Services for Maximizing the Educational and Economic Impact of STEM
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Executive Summary

Since its founding nearly 10 years ago, Science Foundation Arizona has helped institutions of many sizes and types capitalize on the promise of science, technology, engineering, and math education to advance human talent and economic opportunity. With an array of proven services, SFAz is now offering its expertise for hire to institutions that desire to achieve success in these important areas, which have such an important role in workforce preparedness and economic growth. Our offerings include these critical programs:

I. **STEM Success Analysis**
   Featuring expert review and data-based assessment to help initiate, grow, and improve STEM programs for maximum educational and economic value at every level of K-20 education.

II. **STEM Success Strategic Planning**
   Delivering comprehensive, tailored strategies that increase the quality and number of STEM K-20 students and degrees, including for underserved communities.

III. **STEM Success Implementation**
   Providing expert guidance (including pedagogical, curricular, and program design) to boost the number of STEM students who earn certificates and associate’s, bachelor’s, and advanced degrees.

IV. **STEM Success Sustainability**
   Offering strategies and practices that:
   - increase success in securing grants from major non-profit foundations, notably the National Science Foundation; and
   - engage business and community collaborations across the K-20 system, including public-private partnerships, cross-training programs, and internship programs.
The Challenge

Science and technology have transformed the economy. In so doing, they have opened up job opportunities at a dramatic pace and created exciting prospects for individuals with the education to capitalize on what can be life-changing careers.

Economic growth in communities across the country, and in many ways for the U.S. as a whole, increasingly depends upon innovations and talent in STEM fields. But for all the recent expansion in related economic areas, the nation’s elementary, secondary, and post-secondary education system (“K-20”) is not meeting the demands of powerful national and global trends in science and technology.

The resulting deficiencies are a challenge to the education system and economy, and to communities and states nationwide. More than that, these deficiencies create daunting prospects for the countless individuals who are facing tectonic scientific and technological forces, and aspiring to build a better future, despite inadequate education or training.
1. The SFAz History

SFAz was founded in 2006 as a grant-making organization through a joint commitment of Arizona industry leaders and the state’s executive and legislative branches. Its charge was to advance and diversify the educational, scientific, and economic future of Arizona by:

- Investing in scientific and engineering areas of greatest economic importance to Arizona.
- Facilitating strategic collaborations among Arizona research institutions, educational institutions, and industry.
- Supporting effective education in STEM fields.
- Attracting and retaining world-class jobs and talent.

Building on that mission, in 2008 SFAz created the Arizona STEM Network, which extended its work and made it a leader in leveraging the strengths of the most successful education programs for educational and economic advancement. The network is now an effective collaboration of businesses, educators, government, and philanthropy. SFAz acts as the backbone organization by convening partners, facilitating communications, and helping to coordinate activities across sectors.

Along the way, SFAz has developed five STEM Resource Guides, evaluated and endorsed by the national STEMx Network, to help schools, districts, and community colleges assess their STEM education delivery, implement STEM best practices, and create more comprehensive STEM programs. SFAz also has identified, evaluated, and collated more than 400 open-source STEM resources and tools for teachers, students, and parents that expert insights continue to dynamically improve.
# 2. The SFAz Impact

In its first decade, SFAz’s initiatives have resulted in a **wide-ranging series of educational and economic benefits** for Arizona and other states. These advances include the following:

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<th><strong>Awarded nearly $51.6 million in grants</strong> focused on improving and expanding STEM education.</th>
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<td><strong>Involved 6,326 students in early college STEM academies</strong> via a network of rural community colleges.</td>
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<td><strong>Funded programs reaching nearly 508,841 students and 14,113 K-12 teachers</strong> statewide, notably across many rural areas.</td>
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<td><strong>Supported 460 STEM internships, and 1,583 STEM certifications and degrees</strong>, and certifications via this rural community college network.</td>
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<td><strong>Assisted 11 Hispanic-serving community colleges</strong> in planning STEM pathways strategies and competing for external funding with <strong>30% success</strong> and <strong>$1.05M</strong> awarded through NSF grants.</td>
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<td><strong>Built a statewide network of STEM support</strong> for educators, non-profit organizations, and industry groups.</td>
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Western Maricopa Education Center (West-MEC) was created as a Joint Technical Education District in 2002 to assist both high school students and young adults in finding a faster way forward in life, notably through career and technical education. Today West-MEC includes 12 member high school districts, covers more than 3,600 square miles, and serves more than 23,000 students.

SFAz provided to West-MEC its sustainable internship model for community colleges and technical high schools, which they implemented with seed funding that SFAz awarded with support from a private foundation. The model requires targeted industry coordination and student assignments with funding in the form of stipends.

SFAz built this model after identifying a serious problem: Because the education and business communities focus on placing four-year degree students in internships with mid-to-large sized companies, there are grossly underdeveloped opportunities for middle-skills students at small- to medium-sized companies. This problem persists even though middle-skill jobs account for 53% of Arizona’s labor market. In fact, only 47% of the state’s workers are trained to the level of the highly technical, STEM-based middle skills.

For the past few years, West-MEC and SFAz have worked together to deliver the SFAz Middle Skills Internship Program for West-MEC students. The many positive results include these impacts on individual lives:
167 students have enrolled in the Medical Assistant Program, completed internships and became eligible for certification testing.

88 (53% of internship completers) were offered a job.

59 of the 61 industry sites will take interns again next year.

The program has proven so valuable that West-MEC has moved the administrative and infrastructure costs off the grant and institutionalized them as part of its own operating budget.
3. The SFAz Services

Today SFAz has a two-pronged mission:

1. SFAz continues to secure grants from a wide range of institutions, mostly national foundations, and to use those funds to build strong STEM-oriented programs at diverse K-20 institutions.

2. Through its cadre of STEM experts, SFAz delivers fee-based services to state organizations, K-12 schools and school districts, community colleges, and colleges and universities interested in strategically improving or expanding STEM education and workforce programs. SFAz services provide a critical mass of expertise for diagnosing, strategizing, developing, and sustaining highly impactful STEM programs. The primary offerings include these four services.

I. STEM Success Analysis

The SFAz approach to STEM success starts from the ground-up for those programs, schools, districts, communities, or states seeking expert review and data-based assessment of opportunities for initiating, growing, or improving programs for educational and economic impact at every level of K-20 STEM education.

SFAz applies its diagnostic expertise to help clients evaluate STEM program potential and determine how best to align education practices, policies, goals, and resources. This analysis features assessment of the following:

“The facilitated discussion with SFAz about the assessment results made us more aware of the unique strengths and weaknesses on our campus. We felt empowered to move forward with a STEM plan and eager to leverage the experiences of other STEM faculty on campus.”

—ANIL KAPOOR, BIOLOGY FACULTY, PHOENIX COLLEGE
• current programs or curricula
• teacher and faculty resources
• existing degree or certificate structures
• strategic opportunities for growth and improvement

This assessment can also include policy and budget analysis for structural improvements in aligning goals, management, and resource allocation.

This analysis delivers a prioritized array of tools and programs that can accelerate implementing a fully productive and sustainable teaching and learning STEM system.

II. STEM Success Strategic Planning

SFAz applies its strategic and technical expertise to help school districts and community colleges boost educational innovation and build strategies that make programs focused on STEM education more productive and higher-performing.

SFAz’s approach to strategic planning for STEM success encompasses these two overarching steps:

• We tailor best practices to the particular needs, goals, and educational and economic context of K-20 schools and districts that desire to increase the quality and number of STEM students and degrees. This focus on cultural relevance is critical for long-term program success, especially in building programs with underrepresented communities.

• We can include applied research that helps clients identify the critical variables for improving STEM learning (e.g., teacher professional development, curriculum, content, pedagogy).

The resulting strategy typically recommends programs, collaborations, pedagogy, course content, and curricula—or improvements in existing offerings—that enable clients to increase student STEM learning and enrollment.
III. STEM Success Implementation

As this summary suggests, the expertise that SFAz delivers for clients touches upon every area of program development in education and includes:

- Curricula
- Pedagogy
- Course content
- Teacher and faculty resources
- Educational policies
- Deployment of educational technologies
- Cross-institution collaborations

SFAz builds these types of implementation programs around a focus on student learning, workforce preparation, and long-term programmatic impact—for example, program redesigns that improve K-20 STEM teaching.

Through its STEM Success Implementation processes, SFAz helps individual institutes, school districts, community colleges, colleges, universities, communities, and states implement programs that boost the number of STEM students who earn certificates and associate’s, bachelor’s, and advanced degrees.

IV. STEM Success Sustainability

With its sustainability expertise, SFAz helps clients build meaningful STEM-oriented connections within and across K-20 institutions and systems (notably between K-12 and community colleges), develop educational investments and partnerships with business, and secure federal grants. These outcomes can include:

- **Strong learning networks** that bring together K-12 schools, community colleges, four-year colleges, research universities, science & technology industries, and other private- and public-sector organizations.

- **Partnerships** that change the school culture and community fabric to embrace STEM.

- **Engagement** of businesses, industry, and community organizations in STEM education.
SFAz also builds **dynamic review** processes for continuous monitoring and improvement of STEM programs, including:

- work promoting the sharing of innovation transfer, scale-up strategies, and model STEM program elements between and among participating STEM education sites and

- managing of **program evaluations** to deliver actionable results.

Sustainability also requires funding, which is where clients can benefit from SFAz’s **proven success securing major grants at the state and national level**, notably from the National Science Foundation. SFAz has also secured large private investments, and helped other institutions build sustainable STEM programs through meaningful partnerships with business enterprises.

Acting on all it has learned, SFAz supports clients—whether they be educational institutions or related entities—in securing grants from non-profit foundations at the national and state level. Likewise, SFAz makes available to clients its expertise in engaging **business and community collaborations across the K-20 system**, including public-private partnerships, cross-training programs, and internship programs.

This focus on sustainability not only creates a pipeline of resources for growing and improving STEM programs, but also:

- Expands educational and workforce opportunity (through such programs as **research and industry internships** for talented high school seniors).

- Increases **community commitment** to the future of the STEM programs.

- **Raises the profile** of the programs among future students and partners.

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“The [SFAz] Kickstarter team has provided ongoing mentorship and assistance throughout the STEM planning process which supports our College in applying for federal STEM grants and developing a sustainable capacity for writing more competitive grant proposals in the future.”

– TINA MERLINO, ACTING DIRECTOR INSTITUTIONAL & EFFECTIVENESS, SAN JOAQUIN DELTA COLLEGE
Community colleges have an opportunity to respond to the growing demand for students with STEM skills. Through detailed analysis and extensive interviews and research with community colleges, SFAz has identified a set of challenges most such institutions face, including:

- No common definition of STEM
- Lack of cohesive, supported STEM plan across colleges
- Students not completing STEM degrees
- Disengaged faculty and high faculty turnover
- Lack of industry involvement
- Low transfer rates
- Local barriers (e.g., location, preparation)

Acting upon this situation, SFAz has developed tools and resources to assist institutions in determining how comprehensive their programs and services are for recruiting and retaining students in STEM, and translating that into college-wide STEM plans. This plan helps community colleges assess, plan, implement, and sustain STEM Pathways that produce the following outcomes:

- Increased STEM student success.
- Greater student preparation to meet local STEM workforce needs.
• Stronger **faculty engagement and collaboration** across the college.

• **United visions and strategies** for STEM across college systems.

• Proposals that have greater success than typical in securing grant awards.

For example, SFAz is helping 11 Hispanic-serving community colleges across Arizona through the KickStarter program. To date, proposals developed with SFAz through this program have achieved a **funding-success rate of 30%**.
4. Areas of Special Expertise

SFAz also has special expertise in delivering educational improvements that benefit underrepresented students, especially in fields of information and computer sciences.

Improving the Success Rates of Underrepresented Students

To advance the educational opportunities available to students otherwise marginalized by status-quo systems, SFAz makes an array of STEM-services available for hire to schools, districts, colleges, and states. Drawing on its experience with schools that serve Hispanic and Native American students, SFAz provides this multifaceted, culturally relevant, and site-specific assistance to rural and urban schools and districts that enroll significant numbers of underserved students and whose STEM learning outcomes are inadequate. These services focus on:

- Increasing participation and support by parents and communities.
- Ensuring the full implementation and sustained use of the curriculum-instruction-assessment continuum to boost performance and outcomes.
- Conducting annual analyses of student academic performance and iteratively employing the results to design continuous improvement strategies.

Expanding Opportunity in Information and Computer Sciences

SFAz’s Computer Science Project addresses the particular education and workforce preparation of Native American youth and of other underrepresented students in rural and urban communities that are characterized by deep poverty and limited employment options. SFAz draws on privately developed curricula, such as Code.org and Google CS First.

To ensure the strength of these programs, SFAz helps build partnerships among the participating tribal nations, public school districts, local community colleges and universities, and the relevant
local information technology and computer science business communities. Such partnerships are critical for many reasons, including to help **ensure sufficient numbers and preparation of teachers** to serve as the instructional workforce of the program.

The program builds integrated series of mutually reinforcing programs, such as:

- Middle-school computer science/robotics after-school clubs
- Year-long high school courses
- External workforce experiences

Participating students acquire the knowledge and skills necessary for **information technology industry certification** and, if they desire, enrollment in higher education computer science and information technology degree programs.

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**SFAz helped West Hills Coalinga Community College**, a Hispanic Serving Institution, in California, successfully pursue a **$200,000 Advanced Technological Education grant from NSF**. The award funds a program called “Welding Education Distance Community Outreach” that is designed to meet the needs for a growing sector of advanced welding technicians in the west side of the Central Valley area in California.
SFAz in Action:  
*Increasing Opportunity through Computer Coding*

Underrepresented minority students comprise 20% of those taking AP computer science exams, and female students make up 27%. Their representation is even scarcer in higher education; for example, 83% of computer science majors at the university level are men. Yet, in today’s high-tech environment, computer science presents a tremendous economic opportunity.

In 2015-16, SFAz partnered with Code.org to deliver professional development in **computer science to more than 300 K-6 teachers across Arizona**. The results have been dramatic:

- These teachers delivered the curricula in after-school clubs and electives, impacting more than **9,000 students statewide**. The majority (78%) of the targeted students were Hispanic.

- Five targeted computer-science after-school clubs were established in three Phoenix inner-city school districts with high needs and large populations of underrepresented groups. These STEM clubs provided more than **50% of the applicants** to the newly opened Phoenix Coding Academy Specialty High School.

The opportunities for impact in this area continue to grow. Recently, SFAz and Grand Canyon University together formed the Arizona Code.org Regional CS Partnership, which has provided training in AP Computer Science Principles and Computer Science Discoveries to 64 teachers. These 64 teachers joined
over 500 others from across the southwest at the Code.org TeacherCon. One teacher from the TeacherCon workshop observed, “Every major educational program that has come out recently has either been directly from—or the result of a partnership with—Science Foundation Arizona.”
5. The Opportunity

SFAz has helped communities, schools, community colleges, four-year colleges, and research universities **create and transform programs in STEM fields in dramatic ways**. Drawing upon our hands-on experience and expertise, we stand prepared to guide and support you in achieving your STEM vision, whether the success you desire is any or all of the following:

- A **comprehensive STEM curriculum** that inspires the best in students.
- Innovative programs that **connect STEM learning to jobs**.
- **New partnerships** with like-minded institutions.
- **Foundation and private funding** that boosts your STEM initiatives.
- Or any combination of these and related ambitions that can **turn ideas for STEM education and economic growth into reality**.

SFAz has committed to this work because we know that STEM fields are among the most important today for **changing lives and increasing opportunity**. No foundation in America, in fact, is more focused than SFAz on helping other institutions capitalize on the promise that these fields offer.

We appreciate your own interest in the potential of STEM fields to **create new paths of possibility for others**. We would welcome the opportunity to discuss your strategic vision and how SFAz can serve you in bringing its fullest potential to life.
Teacher competence and confidence in teaching STEM courses and the steady educational improvement of student learning go hand in hand. SFAz’s STEM Immersion Guide provides the practical tools and information that enable teachers, schools, districts, and administrators to improve student outcomes by integrating STEM.

In 2013 SFAz was asked to help develop **STEM training and education programs in a three-year initiative designed at 19 schools in seven districts across Arizona**: Alhambra, Altar Valley, Bagdad, Congress, Killip, Salt River, and Yuma. These areas covered an array of settings, including rural, suburban and Native American reservation.

All told, the program involved **5,172 students from K-12 and 154 teachers and administrators**. Of these students,

- more than **75% (3,930) were non-white**,  
- more than **30% (1,631) spoke another language than English first**, and  
- **3,870 students were from Title I free and reduced-lunch status**.

### The SFAz Role

Working with the project sponsor, the Helios Education Foundation, SFAz designed strategies to improve the STEM education programs in these schools.
in a systematic fashion. SFAz’s extensive support included:

- Helping sites prioritize activities to address teaching needs, build capacity and reduce barriers to change.

- Writing **strategic plans, benchmarking results, and tracking budgets**.

- Offering feedback about curriculum and lesson plans.

- Providing connections to outside organizations and the community.

- Providing **guidance for sustaining progress during changes in leadership**.

- Helping schools/districts share ongoing results with parents and the community.

**Project Implementation**

The carefully staged and supported process of STEM implementation included:

- Establishing a baseline of STEM immersion that ensured accountability and allowed any changes to be carefully documented.

- Grounding sustainability plans in the realities of each site's context.

- Receiving funds from the related grant that were tied to the **achievement of milestones**.

- Site-specific **program designs built to adapt to dynamic changes in school/district priorities**, leadership, and progress.
The Results

The STEM Education Evaluation Center at TERC (a nonprofit education research and development organization in Cambridge, MA) conducted a three-year evaluation of the project that used qualitative and quantitative research methods and best-practice statistical assessments. **The study found that all sites increased the quality and impact of STEM educational experiences.**

For example:

- Teachers increased their STEM content knowledge and pedagogical strategies, including **project-based instruction, hands-on instruction, and integrated community-based projects.**
- Teachers developed more positive attitudes in all STEM areas, including science and technology use; and in awareness of STEM careers.
- **Students made steady progress across the length of the program,** notably expanding their math and science knowledge and skills, with most sites achieving significant gains for students in all or almost all grade levels.
- Many sites have enjoyed a cultural shift in how administrators, teachers, students, and parents view the STEM fields. These subject areas are now seen increasingly as important as English and language arts.

The Future

Many sites have become so convinced of the program’s value that they have systematically transitioned it to school-system budgets and new grants. Many sites are also now **expanding STEM activities, building structures to maintain and upgrade STEM resources, and bolstering STEM awareness**—all of which will help to ensure sustainability.
If you are interested in working with SFAz to increase the scale or effectiveness of STEM education within your organization, please contact

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