

## **Engineering Education Programs Overview (K12, Undergraduate, Graduate)**

Ira A. Fulton Schools of Engineering

Updated: March 26, 2021

### **Part A. K-12 Audience (Students and/ or Teachers)**

Programs / events facilitated by Mike McBride, Director Outreach and Recruitment, Academic and Student Affairs (ASA), Ira A. Fulton Schools of Engineering (FSE).

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#### **1. Engineering Fast Track**

**Web:** <https://explore.engineering.asu.edu/engineering-fast-track/>

- a) Introduction to Engineering: Equivalent to ASU FSE 100 (Introduction to Engineering)  
Introduces the engineering design process; working in engineering teams; the profession of engineering; engineering models, written and oral technical communication skills
  
- b) Programming for Everyone: Equivalent to ASU CSE 110 (Principles of Programming)  
This course is intended to introduce students, with no prior experience, to the fundamental principles of programming, and the field of computer science. Students will be able to describe the basic operating principles of a computer, and design, implement, debug, and test structured imperative algorithms.

\*\* also includes Calculus and Chemistry courses but are not overseen by FSE.

#### **What you could contribute:**

You may develop brief videos that demonstrate key ways in which your research impacts society or a particular aspect that improves or benefits/improves/makes more efficient an engineering technology, etc. Your perspective on how engineering uses science and mathematics with engineering practices to address problems will be helpful to high school youth. These videos can be hosted on our Engineering Fast Track webpage to help high school students understand how engineering is relevant to society. In addition to contributing to the Engineering Fast Track you may also develop podcasts (host the videos on your own lab site) aimed at high school students and their teachers introducing topics in engineering that demonstrate how basic science and mathematics knowledge can be applied in engineering to solve specific challenges thereby making the learning of high school subjects relevant and exciting.

#### **Audience:**

High school students and those not on a standard collegiate path. You could influence their awareness of engineering and its impact AND increase their interest in engineering. Audience may include those interested in preparing to go to college. Students can be anywhere in the world. Your content could fit the above two courses or also be generally about inspiring youth to pursue engineering. Brief videos of 1-3 minutes are more likely to be watched in their entirety.

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### **2. ASU Open Door**

Web: <https://opendoor.asu.edu/> and  
<https://outreach.engineering.asu.edu/events/open-door/>

#### **Description:**

What happens every day at the most innovative university in the nation? This is your chance to experience Arizona State University first hand! ASU opens its doors during **ASU Open Door** and children of all ages can let their imagination run wild.

Every year ASU invites the local community to visit any of the five campus locations, allowing visitors to explore the innovative spaces accessible only to ASU students. Visitors have the opportunity to participate in hundreds of interactive activities and talk to students, faculty and staff. Thrill seekers, lifelong learners, science gurus, art enthusiasts and adventure seekers can explore laboratories, living collections, museums and classrooms and participate in hands-on activities.

As a signature event of the [Arizona SciTech Festival](#), ASU invites you and your family to discover all things science, technology, engineering, arts and math. ASU Open Door celebrates that kids today are smart, tech savvy, and more involved in their own educational experiences than ever before!

The Fulton Schools of Engineering are a major partner in ASU Open Door (at Tempe and Polytechnic campuses). This family-friendly ASU event attracted nearly 18,000 visitors. Visitors can tour our labs and other facilities, participate in activities and learn about engineering, technology, aviation, construction, design and more with hands-on activities and fun demonstrations that showcase the talent and ingenuity of our Fulton Schools faculty and students and inspire the next generation of engineers, builders and makers.

#### **What you could contribute:**

Hands-on experiences for a general audience (families with K-12 students), demos led by your students, lab tours, posters explaining social relevance of your research. You can reach a broad audience and increase awareness about the importance of your research and development to engineering and how it advances society.

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### **3. Girls Make-a-thon**

Web: <https://outreach.engineering.asu.edu/events/girls-make-a-thon/>

#### **Description:**

Come join us for a day of MAKING! Learn what it takes to MAKE a CAREER in engineering, MAKE and broaden your NETWORKS, and DESIGN and MAKE a solution to the Make Challenge. 9th–12th grade girls or 6<sup>th</sup>- 8<sup>th</sup> are invited to attend the one-day Girls Make-a-thon where you will engage with engineering women both in industry and at the university including ASU women faculty and students. Each grade band is an annual event. Girls Make-A-Thon encourages young women to discover and/or pursue their capacity to become STEM-savvy change makers and leaders.

#### **What you could contribute:**

As a female faculty member you can mentor 6<sup>th</sup> -8<sup>th</sup> or 9th–12<sup>th</sup> grade female students by participating in the session to interact with them directly and share your passion and interests in engineering.

#### **Audience:**

**6<sup>th</sup> - 8<sup>th</sup> or 9<sup>th</sup> -12<sup>th</sup> grade female students** who are exploring engineering. Intent of your involvement will be to help inspire these participants to pursue engineering thereby broadening participation of women in engineering.

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### **4. Fulton Summer Academy**

**Web:** <https://outreach.engineering.asu.edu/summer-programs/>

#### **Description:**

Through participation in Fulton Summer Academy, students in grades 1-12 get the opportunity to experience life on campus and take part in instructor-led engineering design challenges and activities. Our camps utilize best practices in hands-on STEM to actively engage participants and empower them to seek out other STEM opportunities beyond their experience at ASU. We offer a variety of programs – from half-day to full day week-long camps, and overnight week-long camps – there is something for everyone.

#### **What you could contribute:**

You can offer your own camp for a specific target audience (say, a 2 half-day or full-day camp) or you can work with the FSE Engineering Education Outreach and Recruitment team to help develop a module (2-3 hour or a day long experience) that fits a theme in one of the camps her team delivers.

#### **Audience:**

Any grade range between 1 and 12. Content will have to be developmentally appropriate and highly engaging (not like school). The opportunity will be to inspire and promote interest in engineering.

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### **5. EPICS High**

Web: <http://epics.engineering.asu.edu/epics-high-school/>

#### **Description:**

EPICS High is a service learning and social entrepreneurship program that focuses on engineering and human-centered design providing solutions to real world problems. We currently partner with just over 35 schools in the greater Phoenix area, and have support from great industry partners to continue program expansion. EPICS High has an impressive list of benefits to the students, schools, and community, but one of the best parts of the program is that it's completely free to our partner middle school, high schools, and community colleges. In addition, our schools are supported with an outstanding curriculum, aligned to standards, and easily available to teachers. With access to ASU's Fulton Schools of Engineering students and plenty of opportunities for students to succeed, EPICS High is a tool that helps educators move students from observers in their community to participants. Projects have addressed solutions for local as well as global audiences. Examples include: develop a water filtration system for families in the Philippines, design a compost system using lunchroom waste for use at school garden, design and build a secure storage system for donated bikes later given to families in need, and develop an app for Lowe Observatory providing broader learning access to the community. We believe in preparing ALL students to achieve high academic goals, attend college, and become community leaders which is at essence and core of our EPICS High program.

#### **Curriculum:**

Online curriculum is available for university, community college, high school and middle school. This flexible curriculum can be implemented in a standalone elective class; woven into current subjects like biology, environmental science, engineering, chemistry, or business; or run as an after-school program. The program can be offered in a semester or year-long. Curriculum is designed and maintained by Purdue University and modified by Arizona State University.

#### **Teacher Training:**

We have developed a five-day teacher workshop to prepare teachers for implementing EPICS High into their classrooms. Topics covered are EPICS High curriculum, community partners, human-centered design, Internet of Things, and Student Success.

#### **Pitch Funding:**

This competition is an opportunity for students to submit their best 4-minute pitch on their EPICS project as well as show off their budgeting, organization, and public speaking skills to the EPICS Review Committee. The EPICS High Pitch Funding Request will require the following:

- Demographics information about your team
- URL / Link to your Pitch Video
- Modified project charter
- Project timeline
- Project budget
- Team roles and responsibilities

#### **Showcase:**

The EPICS High Showcase is an end-of-the-year event, designed to exhibit team projects and celebrate their success and impact on the communities around them. Industry partners, faculty, and staff evaluate

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students on their project and how well they present the information. Top teams in the EPICS design process are given scholarships to Fulton Schools of Engineering and those winning the Cisco Innovations Challenge portion win cash awards.

### **What you could contribute:**

A learning module for teachers who facilitate EPICS HIGH on relevant topics: Internet of Things, rapid prototyping, integration of sensor technology to track specific tasks, methods to generate ideas for innovation, etc. You can deliver the learning module during a professional development session to ASU EPICS high school educators (90 minutes OR 2-3 contact hours)

### **Audience:**

You may directly impact **high school educators** who are teaching Engineering Projects in Community Service by helping them build their skills repertoire to support their students. And through them, you will likely influence experiences for their students.

Alternatively, you can invite a specific audience (say students from an EPICS program that is in a high needs school district, i.e., where there are large populations of those with financial need, first generation students, and under-represented ethnic minorities) of **high school students** to attend a 2-3 hour workshop that you host with a lab tour and demonstration, interaction with members of your research team (undergrads, grads, post docs, etc). Experiences have to be highly engaging and interactive where students are “doing” an experiment or engaged in design, etc.

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### **6. Teacher Professional Development via Summer Experience in your lab**

#### **Description:**

Host a high school teacher in your lab during the summer for a month (offer a nominal stipend of \$1000 to \$2000 from NSF CAREER funds). Emphasis is on developing capacity in teachers to integrate engineering into their teaching repertoire. A specific outcome could be to develop learning experiences that can be tested by the teacher in her/his classroom during the subsequent Fall semester and for you to receive feedback to further improve the learning experience which can then lead up to an experience in Young Engineer Shapes the World or the Fulton Summer Academy. The final outcome is that you can contribute a learning module to FSE Engineering Education for use with other audiences via their programs; which is a way for your contribution to sustain beyond your own NSF CAREER project.

You may expect the teacher to work in your lab over the course of 4 weeks for a set amount of time understanding your research and background, developing an idea for a learning experience that they can take back to their classroom. This is a way to build capacity in high school educators while broadening awareness about your engineering research to high school students through the teacher. Could be useful for later RET supplemental funds as a proof of concept effectively implemented through your NSF CAREER project.

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### **7. Virtual Engineering Outreach: ASU for You**

<https://asuforyou.asu.edu/home>

#### **Description:**

ASU for You is an approach to education that supports Universal Learners® with resources from a national research university — recognizing that to meet the needs of a rapidly changing, technology-driven world, people will need to access education and learning platforms throughout their lives. If you have a learning resource that the ASU community can utilize, please complete this [request form](#). The FSE ASU for You team will review your request and reach out with any further questions.

#### **What you could contribute:**

A brief 30-second or 1-minute video explaining a key concept or a well-designed learning activity with pictures or brief video that allows for students/families/teachers to try the activity out to experience engineering. You may also develop podcasts aimed at high school students and their teachers introducing topics in engineering that demonstrate how basic science and mathematics knowledge can be applied in engineering to solve specific challenges thereby making the learning of high school subjects relevant and exciting. You would host these resources—videos, lessons, podcasts—on your own lab site.

## **Part B University students with a focus on Entrepreneurship and Innovation**

These are programs and events offered by Entrepreneurship and Innovation staff at ASU and also E&I faculty/staff in Fulton Schools of Engineering (FSE). **Note:** These programs are not directly facilitated by FSE. If you intend to contribute something specific via these programs, you should contact the individual(s) listed in the appropriate program webpage(s) to work out specifics.

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### **1. ASU Venture Devils**

**Focus:** Teaching entrepreneurship at the university level; however, could be adapted for the high school level.

**Web:** <http://links.asu.edu/GoVentureDevils>

#### **Course Goals**

The Venture Devils program aims to:

- a) Formally engage and educate founders of all statuses and to track the developmental progress of their affiliated ventures.
- b) Pair participant founders with a dedicated Venture Mentor who will educate and guide the iterative advancement of the founder(s) and their affiliated venture(s).
- c) Provide a formal process for participating founders and their affiliated ventures to be continuously evaluated and potentially pre-qualified for ASU funding opportunities and additional support services, including dedicated workspace, throughout the rolling course offering.

#### **Learning Outcomes**

This program is designed to be completed iteratively. In general, during each 7.5 week iteration, each participant is expected to demonstrate that they are able to:

- Learn, synthesize, and share current methods, tactics, and strategies for launching and developing a new venture, which may include, but will not be limited to: customer discovery/development/ acquisition, product/service development, intellectual property development and protection, entity formation, capitalization, evidence-based pitching, and early-stage growth drivers.
- Iteratively develop and present an evidence-based pitch deck that incorporates the “fact-based” and “data-driven” proof that is now required to ensure transparency, authenticity, and traction for today’s entrepreneurs.
- Develop professional skills and habits as it relates to working with mentors, partners, and other key members of a venture development network.

#### **Venture Devils Materials**

- Venture Devils Overview Video: <http://bit.ly/2qcNApt>
- Venture Devils Overview Deck: <http://links.asu.edu/VentureDevilsDeck>
- Venture Devils Syllabus: <http://links.asu.edu/VentureDevilsSyllabus>
- Venture Devils Modules: <http://links.asu.edu/VentureDevils>

**Contact:** Brent Sebold [Brent.Sebold@asu.edu](mailto:Brent.Sebold@asu.edu) [E&I and FSE Faculty]

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### **Part C Undergraduate and Graduate Engineering Students**

These are programs and events offered by Fulton Schools of Engineering (FSE) via Academic and Student Affairs you can use to develop deeper engagement in engineering for students beyond their academic coursework.

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#### **1. Fulton Undergraduate Research Initiative (FURI)**

Web: <https://furi.engineering.asu.edu>

##### **Description:**

**Undergraduate students** in the Ira A. Fulton Schools of Engineering can be funded in FURI, the beginning of their second semester of attendance at ASU until their last semester. The FURI program operates during summer, fall, and spring semesters. Students are eligible for two semesters of funding. All applicants must be undergraduate students in the Ira A. Fulton Schools of Engineering and in good academic standing (i.e. not on academic probation) to be eligible for FURI. Online students are also welcome to apply!

Faculty mentors must be faculty in the Ira A. Fulton Schools of Engineering. They also must not be on sabbatical, on leave, or on vacation during the majority of the FURI mentoring time period.

Current funding for a student is \$1500/semester and up to \$400/semester for materials related to the project. You can typically expect a FURI student to work 5 hours/week for duration of the semester in your lab for this type of funding.

##### **Context:**

Since 2016, over 250 faculty mentors have taken part in the program directly impacting more than 800 students. Over 22% of participants identified with one or more minority groups (Native American, Hispanic, Native Islander, or Black/African-American). And nearly 30% of participants have been women. In 2020, 72 faculty mentors took part in the program directly impacting 144 students. This is a robust program that attracts students to conduct research with faculty.

##### **What you could contribute:**

You may begin to mentor undergraduate students through FURI in your lab to show a track-record in mentoring this population. 1-2 students a semester may be appropriate. Later when seeking NSF funding, you can build upon these FURI awards supported by FSE and keep interested students in your lab beyond FSE funding to help mentor the next generation of research scholars in your field, encouraging these students to enter research-based graduate programs. The students can be funded with NSF funds at the same rate as the FURI program. You can publish conference papers or other publications with undergraduate students, encouraging student to apply to an REU, consider attending a PhD program, and thereby help grow the next generation of scholars.

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### **2. Master's Opportunity for Research in Engineering (MORE)**

**Web:** <https://graduate.engineering.asu.edu/more/>

#### **Description:**

The Master's Opportunity for Research in Engineering (MORE) is designed to enhance the Ira A. Fulton Schools of Engineering **graduate student's** engineering and technical graduate curriculum by providing hands-on lab experience, independent and thesis-based research, and the opportunity to travel to professional conferences. The MORE program operates during summer, fall, and spring semesters. Students in MORE develop an idea under the mentorship of a Fulton Engineering faculty member, then apply for funding. Once accepted, they perform research, attend workshops, prepare research summaries, and participate in the research symposium.

Students will be paid a stipend of \$1,500 their funded semester(s), which will be disbursed at the end of the semester as a stipend. Students must complete all the MORE requirements and perform to the mentor's satisfaction to receive the stipend. Participants are also eligible to apply for up to \$400 in research supplies per funded semester. Students are encouraged to work with their faculty mentor to discuss continued funding from the faculty member's grants or other sources.

#### **Context:**

This is a relatively new effort, launched in 2017-18 to give graduate students opportunities to expand their skills. Similar to FURI, you may use this opportunity to expand opportunities for and include women, first-generation students (students whose parents do not have a college degree), those with socio-economic need, and/or under-represented ethnic minorities to broaden participation in engineering.

Since Spring 2018, over 25 faculty mentors have taken part in the program directly impacting 195 students. Over 35% of participants have been women.

#### **What you could contribute:**

You may begin to mentor graduate students through MORE in your lab to show a track-record in mentoring this population. 1-2 students a semester may be appropriate. Later when seeking NSF funding, you can build upon these FURI awards supported by FSE and keep interested students in your lab beyond FSE funding to help mentor the next generation of research scholars in your field, encouraging these students to enter research-based graduate programs. The students can be funded with NSF funds at the same rate as the FURI program. You can publish conference papers or other publications with graduate students and thereby help grow the next generation of scholars.

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### **3. Grand Challenges Scholars Program (GCSP)**

Web: <https://gcsp.engineering.asu.edu/>

**Description:** The Fulton Grand Challenge Scholars Program combines innovative curriculum and cutting-edge research experiences into an intellectual fusion that spans academic disciplines and includes entrepreneurial, global and service learning opportunities.

The program's goal is to prepare tomorrow's engineering leaders to solve the grand challenges facing society during the next century. Through completion of the five components of the program, students will have the opportunity to engage in research relating to their selected grand challenge, explore interdisciplinary coursework, gain an international perspective, engage in entrepreneurship, and give back to the community through service learning.

Fulton Engineering students who complete the program will achieve the distinction of Grand Challenge Scholar, endorsed by both ASU and the National Academy of Engineering (NAE), and will be uniquely prepared to collaborate and succeed in a transdisciplinary and global environment.

**Context:**

GCSP students can receive \$1600 in funds to conduct research with a faculty member on a research topic that is related to a grand challenge theme.

FSE offers a summer institute (see: <https://gcsp.engineering.asu.edu/grand-challenge-scholars-program/gcsp-summer-institute/>) for incoming freshmen admitted into the GCSP at ASU. Participation is limited to 40-50 students. This is a week-long residential program aimed to engage students and give them a preview about the NAE grand challenges introducing them to faculty and the research that faculty conduct that is directly contributing to the NAE grand challenges.

**What you could contribute:**

During the GCSP summer institute, you may offer a research lab tour and interaction with you where you present about your research and how it relates to or addresses a NAE grand challenge. This will help in recruiting students to your research lab and also address your broadening participation in engineering goals by sharing your research efforts with undergraduate students.

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You can serve as a GCSP mentor to a student who wants to conduct research on an NAE Grand Challenge related theme. By having a GCSP student work in your lab with your mentorship you can help develop the next generation of engineering scholars who are better prepared to address global challenges. You can keep interested students in your lab beyond FSE GCSP funding to help mentor the next generation of research scholars in your field, encouraging these students to enter research-based graduate programs. The students can be funded with NSF funds at the same rate as the FURI program. You can publish conference papers or other publications with graduate students and thereby help grow the next generation of scholars.

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### 4. Engineering Futures

Web: <https://sstem.engineering.asu.edu/>

#### Description:

Engineering Futures supports persistence in engineering of first-generation students, women, under-represented ethnic minorities, and those with financial need. To address the challenges of first-generation students, throughout the first two years, students will be mentored to foster their engineering identity while focusing on support for transition to college.

Support for transition to college includes encouragement and help to form peer learning study groups, study habit workshops, note-taking methods, time management, and financial aid-education.

Support for engineering identity development in year 1, include opportunities to meet industry professionals, visits to industry sites to learn first-hand what engineering workplaces look like, engage with engineering leaders through a speaker series, and attend recurring choice-based 2-hour technical and soft skills building workshops. In year 2, students will be encouraged to engage in social entrepreneurship through interdisciplinary coursework in FSE 104: Engineering Projects in Community Service; and/or join a student organization of choice with over 60 to select from.

At the end of year 2, qualified students will be encouraged to apply to serve as an Undergraduate Teaching Assistant. In year 3, students will be encouraged to engage in research experiences through the Fulton Undergraduate Research Initiative.

**Why the focus on first generation students?** Overall enrollment of engineering first-time freshmen at ASU has grown significantly over the last few years.

Table 1. Enrollment of First-Generation Students who are First-time Full-time Freshmen

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
First-time Full-time Freshmen Entering Cohort	1,495	1,763	2,037	2,452	2,687	2,695	2,721	3,262
First-Generation	367	389	446	528	570	564	589	629

Table 2. Persistence in Engineering of Fall 2016 Engineering First-Time Full-Time Freshmen

	Enrolled		
Fall 2016 Enrollment	1 year later	2 years later	3 years later
First (n=564)	68%	48%	43%
Continuing (n=1,626)	76%	62%	57%

Persistence (Table 2) of first-generation students is significantly lower than that of continuing generation students. Often first-generation students perceive engineering as economically infeasible, and socially and personally irrelevant to their lives. This unmet need is worthy of attention and represents an untapped talent pool in engineering. First generation entry into engineering is viewed as challenging in comparison to other disciplines (e.g., social sciences, liberal arts) for reasons, such as lack of role models

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and a support system within and outside the confines of family. Lack of adequate financing and a paucity of knowledge about potential revenue streams to support college completion also impact entry.

### **What you could contribute:**

You can offer a 2-3 hour technical skills workshop or 2 hour introduction to research session or an “Adventures in Engineering” seminar (~20-30 minutes) to Engineering Futures students thereby increasing their access to you and enhancing their confidence and awareness about engineering.

See <https://science.asu.edu/asu-engineering-boot-camp-prepares-students-make-societal-impact> for an example of a week-long technical skills and entrepreneurial mindset development week-long program that was offered in summer 2019 to Engineering Futures students.

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### **Part D. Context statement you can modify and include in your proposal's education plan**

The Academic and Students Affairs in the Ira A. Fulton Schools of Engineering under Dr. Tirupalavanam Ganesh's leadership facilitates engineering education outreach to PreK-14 populations of students, families, and teachers; and offers undergraduate student engagement and success activities. In 2019-20, over 6000 families, 17,000 K-12 and community college students, and nearly 450 teachers and teacher candidates from a range of K-12 schools—traditional public, charter, and private—were served. The Fulton Schools have protocols and MOUs in place to work with over 35 Phoenix area schools, teachers, and students. This office coordinates design and delivery of a variety of engineering education experiences in a comprehensive and collaborative manner, including recruitment of participants and facilitates communication among faculty, target K-12 and community college populations, and undergraduates to support engineering education activities. Their focus is on broadening participation in ASU engineering to reflect the demographics of Arizona.

[To address recruiting mechanisms, PIs can add the statement below.]

Recruitment of participants will take place according to pre-established communication methods that ASU's Engineering Education has with Phoenix area schools to promote faculty-student-teacher interactions in K-12 settings. Fulton Schools of Engineering (FSE) have protocols and MOUs in place to work with over 35 Phoenix area schools, teachers, and students. FSE has instituted this centralized structure to more effectively facilitate STEM activities and university faculty interactions with K-12 students, teachers and administrators in the school districts. This framework helps to minimize program and teacher contact overlaps, undue administrative burdens on the schools, and most importantly, it seeks to promote sustained student experiential learning. **Letter from FSE Engineering Education is included in the proposal package.**

If you wish to look-up demographics of particular schools or school districts located in the greater Phoenix area or the Maricopa County area, you may search this National database and include details in your proposal: <https://nces.ed.gov/ccd/schoolsearch/index.asp>.

#### **Contact Information:**

**Michael McBride**

Director, Outreach and Recruitment

Academic and Student Affairs, Ira A. Fulton Schools of Engineering

[Mike.McBride@asu.edu](mailto:Mike.McBride@asu.edu)

**Tirupalavanam G. Ganesh, PhD**

Tooker Professor & Assistant Dean, Engineering Education

Academic and Student Affairs, Ira A. Fulton Schools of Engineering

[tganesh@asu.edu](mailto:tganesh@asu.edu)