INTRODUCTION

In 2009 Science Foundation Arizona (SFAz) invested nearly $1M in Cochise College, located in Sierra Vista, Arizona, to begin development of a STEM Pathway. This investment led to a robust early college academy and a compilation of K-12 STEM outreach initiatives. The program also identified additional opportunities to improve the STEM Pathway. To address these, in 2011 SFAz and Cochise College continued their partnership with a $900K National Science Foundation (NSF) grant (DUE#1003847) that completed their STEM Pathways Program and produced a STEM Pathways Model and easy-to-use online STEM Pathways Guide.

THE STEM PATHWAYS MODEL

The STEM Pathways Model is a comprehensive matrix of community college-centered programs and strategies that function to enhance connections between high schools, universities and jobs. STEM Pathways offer students multiple opportunities to explore and prepare for successful careers in new and emerging STEM fields, expanding beyond the notion that the only pathway to success is through a four-year university.

Community colleges are well positioned to lead and collaborate in a STEM Career Pathways process to:

1. Prepare students for jobs requiring academic preparation and credentialing.
2. Build collaborations between K-12 & higher education, between CTE & academic sectors.
3. Deeply integrate industry-based partnerships.

The three primary components of the STEM Pathways Model:

1. **Education Outreach and Career Exploration:** Community college-led activities and events that generate enthusiasm and interest in STEM degrees and careers.
2. **Foundational Knowledge and Skills:** Education programs and strategies that improve students’ foundational and expanded knowledge in math and other STEM-based fundamentals.
3. **Transferable Certifications and Degrees:** Job experiences and competency-based programs at industry with assessments that align to industry-recognized credentials and credits that transfer toward college degrees.

The four underlying attributes of the STEM Pathways Model:

1. **Student Support Strategies:** Resources, processes and strategies that encourage student success.
2. **Industry Engagement:** Vital to keeping schools current, providing teachers with resources, and capturing student interest in STEM careers.
3. **Technology:** Integrated across the Pathway to provide better access to education resources, virtual tours, internships and mentorship.
4. **Curricular Alignment:** Ensures all course credits count toward a credential.
**STEM PATHWAYS MODEL**
Science Foundation Arizona - The Arizona STEM Network

<table>
<thead>
<tr>
<th>PATHWAY COMPONENTS</th>
<th>A. STEM EDUCATION OUTREACH AND CAREER EXPLORATION (Recruitment) - Community college-led activities and events that generate enthusiasm and engage student interest in STEM career fields prior to college.</th>
<th>B. FOUNDATIONAL KNOWLEDGE AND SKILLS (Retention) - Education programs and strategies that improve college students' foundational STEM knowledge and skills.</th>
<th>C. TRANSFERABLE CERTIFICATIONS AND DEGREES (Workforce) – Job experiences and competency-based programs at industry with assessments that align to industry-recognized credentials.</th>
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<tr>
<td>1. STUDENT SUPPORT STRATEGIES/Resources, processes and strategies that encourage student success.</td>
<td>A1. Student-success strategies are incorporated in outreach activities and events that promote STEM career exploration.</td>
<td>B1. Student-support strategies lead students to achieving foundational STEM knowledge and skills.</td>
<td>C1. Student-support strategies help students optimize course selection and credits earned toward a stackable credential or degree.</td>
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<td>2. INDUSTRY ENGAGEMENT - Vital to keeping schools current, providing teachers with resources, and capturing student interest in STEM careers.</td>
<td>A2. Industry plays a supporting role in outreach activities, tours and events, capturing student interest in real-world STEM opportunities.</td>
<td>B2. Industry contributes to program development and mentors students in real-world experiences.</td>
<td>C2. Industry offers internships, apprenticeships, and job-shadowing experiences that guide students to earning industry-recognized certifications and degrees.</td>
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<td>3. TECHNOLOGY - Integrated across the Pathway to provide better access to education resources, virtual tours, internships and mentorship.</td>
<td>A3. College outreach activities have access to technology labs and technical equipment that generate student interest and awareness of STEM careers.</td>
<td>B3. Technology programs offer students hands-on learning experiences; technology is utilized to access instruction and student learning opportunities between institutions.</td>
<td>C3. Technical equipment is available at industry for students to gain the appropriate experience and prepare for competency-based testing and certifications.</td>
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<td>4. CURRICULAR ALIGNMENT - Ensures all course credits count toward a credential.</td>
<td>A4. College Outreach activities and events inform parents and students about curricular alignment to STEM career programs.</td>
<td>B4. Dual enrollment or early college STEM academies, including intrusive advisement that lead to student success.</td>
<td>C4. Colleges and industry align curriculum with industry-recognized certifications and include credits that transfer toward stackable degree programs.</td>
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**COCHISE OUTCOMES INFORM STEM PATHWAYS MODEL**

SFAz developed the STEM Pathways Model in partnership with Cochise College whose research of STEM Pathways programs informed the model. The results of this research (Charts A – D) show a growth in student and industry participation, with more students participating in early college programs, pursuing STEM degrees, working as interns, and then hired fulltime into local STEM jobs. Additional input from community college leaders helped optimize the STEM Pathways Model as did a literature review that included *Pathways to Prosperity: Meeting the Challenge of Preparing Young Americans for the 21st Century*, Symonds, W.C., Schwartz, R., Ferguson, R.F., 2011.

**IMPLEMENTATION OF THE STEM PATHWAYS MODEL**

An online STEM Pathways Guide and Assessment Tool have been developed to assist community colleges develop their own STEM Pathways strategies to increase recruitment and retention of students in programs meeting local workforce needs. This Guide provides colleges with an easy-to-use roadmap for researching, planning and implementing STEM Pathway programs. The Guide includes pathway descriptors, attributes, and over 30 examples, and is available at [http://stem.sfaz.org](http://stem.sfaz.org). Forming a Professional Learning Council represented by members of the community college, local school districts, administrators and teachers, and local industry, will enhance the development and delivery of STEM Pathway programs and strategies.
A total of 151 students have participated in the Early College Academy over 5 years, doubling from 14 students in 2009 to 30 students in 2014. 77% continued on to post-secondary STEM education.

Annual industry participation in Cochise’s STEM Outreach programs increased 23% over 3 years, and annual K-12 participation increased 35%, from 1700 to 2300 students, resulting in a total 6544 students over 3 years.

A total of 50 student interns participated over 3 years, growing from 10 interns in 2012 to 22 interns in 2014, with 60% landing fulltime jobs. An additional 14 community college students were hired fulltime in 2014 without a prior internship.

Companies offering grant-funded internships grew from 1 to 9 over 3 years; 12 companies jumped on board in the third year by offering internships that were paid by the company.
DISSEMINATION OF THE STEM PATHWAYS MODEL

With funding support from NSF, SFAz is assisting Arizona’s rural community colleges and Hispanic-Serving Community Colleges nationwide achieve similar results by developing STEM Pathway programs to improve the recruitment and retention of students, Hispanic students in particular, into STEM fields and careers.

Hispanic-Serving Community Colleges (HSCC) Kickstarter (NSF #1450661, 10/1/14)
SFAz has issued a Call for Applications to HSCCs to participate in its intensive, comprehensive technical assistance program designed to prepare and position them to compete successfully for federal funds focused on student recruitment and retention in STEM fields. This work introduces the STEM Pathways Model and Resource Guide to assist community colleges in their strategies to increase recruitment and retention of students in technical career pathway programs to meet local workforce needs.

SFAz+8: Building Capacity for STEM Pathways in Rural Arizona (NSF DUE#1400687, 9/1/14)
SFAz is facilitating a network of Arizona’s eight rural community colleges to accelerate delivery of key STEM Pathways programs and activities to achieve impacts similar to those demonstrated at Cochise College, namely to prepare more students with STEM certifications and degrees that support local and state workforce demands.

COMMUNITY COLLEGE PARTNERS

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