STEM READY AMERICA

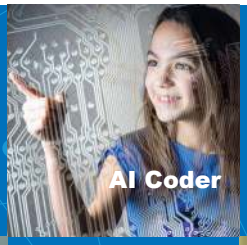
Inspiring and Preparing Students for Success With Afterschool and Summer Learning

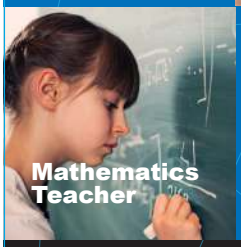
This collection of articles is excerpted from a new resource, *STEM Ready America: Inspiring and Preparing Students for Success with Afterschool and Summer Learning.* In this volume, Executive Editor Ron Ottinger and Contributing Editors Cary Sneider and Ian Hickox have collected expert perspectives on the state of the field of STEM learning—especially in afterschool and summer learning opportunities.

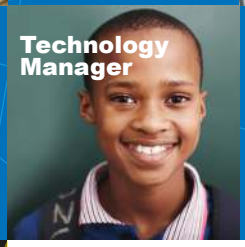
Collectively, these writings from more than 40 thought leaders highlight how young people are developing STEM knowledge and skills that will prepare them to be successful in school today and the workforce tomorrow.

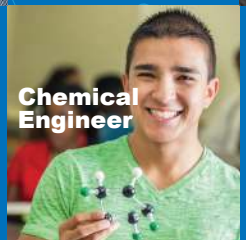
The articles provide persuasive evidence and real-world examples to inform effective partnerships, policies, and actions to bring quality STEM learning to children and youth across the nation. This volume is focused in three key sections:

- **The Evidence for STEM**
- **Partnerships for STEM Learning**
- **Ensuring Access to Quality STEM Learning**









Developed by STEM Next with support from the Charles Stewart Mott Foundation, *STEM Ready America* builds on the award-winning 2013 publication *Expanding Minds and Opportunities: Leveraging the Power of Afterschool and Summer Learning for Student Success* edited by Terry K. Peterson, Ph.D., which made the definitive case for the power and effectiveness of afterschool programs and summer learning.

For more information about STEM Ready America and to download articles visit: www.stemreadyamerica.org.

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Evidence and examples on how young people are developing STEM knowledge and skills that will prepare them to be successful in school today and the workforce tomorrow.
www.STEMReadyAmerica.org

Career and College Exploration in Afterschool Programs in Science, Technology, Engineering, and Mathematics (STEM)

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STEM Next | Charles Stewart Mott Foundation

A high school diploma is no longer enough to get by in the current job market. A Georgetown University report projects that by 2020, 65 percent of all jobs in the United States economy will require postsecondary education and training beyond high school compared to 28 percent in 1973 (Carnevale, Smith, & Strohl, 2013). The trends responsible for the increased need for a skilled workforce include a transition to a skill-intensive service economy with increased productivity, demands for more sophisticated goods, and a rise in information technology (Carnevale & Rose, 2015).

High-level knowledge, skills, and abilities are crucial to success in our current economy, and science, technology, engineering, and mathematics (STEM) knowledge and skills are increasingly necessary. STEM jobs are among the fastest growing occupations in the country. Between 2010 and 2020, 2.6 million STEM job openings are projected to be created, a growth rate of 26 percent (Carnevale, Smith, & Strohl, 2013). Significantly, 95 percent of STEM occupations require postsecondary education and training, the highest concentration among all occupations (Carnevale, Smith, & Stohl, 2013). Despite the need for a more highly skilled STEM workforce, only 41 percent of 2016 ACT-tested high school graduates met the college readiness benchmark in mathematics, 36 percent met the benchmark in science, and only 26 percent met college readiness benchmarks in all four subjects (ACT, 2016).

In addition to postsecondary credentials, youth need other in-demand skills to succeed at work. Tony Wagner, at Harvard University, argues that in today's knowledge economy, students need skills such as critical thinking, collaboration,

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communication, creativity, adaptability, imagination, and entrepreneurism to be successful in college and to participate economically and civically. He laments the fact that these skills are noticeably underemphasized in instruction and assessments in American schools and that youth have few opportunities to develop such skills in school settings (Wagner, 2010). Additionally, in a survey of 400 employers and over 600 college students, researchers found that employers highly value "cross-cutting skills," such as written and oral communication and teamwork, skills that are applicable to all fields or content areas. Many college students reported their colleges were doing well at preparing them for the workforce, while employers indicated room for improvement (Hart Research Associates, 2015).

We can do a better job helping prepare our youth for careers, and STEM careers in particular, by both improving what happens in schools and by providing high-quality learning opportunities through afterschool and summer programming. Afterschool programs are an important component of the "learning ecosystem" that is made up of various institutions working together to support student learning and development, especially in STEM education (Krishnamurthi, Ballard, & Noam, 2014). Afterschool programs create learning opportunities that build academic and employer-desired skills, expose youth to college and career opportunities, and foster youth identity development. In addition to these opportunities for learning, development, and exposure, afterschool programs contribute to positive outcomes like increased attendance and reduced delinquency (Afterschool Alliance, 2011). Furthermore, participation and demand for afterschool programs are higher among children from low-income households compared to high-income households, and higher among African-American and Hispanic children than Caucasian children (Afterschool Alliance, 2014). As these populations are traditionally underserved and underrepresented, especially in STEM fields, afterschool programs can serve as

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vehicles for expanding opportunity for these youth. Afterschool and summer learning programs are able to both prepare youth for postsecondary education and for careers in various ways. Afterschool and summer learning programs can expose youth to potential careers and the requirements to obtain jobs in STEM professions. These settings can highlight the importance of college by taking youth on visits to college campuses, working with students and families to identify prospective colleges, providing assistance in the college application process, helping families navigate the financial assistance jungle, and providing encouragement and support to students who would not otherwise see themselves as college-goers. These activities, which many high schools do not have the time and resources to provide, are key to helping students become college-ready and make a successful transition into college (Education Trust-West, 2011; Herrera, Linden, Arbreton, & Grossman, 2011; Seftor, Mamun, & Schirm, 2009; Bowles & Brand, 2009).

It is particularly important for certain groups of students to have access to high-quality afterschool programs that expose them to STEM careers. Women, African Americans, and Hispanics are historically underrepresented in STEM employment.

Afterschool and summer learning programs can also provide youth with opportunities to learn about careers, participate in internships or work experiences, participate in community service or volunteer projects, and even earn a stipend for their work. Since activities of this nature are rarely scheduled into the regular school day, they are important for youth who have little exposure to careers or who are unfamiliar with the workplace (Afterschool Alliance, 2009; Halpern, 2008; Hirsch, Hedges, Stawicki, & Mekinda, 2011; Moran, n.d., Bowles & Brand, 2009).

It is particularly important for certain groups of students to have access to high-quality afterschool programs that expose them to STEM careers. Women, African Americans, and Hispanics are historically underrepresented in STEM employment (Landivar, 2013). These subpopulations are less likely to participate in high-level STEM coursework in high school, which is associated with pursuing STEM majors in college, contributing to underrepresentation in the field (Tyson, Lee, Borman & Hanson, 2007; Maltese & Tai, 2010; National Science Foundation, 2017). Additionally, a survey of high school students conducted by the Research Consortium of STEM Career Pathways found that while males and females alike equally understand the importance of STEM courses for their careers, females are 38 percentage points less likely than males to aspire to a STEM career and are less confident in their STEM abilities (Student Research Foundation, 2016). Afterschool programs can serve a critical role in exposing youth, especially those from underrepresented populations, to STEM fields.

Examples of High Quality STEM Afterschool Programs

The programs described below exemplify how high-quality afterschool and summer learning programs provide not only learning opportunities for students to further explore STEM fields but also an intentional focus on postsecondary educational opportunities and careers within those STEM fields. The programs profiled below include Project Exploration, Lehigh Carbon Community College Schools and Homes in Education Program (SHINE), and Evoking Learning and Understanding Through Investigations of the Natural Sciences (EVOLUTIONS).

Project Exploration

Among Project Exploration students and alumni surveyed, 95% had graduated high school or were on track to graduate, nearly double the overall average of Chicago Public School students.

Project Exploration is a nonprofit organization that empowers and mentors underrepresented youth in Chicago, Illinois, through free experiential science, technology, and engineering programming during out-of-school time. Project Exploration serves approximately 300–400 Chicago Public School students annually in grades 6–12. The program seeks to increase the accessibility of STEM programs, by primarily serving youth of color, low-income youth, females, and those who would be first-generation college students—with a mission of addressing issues of equity, access, and opportunity in secondary and postsecondary education and STEM fields. The program does more than build scientific knowlede; it also encourages development of nonacademic skills like leadership, teamwork, and self-confidence, and creates programming with student's interests and experiences in mind. Additionally, Project Exploration focuses on developing long-term relationships among students, science educators, scientists, and mentors (Change the Equation, n.d.; One Good Deed Chicago, n.d.). STEM Facilitators, individuals who are currently studying or have recently graduated from college in a STEM field, act as mentors and points of contact for students. Programs include summer opportunities to work alongside practicing scientists; Sisters4Science, a leadership development program for middle-school girls led by female facilitators; Science Giants, a program in which high school students train to be junior STEM Facilitators and work with elementary school students; and Science Digests, daylong programs in which students can work with a STEM professional on hands-on activities. Project Exploration has produced positive student outcomes and become a leader of STEM efforts in Chicago. A 10-year retrospective study found that among students and alumni surveyed, 95 percent had graduated high school or were on track to graduate, nearly double the Chicago Public Schools' overall rate (Chi, Snow, Goldstein, Lee, & Chung, 2010; Lyon, 2011). Sixty percent of students in the report said they had enrolled in four-year colleges to pursue STEM fields; further, 60 percent of those students who graduated college did so with a degree in STEM-related fields (Chi, Snow, Goldstein, Lee & Chung, 2010; Lyon, 2011).

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In addition, Project Exploration is leading work in Chicago to develop a STEM Learning Ecosystem through the work of the Chicago STEM Pathways

Cooperative (STEM Co-op). The STEM Co-op is a citywide effort to improve, identify, and connect opportunities for STEM learning for children and youth in the city of Chicago from cradle to career, regardless of ability or background. The STEM Co-op will build a robust strategy and backbone for coordination across diverse sectors involved with STEM teaching and learning. Ultimately, informed by shared data, the STEM Co-op aspires to build instructional leadership among partners, ensure access to STEM opportunities for all Chicago young people, and improve quality across programmatic settings. The STEM Co-op has cross-sector commitment from diverse stakeholders, including the Chicago Public School system; afterschool, out-of-school time, and summer programs; STEM-focused community institutions, including museums and science centers; institutions of higher education; STEM professional associations; private sector STEM-focused companies; and philanthropic foundations.

Among SHINE students who were specifically identified as being in need of improvement, over an eight-year span of data collection, 81% of those students improved their homework completion, and 79% improved their academic performance.

SHINE

Lehigh Carbon Community College SHINE is a 21st Century Community Learning Centers afterschool program administered by the Lehigh Carbon Community College (LCCC). The program began as part of a grassroots movement in Carbon County, Pennsylvania, to provide a pipeline of educational and social services for children from birth through college. SHINE serves students at 11 sites across 7 school districts that span more than 700 miles in rural Pennsylvania (Afterschool Alliance, n.d.). One of the four core goals of the program is to increase students' knowledge of STEM. The program has done so by creating comprehensive programming for multiple age groups. SHINE has developed a 32-week intensive afterschool curriculum based on state and national standards for fourth and fifth grade students. The program emphasizes STEM (specifically high-priority occupations), workforce skills, and nonacademic skills like problem solving and communication. This STEM pipeline continues as students in sixth through eighth grades have the opportunity to participate in the SHINE Career Academy, in which they engage in hands-on

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activities and skill experiences with a focus on high-priority science, technology, engineering, arts, and mathematics (STEAM) careers. The Academy takes place at the Carbon Career and Technology Institute, providing students with access to STEM educators, laboratories, and equipment. Students complete six 6-week career projects on topics such as environmental science, car design, and robotics. Strong relationships with business and industry allow these partners to contribute to curriculum, host student projects, and serve as guest lecturers (Afterschool Alliance, n.d.). As a result, students not only expand their STEM knowledge but also gain exposure to college and career pathways in STEM fields.

Among students who were specifically identified as being in need of improvement, over the eight-year span of data collection, 81 percent of those students improved their homework completion, and 79 percent improved their academic performance (Institute for Public Policy & Economic Development, 2016). As measured using the Harvard PEAR assessments, the report notes that the majority of students reported they were excited about math and science (The Institute for Public Policy & Economic Development, 2016).

EVOLUTIONS

EVOLUTIONS offers SciCORPS, a youth employment program where students can gain paid work experience by working as science interpreters at the Peabody Museum.

EVOLUTIONS is a multiyear afterschool program for high school students at the Yale Peabody Museum of Natural History in New Haven, Connecticut. The program focuses on four main areas: science literacy, college preparation, career awareness, and transferrable skill development. The program serves approximately 120 students—primarily students of color and low-income students—about half of which would be the first generation in their family to attend college. Through EVOLUTIONS, students have the opportunity to learn about current research in STEM fields, receive college counseling and take tours of local colleges, build a résumé, have an internship, and develop employer-desired skills like leadership and communications. Additionally, through participation in the program, students can earn academic credit, as well as community service or work hours. EVOLUTIONS seeks to recruit students in ninth and tenth grade and maintain their participation until they graduate. Ninth and tenth graders take weekly classes with hands-on activities and field trips that culminate in research and creation of an exhibit that is displayed in the museum.

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In addition to weekly classes, EVOLUTION offers SciCORPs, a youth employment program where students can gain paid work experience by working at the Peabody Museum. Participants begin as volunteers; they then become science interpreters who share knowledge with visitors. Finally, they become program fellows who act as supervisors and content developers. A select group of EVOLUTION afterschool participants also have the opportunity to work as paid interns in Yale University science labs alongside faculty and graduate students.

Through annual pre- and post-experience surveys and focus groups, students indicate that knowledge about college and careers and the ability to have a paid internship or job opportunity are some of the primary benefits of participation in the program (Rath, 2016). In 2016, 75 percent or more of all students surveyed reported increases in the ability to conduct science and work in teams as well improvements in communication skills, field research skills, and science literacy (Rath, 2016). Additionally, more than 63 percent of parents said that EVOLUTIONS had increased their child's school performance and more than 75 percent said the program helped their child prepare for college (Afterschool Alliance). In spring 2017, of the 25 graduating seniors of EVOLUTIONS, all have postsecondary plans: 24 will be attending college, and one will serve in the military (A. Motto, personal communication, May 8, 2017).

These three programs highlight how afterschool and summer learning programs can be structured in a multitude of ways while being intentional in their content focus and facilitating real-world experience for youth and exposure to STEM postsecondary and career opportunities that build employer-desired skills.

Conclusions & Recommendations

Many afterschool and summer learning programs expose children and youth to engaging and exciting STEM activities and ideas. Not all programs are intentional about helping youth prepare for study or careers in those STEM fields. At a time when our economy needs more individuals with STEM skills, and the average citizen needs a working knowledge of STEM, afterschool and summer learning programs can be a tremendous resource to help more youth be college and career ready in STEM. Here are some steps program leaders can take to promote more STEM learning.

Intentional and explicit focus on STEM. Program leaders can ensure that afterschool and summer learning programs have an intentional and explicit focus on developing students' STEM knowledge, skills, and identity. While many programs incorporate aspects of STEM learning, the activities are sometimes randomly incorporated and lack a comprehensive focus. Programs can develop STEM activities that are consistent and intentional, developmentally appropriate for age and interest, and that lead to higher levels of knowledge and engagement. Afterschool and summer programs can also offer learning opportunities like project-based learning, working with professionals in the field, and developing a network of mentors and connections that enable students to engage with STEM concepts within a real-world context. Such programs can encourage and inspire students—especially girls and students from populations underrepresented in STEM fields—to develop a STEM identity and pursue further learning experiences, including postsecondary education and STEM careers.

Preparation for college. Afterschool and summer program leaders can also arrange for youth to tour college campuses, where they can see and learn about STEM-focused college studies or use college facilities for STEM projects. Mentors and advisors can help youth in selecting postsecondary education institutions in STEM fields and support them during the application and financial aid process. Exposure and guidance for how to prepare for and pursue STEM at the postsecondary level is especially important for youth from populations underrepresented in STEM fields.

Career awareness and readiness. Afterschool and summer learning programs can expose youth to STEM careers by inviting STEM professionals to speak about their jobs, help youth with projects, mentor youth, or provide tours of their workplaces. Having opportunities for youth to experience a workplace, and even earn money, can be a tremendous benefit. Apprenticeships or internships are one option; work experience can also be gained from volunteer or service projects during which youth work side by side with skilled adults and mentors. Asking young people to make presentations and practice communication, collaboration, and teamwork are all important skills that are highly valued in the workplace and are often a natural part of afterschool and summer learning programs. It is also helpful for programs to explicitly make the connection between learning certain skills and their value to employers, so youth understand that their efforts really make a difference to their future.

Youth need to develop a wide range of knowledge, skills, and abilities to be successful adults and participate fully in the labor market. This is especially true for underrepresented and at-risk populations. Afterschool and summer learning programs should be viewed as an essential component in the learning ecosystem to help more youth be prepared for careers in STEM.

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