenz**, a diversity and inclusion consulting firm, an advisor on The Family Engagement Project for STEM Next, and a Visiting Scholar for the University of California Women in Tech Initiative. She received her doctorate in Social & Cultural Studies and Metrics from the University of California, Berkeley. Dr. Sammet is passionate about leveraging social encouragement to inspire girls in tech and is delighted to support her teen daughter's STEM skills via film-making and entrepreneurship.

About STEM Next Opportunity Fund

STEM Next Opportunity Fund is taking a leading role in raising awareness and advancing promising practices on family engagement. Through a multi-year project that leverages research, convenings, publications, and a national social media campaign, STEM Next is pursuing an ambitious agenda on family engagement in the informal realm with application to formal education. Our objectives include convening foundations, corporations, national youth-serving organizations, community-based organizations, and policy makers to reform, elevate, and scale family engagement and catalyze investments in family engagement.

You can learn about our work on STEM Next Opportunity Fund's **website**. We hope you will join us in making family engagement a game changer in attaining #STEM4All.

We welcome your feedback. Send us your comments and questions to familyengagement@stemnext.org.



Endnotes

1. Castro, M., Expósito-Casas, E., López-Martín, E., Lizasoain, L., Navarro-Asencio, E., & Gaviria, J. L. (2015). Parental involvement on student academic achievement: A meta-analysis. *Educational Research Review*, 14, 33-46.
Hill, N. E., & Tyson, D. F. (2009). Parental involvement in middle school: A meta-analytic assessment of the strategies that promote achievement. *Developmental Psychology*, 45(3), 740-763.
Jeynes, W. H. (2007). The relationship between parental involvement and urban secondary school student academic achievement: A meta-analysis. *Urban Education*, 42(1), 82-110.
Jeynes, W. (2012). A meta-analysis of the efficacy of different types of parental involvement programs for urban students. *Urban Education*, 47(4), 706-742.
Wilder, S. (2014). Effects of parental involvement on academic achievement: a meta-synthesis. *Educational Review*, 66(3), 377-397.
2. Weiss, H., Lopez, M. E., & Caspe, M. (2018). *Carnegie Challenge Paper: Joining Together to Create a Bold Vision for Next Generation Family Engagement*. Global Family Research Project. Retrieved from https://www.carnegie.org/media/filer_public/f8/78/f8784565-4bd6-4aa3-bd80-2b98fd43380e/parent-engagement-2018.pdf
3. Bayer. (2015). *Bayer Facts of Science Education XVII. Executive Summary and Key Findings*. Retrieved from https://s3.amazonaws.com/rdcms-pta/files/production/public/Images/Bayer_Facts-Exec_Summary-2015.pdf
4. Silander, M., Grindal, T., Hupert, N., Garcia, E., Anderson, K., Vahey, P., & Pasnik, S. (2018). *What Parents Talk About When They Talk About Learning: A National Survey about Young Children and Science*. New York, NY, & Menlo Park, CA: Education Development Center, Inc., & SRI International.
5. Rozek, C. S., Svoboda, R. C., Harackiewicz, J. M., Hulleman, C. S., & Hyde, J. S. (2017). Utility-value intervention with parents increases students' STEM preparation and career pursuit. *Proceedings of the National Academy of Sciences*, 114(5), 909-914.
Harackiewicz, J. M., Rozek, C. S., Hulleman, C. S., & Hyde, J. S. (2012). Helping parents to motivate adolescents in mathematics and science: an experimental test of a utility-value intervention. *Psychological Science*, 23(8):899-906.
Dabney, K. P., Chakraverty, D., & Tai, R. H. (2013). The association of family influence and initial interest in science. *Science Education*, 97(3), 395-409.
6. Google CS Ed Research Group (2014). *Women who choose computer science--what really matters: The critical role of encouragement and exposure*. Technical report, Google. Retrieved from https://docs.google.com/file/d/0B-E2rcvhnIQ_a1Q4VUxWQ2dtTHM/edit

Endnotes Continued

7. Berkowitz, T., Schaeffer, M.W., Maloney, E.A., Peterson, L., Gregor, C., Levine, S.C., & Beilock, S.L. (2015). Math at home adds up to achievement in school. *Science*, 350, (6257), 196-198.
8. Schaeffer, M. W., Rozek, C. S., Berkowitz, T., Levine, S. C., & Beilock, S. L. (2018). Disassociating the relation between parents' math anxiety and children's math achievement: Long-term effects of a math app intervention. *Journal of Experimental Psychology: General*, 147(12), 1782-1790.
9. Dou, R., Hazari, Z., Dabney, K., Sonnert, G., Sadler, P. (2019). Early informal STEM experiences and STEM identity: The importance of talking science. *Science Education*, 1-15.
10. Remake Learning. (2007). Learning Together. *A decade of collaboration and learning across Greater Pittsburgh and West Virginia*. Retrieved from https://remakelearning.org/wp-content/uploads/2017/10/Learning-Together_digital.pdf
11. Chand, S. (2018). *Remake Learning Days Report to Sponsors*. Pittsburgh, PA.
12. Ishimaru, A.M., & Bang, M. (2016). *Toward a Transformative Research and Practice Agenda for Racial Equity in Family Engagement*. 2015-2016 Family Leadership Design Collaborative White Paper. Seattle: University of Washington: UW-FLDC Research Team.
13. IDEO. *IDEO.org approach on human-centered design*. Retrieved from <https://www.ideo.org/approach>
14. Mariam, A. (2018). *Parent Innovation Institute: Co-creating Solutions with Parents*. Global Family Research Project blog. Retrieved from <https://globalfrp.org/Articles/Parent-Innovation-Institute-Co-creating-Solutions-with-Parents>
- Singh, S. (2019). *Sustaining a Human-Centered Design Approach to Engaging Families*. Global Family Research Project blog. Retrieved from <https://globalfrp.org/Articles/Sustaining-a-Human-Centered-Design-Approach-to-Engaging-Families>
15. Global Family Research Project. (2018). *Human-Centered Design: An Innovative Tool for Professional Learning in Family Engagement*. Retrieved from https://globalfrp.org/content/download/295/3154/file/GFRP_Human-CenteredDesignGuide.pdf
16. Spicer, J. (2018). Moving Beyond the 4 Myths of Maker Education. *Education Reimagined*. Retrieved from <https://education-reimagined.org/myths-of-maker-education/>

Endnotes Continued

17. Bequette, M., Causey, L., Schreiber, R., Pennington, R., Braafladt, K., & Svarovsky, G.N. (2018). *Summaries of the Making Connections Project and Play Tinker Make Activities*. Science Museum of Minnesota. Retrieved from <http://www.informalscience.org/sites/default/files/Making%20Connections%20Practitioner%20Guide.pdf>
18. Roque, R., & Leggett, S. (2017). *Family Creative Learning Facilitator Guide*. Retrieved from <http://familycreativelearning.org/guide/FCLGuide-20170628.pdf>
19. Honey, M. (2016). A Parent's Role in STEM Education. *Medium*. Retrieved from <https://medium.com/carnegie-corporation-education-program/a-parents-role-in-stem-education-c4bd26574fdf>
20. Henriquez, A. (2018). NYSCI Neighbors. Creating Locally Driven Authentic Opportunities for Immigrant Parents in a STEM Ecosystem. In M. Caspe, T.A. Woods, & J.L. Kennedy (Eds.) *Promising Practices for Engaging Families in STEM Learning*, pp. 137-146. Charlotte, NC: Information Age Publishing.
21. Bayer (2015). *Bayer Facts of Science Education XVII. Executive Summary and Key Findings*. Retrieved from https://s3.amazonaws.com/rdcms-pta/files/production/public/Images/Bayer_Facts-Exec_Summary-2015.pdf
22. Schaeffer, M.W., Rozek, C.S., Berkowitz, T., Levine, S.C., & Beilock, S.L. (2018). Disassociating the relation between parents' math anxiety and children's math achievement: Long-term effects of a math app intervention. *Journal of Experimental Psychology: General*, 147(12), 1782-1790. Retrieved from <http://dx.doi.org/10.1037/xge0000490>
23. Hill, C., Corbett, C., & St. Rose, A. (2010). Carol Dweck research reported in *AAUW Why So Few? Women in Science, Technology, Engineering, and Mathematics*. Washington, DC: AAUW. Retrieved from https://www.aauw.org/aauw_check/pdf_download/show_pdf.php?file=why-so-few-research
24. Ahumada, J., Gragg, M., & Gonzalez, R.. (2017). *Curiosity Machine family workbook. A guide for families who want to learn and build together*. Los Angeles: Iridescent. Retrieved from <https://s3.amazonaws.com/curiositymachine/units/resources/familyworkbook-ENG.pdf>
Curiosity Machine and Parents. Growth Mindset. (2018). Youtube videos. Los Angeles: Iridescent. Retrieved from <https://www.youtube.com/watch?v=zZotlhAwZfl>
25. Girl Scout Research Institute. (2019). *Decoding the Digital Girl. Defining and Supporting Girls' Digital Leadership*. New York: Girl Scout Research Institute. Retrieved from https://www.girlscouts.org/content/dam/girlscouts-gsusa/forms-and-documents/about-girl-scouts/research/GSUSA_GSRI_Decoding-the-Digital-Girl_Full-Report.pdf
26. *Raising Awesome Girls website*. New York: Girl Scouts of the USA. Retrieved from <https://www.girlscouts.org/en/raising-girls/school/STEM.html>

Endnotes Continued

27. York, B.N., & Graham, T. (2017). Evidence-based text messages for parents. *Ready at Five School Readiness Symposium – Equity in Literacy Must Start Early*. Retrieved from https://www.readyatfive.org/images/Ready4K_-_Ready_at_Five_-_School_Readiness_Symposium_-_2017_December_14.pdf
- Nazarian, T. (2018). With \$2.65M Seed Funding, Creator of Ready4K Aims to Build ‘On-Demand Library for Parenting Tips.’ *EdSurge*. Retrieved from <https://www.edsurge.com/news/2018-01-17-with-2-65m-seed-funding-creator-of-ready4k-aims-to-build-on-demand-library-for-parenting-tips>
28. Pinkard, N. & Austin, K. (2010). Digital Youth Network: Creating New Media Citizens through the Affinity Learning Model. *International Journal of Learning and Media*, 2(4).
29. Barron, B., Martin, C.K., Takeuchi, L., & Fithian, R. (2009). Parents as learning partners in the development of technological fluency. *International Journal of Learning and Media*, 1, 55-77.
- Martin, C.K., Pinkard, N., Erete, S., & Sandherr, J. (2016). Connections at the family level: Supporting parents and caring adults to engage youth in learning about computers and technology. In Y. Rankin & T. Jakita (Eds.), *Moving Students of Color from Consumers to Producers of Technology* (pp. 220-244). Hershey, PA: IGI Global.
30. Miller, C.C. (2018, December 25). The relentlessness of modern parenting. *The New York Times*. Retrieved from <https://www.nytimes.com/2018/12/25/upshot/the-relentlessness-of-modern-parenting.html>
31. DiSalvo, B., Reid, C., & Roshan, P.K. (2014). They Can't Find Us: The Search for Informal CS Education. *Proceedings of the 45th Association for Computing Machinery Special Interest Group on Computer Science Education*, 487-492. doi>10.1145/2538862.2538933
32. Breiner, H., Ford, M., & Gadsden, V.L. (Eds.) (2016). *Parenting Matters: Supporting Parents of Children Ages 0-8*. Washington, DC: The National Academies Press.
33. Keeling, D. (2016). 5 Reasons Employers Should Care about Families and Schools. *EdNavigator*. Retrieved from <https://www.ednavigator.com/blog/5-reasons-employers-should-care-about-families-and-schools>
34. Kekelis, L. (2018). *Set a Place at the STEM Table for Youth with Disabilities and their Families*. San Diego: STEM Next Opportunity Fund, Retrieved from <http://43ot971vwwe7okplr1iw2ql1-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Set-a-Place-at-the-STEM-Table.pdf>
35. Ishimaru, A. M., & Bang, M. (2016). *Toward a Transformative Research and Practice Agenda for Racial Equity in Family Engagement. 2015-2016 Family Leadership Design Collaborative White Paper*. Seattle: University of Washington: UW-FLDC Research Team. Retrieved from <http://familydesigncollab.org/wp-content/uploads/2017/03/FLDCConvening-Report-Fin-033117.pdf>

Endnotes Continued

36. Vossoughi, S., Escudé, M., Kong, F., & Hooper, P. (2013, October). Tinkering, learning and equity in the after-school setting. Paper presented at the annual *FabLearn conference*, Stanford University, Stanford, CA.
Vossoughi, S., Hooper, P.K., & Escudé M. (2016). Making Through the Lens of Culture and Power: Toward Transformative Visions for Educational Equity. *Harvard Educational Review*, Vol. 86 No. 2.
37. Truitt, H., Swaney, R., Swaney, W., Wethington, N., & Wolfram, N. (2018). Cocreating Transformative Change Making Collective Impact With the Flathead Nation. *Connected Science Learning*, Issue 7. Retrieved from <http://csl.nsta.org/2018/09/cocreating-transformative-change/>
38. Sammet, K., & Kekelis, L. (2018). *Expanding Access and Inclusion in STEM through Culturally Responsive Family Engagement*. San Diego: STEM Next Opportunity Fund. Retrieved from https://43ot971vww7okplr1iw2ql1-wpengine.netdna-ssl.com/wp-content/uploads/2018/07/Case-Study_Expanding-Access-and-Inclusion-in-STEM.pdf
39. Lopez, M. E., Jacobson, L., Caspe, M., & Hanebutt, R. (2019). *Public Libraries Engage Families in STEM*. Boston: Global Family Research Project. Retrieved from <https://globalfrp.org/Articles/Public-Libraries-Engage-Families-in-STEM>
Buterbaugh, J. (2016). Research project brings STEM education to rural families. *Penn State College of Education News*. Retrieved from <https://ed.psu.edu/news/2016-10-12-news/stem-education-rural-families>
40. Shtivelband, A., Roberts, A.W., & Jakubowski, R. (2016). *STEM Equity in Informal Learning Settings: The Role of Public Libraries*. Boulder, CO: National Center for Interactive Learning & Science-Technology Activities & Resources for Libraries. Retrieved from <http://ncil.space-science.org/images/papers/STEM-Equity-Informal-Learning-Settings-122316.pdf>
41. LaConte, K., Holland, A., Lewis, L., & Ross, M. (2018). *Community Relationships to Build Family Access to STEM Learning*. Boston: Global Family Research Project. Retrieved from <https://globalfrp.org/Articles/Community-Relationships-to-Build-Family-Access-to-STEM-Learning>
42. Weiss, H.B., Lopez, M.E., & Caspe, M. (2018). *Joining Together to Create a Bold Vision for Next Generation Family Engagement*. New York: Carnegie Corporation of New York. Retrieved from https://globalfrp.org/content/download/419/3823/file/GFRP_Family%20Engagement%20Carnegie%20Report.pdf
43. Bryk, A.S., Gomez, L., & Grunow, A. (2011). Getting Ideas into Action: Building Networked Improvement Communities in Education. M. Hallinan, (Ed.), *Frontiers in Sociology of Education*. New York: Springer Publishing. Retrieved from <https://www.carnegiefoundation.org/resources/publications/getting-ideas-action-building-networked-improvement-communities-education/>

Endnotes Continued

44. Wilkerson, S.B., & Haden, C.M. (2014). Effective Practices for Evaluating STEM Out-of-School Time Programs. *Afterschool Matters*, 10-19. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1021960.pdf>
45. Bevan, B., Ryoo, J.J., Forrest, J., & Penuel, W.R. (2015). *Enriching and Expanding the Possibilities: Research-Practice Partnerships in Informal Science Education*. San Francisco: Research + Practice Collaboratory. Retrieved from http://researchandpractice.org/wp-content/uploads/2015/10/synthesis_InformalRPPs_Oct2015.pdf
46. Dillman, D. A., Smyth, J. D., & Christian, L. M. (2009). *Internet, mail, and mixed-mode surveys: The tailored design method* (3rd ed.). Hoboken, NJ: John Wiley & Sons.
47. Murchison, L., Brohawn, K., Fancsali, C., Beesley, A.D., & Stafford, E. (2019). The Unique Challenges of Afterschool Research. A Practical Guide for Evaluators and Practitioners. *Afterschool Matters*, No. 29, 28-35. Retrieved from <https://niost.org/Afterschool-Matters-Spring-2019/the-unique-challenges-of-afterschool-research>
48. Ferrari, T.M., Futris, T.G., Smathers, C.A., Cochran, G.R., Arnett, N., & Digby, J.K. (2006). Parents' perceptions of family involvement and youth outcomes at an urban 4-H education center. *The Forum*, Vol. 11, No. 2. Retrieved from <https://www.theforumjournal.org/2006/12/03/parents-perceptions-of-family-involvement-and-youth-outcomes-at-an-urban-4-h-education-center/>