Lone Star STEM Project

Table of Contents

INTRODUCTION

The Lone Star STEM Project (the Project), led by Jobs for the Future (JFF) in partnership with the Texas Education Agency (TEA) and the University of Texas Center for STEM Education (UTCSE), will demonstrate an exemplary approach to improving and expanding STEM education. The Project will scale across the State of Texas evidence-based College and Career Readiness Models (CCRMs) that incorporate dual enrollment as a core strategy, with a specific focus on computer science (CS). All of the Texas CCRMs—Early College High School (ECHS); Texas Science, Technology, Engineering, and Math (T-STEM) Academies; Pathways in Technology Early College High Schools (P-TECH); and Industry Cluster Innovative Academies (ICIA)—are secondary school models that blend high school and college coursework to help high-need students develop technical skills, earn college credit, and pursue in-demand career paths.[1] The Project will scale CCRMs throughout Texas by expanding these models in rural, urban, and suburban districts—thereby increasing high-quality STEM opportunities for greater numbers of high-need students, with a particular focus on implementing programs of study that help students gain the skills, postsecondary credentials, and experience necessary to embark on well-paying careers in CS and the emerging field of cybersecurity.

JFF's proposed Education Innovation and Research (EIR) grant ***addresses Absolute Priority 1—Moderate Evidence***. All of the CCRMs that the Project proposes to scale leverage dual enrollment (known within Texas as "dual credit"[*]), which allows high school students to take college courses and earn college credits while still attending high school. Based on a What

[*]This proposal consistently uses the term "dual enrollment" to describe an approach defined as "dual credit" by TEA. In TEA's definition, "dual credit" denotes that a student is enrolled in high school and college simultaneously and receiving high school and college credit for the college course they are taking.

Works Clearinghouse (WWC) February 2018 Intervention report,[2] dual enrollment not only meets the definition of moderate evidence, but meets the definition of strong evidence in subsection (ii) of the Federal Register notice.

The Project also ***addresses Absolute Priority 3—Field-Initiated Innovations—Promoting Science, Technology, Engineering, or Math (STEM) Education, With a Particular Focus on Computer Science.*** Existing CCRMs focus specifically on STEM, and TEA's Foundation High School Program requires all Texas high schools to offer a diploma with five options for endorsement areas, including one focused on STEM. Lone Star STEM will scale these models and further augment them with labor-market-aligned, vertically integrated programs of study ("pathways") that seamlessly span secondary and postsecondary education and enable students to acquire the skills and credentials needed for employment in STEM fields, particularly in CS and cybersecurity. This Project's focus on CS will help close a major gap in Texas's education-to-workforce pipeline, and it will help realize and multiply the impact of recent state legislation that made both CS and cybersecurity top-level priorities for education and economic development efforts. The Project will leverage existing TEA funding to fund a new Lone Star STEM cohort of CCRMs, to which JFF and UTCSE will provide a suite of technical assistance services to support the development of STEM pathways, including in CS and cybersecurity.

By design and definition, Texas's CCRMs prioritize the improvement of educational access, attainment, and achievement for high-need students in particular. Lone Star STEM represents a critical and timely opportunity to strengthen and accelerate such improvement to a far greater scale in diverse geographies across the state, empowering many more high-need students to successfully pursue STEM degrees and careers. Further, the Project will generate a set of highly valuable tools and resources to help the broader field replicate and adapt CS- and cybersecurity-focused STEM college and career pathways in diverse contexts across the nation.

A. SIGNIFICANCE

A.1. Magnitude. Lone Star STEM addresses several problems that threaten shared long-term prosperity in the United States. Good jobs that offer competitive wages and benefits are in shorter supply than they have been in almost 30 years, and those that remain almost always require postsecondary education, but college completion completion rates have grown only slightly since 1980.[3] One-fifth of all U.S. jobs are STEM-related; that number is expected to grow by 16 percent by 2024.[4] Ninety-three percent of STEM occupations offer significantly above-average wages, and half of U.S. STEM jobs require sub-baccalaureate credentials.[5] Job growth and wages are even higher in CS and information technology (IT) fields than for STEM jobs overall.[6] STEM and CS are similarly critical to Texas's economic vitality, and these fields offer many promising job opportunities for young Texans. (See "Unmet Demand" below.)

These data highlight the *critical national importance of* ***increasing postsecondary attainment****, especially in STEM-related fields*. The United States, which once led the world in postsecondary attainment, now ranks 19th among 28 countries studied by the Organization for Economic Cooperation and Development, and just 42 percent of U.S. adults aged 25 or older have earned an associate's degree or more.[7] This gap is especially acute for people of color: only 32 percent of Blacks and 23 percent of Hispanics have earned an associate's degree or more.[8] The United States also has one of the lowest ratios of STEM to non-STEM postsecondary credentials earned in the world, with just 17 percent of all bachelor's degrees (11 percent for Blacks and 14 percent for Hispanics) awarded in STEM fields.[9] But interest in STEM majors is declining, especially among traditionally underrepresented groups, including women, students of color, and economically disadvantaged students.[10] *Persistence in STEM fields is also a major* *obstacle, with women, minorities, and students from low-income backgrounds leaving STEM-related majors at higher rates than their counterparts.*[11] The proportion of Blacks and Hispanics in STEM occupations is less than half of their proportion in the U.S. population overall, and women only account for 30 percent of all STEM workers.[12]

Enhancing STEM attainment and achievement thus promotes equity and reduces inequality while enhancing the United States' global economic and technological preeminence. According to the Congressional Joint Economic Committee, future demand for qualified STEM workers is likely to outstrip supply, requiring increased postsecondary STEM attainment to prevent the United States from slipping further behind in the global economy.[13] The National Science and Technology Council's Committee on Science, Technology, Engineering, and Math Education concluded that correcting this mismatch requires proportional representation of women, minorities, and first-generation students in STEM education.

A.2. National Significance. Leveraging the authority and influence of TEA, the practical instructional expertise and statewide reach of UTCSE, and the national network and systems-building capacity of JFF, Lone Star STEM will scale Texas's STEM-focused CCRMs to all corners of the state, with a new focus on CS and cybersecurity, and an emphasis on increasing postsecondary access and attainment in rural areas and for historically underrepresented students. The Project is of great national significance for two key reasons. First, Texas is a microcosm of the United States in terms of its geographic and demographic diversity. Second, Texas is a proven laboratory for effective educational innovation.

Demographically, Texas represents the future of the United States. While the United States as a whole is projected to become "majority minority" in the 2040s,[14] non-Hispanic whites already comprise less than half of the population in Texas, with nearly 40 percent of Texans identifying as Hispanic and about 13 percent identifying as Black.[15] Nearly 20 percent of Texas public school students—more than a million students—are English Language Learners.[16] Texas has the second-largest economy of any state in the U.S.,[17] yet inequity and poverty abound. The three poorest U.S. counties are all located in Texas,[18] and more than three million youth—60% of the state's public school students—are economically disadvantaged.[19] *Texas's size and heterogeneity will allow this Project to generate impact data on the effectiveness of its core components in highly varied contexts, leading to lessons learned that can be generalized to and applied in diverse contexts across the nation.* Texas is home to major cities, including the megacities of Dallas and Houston, which have the fourth- and fifth-largest populations—and the fourth- and sixth-largest economies—in the United States.[20] But large swaths of the state remain rural: more than four million Texans live in rural regions,[21] and Texas has more schools in rural areas than any other U.S. state.[22] Rural school districts often face budget shortages linked to shrinking tax bases,[23] and shortages of qualified STEM and Career and Technical Education (CTE) teachers lead to a lack of student access to advanced coursework.[24] This Project is specifically designed to increase access, attainment, and achievement in STEM for precisely these high-need, historically underrepresented students and rural regions—recognizing that lessons learned in Texas will be generalizable across the country.

Second, the Project is nationally significant because Texas is a proven laboratory for educational innovation. For over 15 years, JFF and TEA have worked in partnership to develop and demonstrate Texas' national leadership in creating and scaling breakthrough interventions that leverage dual enrollment to enhance high-need students' access, attainment, and achievement. A striking example of this is the scaling of Early College High Schools (ECHS), one of the four dual-enrollment-based CCRMs. The first ECHSs in Texas opened in 2004 with technical assistance from JFF.[25] With the combined leadership of TEA and JFF, advanced and sustained by a five-year U.S. Department of Education Investing in Innovation (i3) grant, ECHSs scaled rapidly across the state. As of the 2017-18 school year, Texas is home to 198 designated ECHSs, with the highest concentrations in some of the state's most economically challenged regions.[26] *Rigorous research demonstrates that students in ECHSs are significantly more likely to enroll in college, and five times as likely to earn a college degree, as comparison students.*[27] *These positive effects were even stronger among minority and low-income students.*[28] This visionary leadership and the strong proof points in Texas generated national attention and momentum. By 2014, JFF and its partners had created or redesigned more than 280 early colleges serving more than 80,000 students nationwide,[29] scaling lessons learned in Texas across the United States. TEA's blueprint for T-STEM schools, which outlines benchmarks and program requirements,[30] has been adopted and adapted by North Carolina.[31] And Massachusetts, often lauded as the leading state in education, is now using Texas as a model for ECHS design.

A.3. Exceptional Approach. The Project represents an exceptional approach to improving STEM education via scaling leading-edge, dual-enrollment-based CCRMs. Fundamentally, the Project provides an immense opportunity to scale innovation that particularly promises to benefit high-need students across the state. With over five million K-12 students in 1,203 public school districts, Texas has the second-largest student enrollment in the country and more than twice as many students as *any other state* except California.[32] Dual enrollment is the core design element for all of the CCRMs that the Project seeks to scale. The WWC intervention report referenced above finds that dual enrollment positively impacts a wide range of student outcomes related to academic attainment and achievement, in both high school and college, with a medium to large extent of evidence—and that it has no negative effects. There is significant overlap between the student populations for which moderate and strong evidence of effectiveness exists and the high-need student groups that the Project aims to benefit. Of the two WWC-reviewed dual enrollment studies cited in the report that met group design standards without reservations, roughly 50 percent of the student samples were low-income, and between 37 and 54 percent were students of color.[33] Another study—one of the three that met WWC's group design standards with reservations—found that dual enrollment's effects were even stronger for low-income students.[34] These samples are broadly consistent with group representation in Texas's school-age population. In the group that met WWC's group design standards with reservations, another study focused specifically on dual enrollees in Texas.[35] The findings associated with these studies support the Project's aim to leverage dual enrollment to increase STEM access, attainment, and achievement in rural areas and among high-need students.

Further, Lone Star STEM builds on TEA's cutting-edge, high-profile drive to expand high-quality CCRMs by offering clear blueprints (see Appendix G) for school design and key outcomes, paired with a publicly visible, outcomes-based designation status. It also leverages favorable state legislation that requires districts to define sequences of advanced coursework that allow students to earn endorsements in specific areas and establishes CS and cybersecurity as top educational and workforce priorities. (See "Unmet Demand" below.) Finally, the Project features a powerful state agency-university-nonprofit partnership that incorporates the deep expertise and broad networks of both JFF and UTCSE (see Figure 1). As described above, JFF has been a national leader in scaling dual enrollment for more than 15 years. JFF also operates the Pathways to Prosperity Network, a formal network of 15 U.S. states and regions focused specifically on developing and scaling STEM labor-market-aligned education-to-career pathways that span high school and college. The Project also builds on the University of Texas STEM Center's highly effective work on growing the number of Texas high school teachers certified to teach CS, in alignment with the national "CS for All" movement.[36]

Figure 1. Lone Star STEM Logic Model

Resources	Activities	Outputs	Outcomes
Financial Resources • Training stipends for 200+ teachers • Implementation grants for 50 schools • High-quality technical assistance **Intellectual Resources** • Expertise from JFF, TEA, and UTCSE • TEA CCRM blueprints **Institutional Capital** • TEA high schools and districts • Access to JFF and its Pathways to Prosperity Network • Access to University of Texas's statewide network and campuses	**Training** • Focused CS and cybersecurity professional development **Implementation** • Competitive grants • Blueprint guidance and technical assistance, including tools • Peer learning community **Tool Development** • Creation of program of study maps, competency maps, and credential maps related to CS and cybersecurity **Continuous Improvement** • Program and teacher surveys; site visits; document review	**Teachers** • Skills and certification to teach STEM courses in CS and cybersecurity **Schools & Districts** • Coherent programs of study in CS and cybersecurity • Increased # of CS-certified teachers • Increased capacity to provide quality, innovative STEM coursework, with an emphasis on rural schools **TEA** • Expanded set of tools and resources to help schools implement CCRM • New curricular resources for CS and cybersecurity	**Students** • Improved performance on achievement tests • Increased HS and college credit and industry credential attainment • Increased representation of high-need students in STEM fields **Districts** • Increased capacity to help students become college and career ready **Nationally** • Expansion of knowledge and resources available to help other states adopt and adapt College and Career Readiness school models

B. STRATEGY TO SCALE

B.1. Unmet Demand. The Lone Star STEM project addresses currently unmet demand for high-quality STEM education that is emerging from industry, government, educators, students, and families. While 60 percent of today's STEM jobs are in computing, *only three percent of Texas high school graduates currently complete a CS class*.[37] There are now more than 45,000 job openings in Texas that require computing skills, but just 19 percent of Texas high schools offer advanced placement CS,[38] and only 18 percent of Texans who graduate with degrees in CS are female.[39] By 2020, there will be one million *more* computing jobs nationwide than qualified employees to fill them.[40] Texas Governor Greg Abbott has designated Information and Computer Technology as a Target Industry Cluster for workforce and economic development, and Texas is already home to more jobs in IT services firms than any state other than California.[41] With over

20,000 job openings, Texas is also one of the leading states for jobs in cybersecurity.[42]

Lone Star STEM will make Texas a model for innovative and equitable solutions that can achieve nationwide scale and impact. Texas legislation already encourages districts to offer access to advanced coursework in STEM, especially in CS. In 2013, Texas's House Bill (H.B.) 5 created the Foundation High School Program, restructuring graduation requirements by requiring all districts to offer high school diploma endorsements in five areas of study—one of which is STEM.[43] A student completing a STEM endorsement must complete Algebra II, Chemistry, Physics, and at least three additional credits in STEM-related courses, including CS courses.[44] The 2017 Texas Cybersecurity Act (H.B. 8) sharpened the state's focus on CS and required the establishment of a state cybersecurity panel, composed of both public and private sector leaders, charged with assessing the state's existing cybersecurity workforce and developing recommendations to address the cybersecurity skills gap and build a talent pipeline.[45] Texas H.B. 3593, also enacted in 2017, directly connected this workforce priority to the K-12 system by amending the state's education code to allow schools to more easily offer cybersecurity courses for high school credit. H.B. 3593 stipulates that computer coding satisfies the state's foreign language requirement; mandates the incorporation of a five-course cybersecurity pathway into the state's existing STEM endorsement; provides for the reimbursement of teachers who earn certifications in cybersecurity; and qualifies courses in cybersecurity for CTE funding.[46]

However, there are not nearly enough Texas teachers qualified to teach in STEM, especially in CS. At the start 2017-18, Texas had a shortage of 30,000 teachers, with an amplified need for more STEM teachers.[47] For CS more particularly, t*here are approximately 1,500 high schools in Texas, but only 71 teachers were certified to teach CS in the 2014 school year*. Motivated by that mismatch, UTSCE partnered with Oracle to offer existing Texas teachers a free online coding course, which generated three times as many applicants as there were available slots.[48] Since then, UTSCE has expanded its efforts, helping 408 teachers complete certifications in CS.[49] Nevertheless, the need for qualified STEM and CS teachers continues to far exceed supply. Lone Star STEM will address this need by training over 200 teachers seeking CS certification.

Families want more and better STEM and CS education for their children. Ninety percent of parents want their children to learn CS, but only 40 percent of schools teach computer programming.[50] Overall enrollment rates in high school STEM CTE courses in Texas have consistently climbed, but the enrollment gap between male and female students has grown.[51] Moreover, the rapid growth in the percentage of Texas students taking CS is overwhelmingly concentrated in affluent schools.[52] Black and Hispanic students are underrepresented as enrollees in Texas's existing STEM endorsement pathways and even more so as STEM endorsement graduates. (See Appendix G for data on disproportionality.) Demand for high-quality STEM coursework and qualified STEM teachers will only continue to increase, as student enrollment in Texas has increased by over 17 percent in the last decade and shows no sign of slowing.[53]

B.2. Strategies that Address Barriers to Scale. Lone Star STEM addresses three major barriers that have limited the scaling of CCRMs, especially those with a STEM or CS focus, in Texas: 1) a shortage of qualified STEM teachers, especially in CS; 2) limited access to STEM advanced coursework and dual enrollment in rural regions; 3) inadequate district/school capacity to design and implement STEM and CS dual enrollment pathways aligned to labor-market needs. This Project will design, implement, and codify solutions for overcoming these barriers.

Shortage of Qualified Teachers. As detailed above, the State of Texas has a shortage of qualified STEM teachers, with an especially acute shortage of CS teachers. A typical U.S. teacher would need to work for up to 30 years to earn a salary equivalent to that of credentialed CS graduate just beginning her career,[54] an earnings disparity that creates a need for innovative strategies to prepare existing teachers to teach CS, cybersecurity, and coding. In two years, UTCSE's WeTeach_CS offerings have helped *more than triple* the number Texas teachers certified in high school CS.[55] Lone Star STEM will leverage UTCSE's deep expertise to serve *over 200 additional teachers* seeking to gain skills and certifications in CS. Quasi-experimental studies have provided suggestive evidence that teacher participation in UTCSE's Texas Regional Collaboratives—a statewide professional development network of P-16 math and science educators—increases their students' academic achievement on state math and science tests.[56] Through the Project, UTCSE will offer teachers 100 hours of professional development each year: 68 hours of online training in Foundations of CS and instructional strategies, and 32 hours of in-person professional learning, including training for the TExES certification exam in CS and the three-day WeTeach_CS Summit. Each cohort of new CS teachers will have access to curricular resources aligned to state guidelines for CSI, which all Texas high schools must offer.

Limited STEM Access in Rural Areas. Despite the rapid growth of dual enrollment programs and access to advanced STEM coursework in Texas districts, spurred largely by the Early College High School Initiative and TEA's subsequent development of additional CCRMs, students in rural areas have remained largely underserved. The reasons are numerous. Dual enrollment depends on academic programming that aligns and integrates high school and college, but rural high schools are often located large distances from potential partner colleges, limiting students' access to college-level courses. Teacher shortages also tend to hit rural areas hardest, and are compounded by the requirement that teachers in dual enrollment courses have additional graduate education. Students and families who live in rural areas may be less exposed to the many high-quality professional opportunities that exist in STEM fields, and therefore less likely to advocate for school models that emphasize them. Finally, developing and launching STEM- and CS-based pathways can be costly, and rural districts often face tremendous budgetary pressure due to shrinking enrollments and tax bases. The Project will employ several strategies to support the adoption of CCRMs by rural districts. TEA will leverage the Project to *administer a competitive grant process, targeting the state's rural districts, that awards funding to launch, extend, and/or expand 25 CCRMs, with a specific focus on STEM and CS*. JFF will provide technical assistance that directly addresses rural challenges, including building capacity for secondary-to-postsecondary alignment and integration and creating communications plans and materials that help students and their families better understand STEM opportunities. UTCSE's supports for teachers incorporate strategies designed for teachers in rural areas.

Inadequate District/School Capacity. While rural schools and districts face unique constraints in developing and implementing CCRMs, many other schools across the state simply do not have the expertise necessary to design and implement innovative programs of study in CS and cybersecurity. Coherent education-to-career pathways must be backwards mapped from employer-validated competencies and industry-recognized credentials with labor market value. Similarly, dual enrollment works best when high schools and local postsecondary institutions work closely together to align course sequences and curricula, yet most K-12 schools lack knowledge of and experience with these strategies. To build school capacity, JFF will perform applied labor market research and engage key state employers to identify the competencies and credentials necessary for students to succeed in Texas's STEM labor market, especially in CS, and will collaborate with TEA to develop aligned dual enrollment pathways, including in cybersecurity. TEA and JFF will provide guidance and support to schools and districts implementing the CCRMs and designing school-level structures and programs that align with the design elements and outcome-based measures contained in TEA's CCRM blueprints.

B.3. Replication Feasibility. Scaling throughout Texas, which is geographically larger and more populous than the entire six-state region of New England, represents a tremendous opportunity to generate proof points and lessons that can be replicated and adaptively integrated into varied contexts nationwide. JFF and Project partners will codify and disseminate information and strategies with the overall goal of helping education systems in other states and regions implement key elements of CCRMs in STEM and overcome common implementation challenges. We will convene a Lone Star STEM school peer-learning network, which will surface common challenges and best practices. JFF and Project partners will document these challenges and successes in publications such as case studies, policy briefs, reports, and blogs. JFF will research and create externally available program of study maps, competency maps, and credential maps in CS and cybersecurity to provide a clear framework for designing dual enrollment pathways that are aligned with regional labor markets and culminate in industry-recognized credentials. Project partners also will present on Lone Star STEM at national conferences with similar focus areas (e.g., STEM, CS, dual enrollment, early college, career pathways, CTE) and will hold Lone Star STEM webinars open to a national audience. Finally, the evaluation from American Institutes for Research (AIR) will provide rigorous research on how CCRMs create better outcomes, the core program elements needed for success, and the differing effects of those elements on key subgroups of high-need students. TEA's CCRM blueprints, which describe inputs and outputs necessary to create high-quality dual enrollment pathways in STEM-specific areas, are also clear and powerful roadmaps for other states.

The Project partners are in an extremely strong position to disseminate these products and cross-pollinate major lessons. JFF is a leader in the national ECHS movement and will share and leverage the lessons learned from the Project with its network of schools, employers, and other institutional partners. JFF will also disseminate best practices for replication via our national Pathways to Prosperity Network, referenced above, and will create a project page on its website, which is highly visible to key national audiences, with tools and resources to support replication. UTCSE's WeTeach_CS program already supports new CS educators in other states, including Georgia, Wisconsin, Arkansas, and Rhode Island, and the University of Texas has campuses and deep relationships with K-12 schools and educators in every major region in the state. TEA and its sister agencies, the Texas Higher Education Coordinating Board (THECB) and the Texas Workforce Commission (TWC), have deep connections to and influence over K-12 schools, institutions of higher education, workforce boards, and the employer community, which they will leverage to support replication during and beyond the grant period. AIR, a nationally recognized leader in research and evaluation, will intentionally design the evaluation to highlight and support effective replication of the Project's core elements.

C. PROJECT DESIGN AND MANAGEMENT PLAN

C.1. Measurable Goals, Objectives, and Outcomes. Lone Star STEM will create, implement, and scale entrepreneurial, evidence-based, field-initiated innovations that will *measurably improve the educational outcomes of high-need students* in STEM overall with an emphasis on CS and cybersecurity, propelling students along pathways to postsecondary credentials and in-demand STEM careers. In Year 1, Lone Star STEM will establish a baseline for performance, which we will use to measure overall progress over the five-year grant period, as reflected in the goals, objectives, and outcomes outlined in Table 1 below.

Table 1: Lone Star STEM Measurable Project Goals, Objectives, and Outcomes

Goal 1: Increase access for high-need students to innovative STEM coursework, including CS, cybersecurity, and other in-demand STEM fields		
Objectives	**Performance Measures**	**Outcomes**

O1.1: Increase the number of schools offering STEM, CS, or cybersecurity coursework, especially in rural areas **O1.2:** Increase access to STEM coursework for high-need and underrepresented students **O1.3:** Increase the number of STEM-focused CTE programs of study offered in schools **O1.4:** Develop, implement, and scale new cybersecurity coursework	**PM1.1:** 10% annual increase in schools statewide offering STEM, CS, or cybersecurity coursework; disaggregated by rural, suburban, and urban **PM1.2:** 10% annual increase in STEM, CS, and cybersecurity courses offered, disaggregated by rural, suburban, and urban **PM1.3:** 15% annual increase over baseline the proportionate representation of high-need, black, Hispanic, female, English language learners, and economically disadvantaged students with access to STEM coursework **PM1.4:** 10% annual increase in schools offering STEM CTE programs of study, disaggregated by type **PM1.5:** 10% annual increase in students concentrating/completing of STEM-focused CTE programs of study, disaggregated by type (baseline to be established in Year 3, with increase taking place from Year 3 to Year 5) **PM1.6:** 10% annual increase in student enrollment in STEM courses, disaggregated by subgroup **PM1.7:** At least 15 new CS and cybersecurity courses offered in schools annually (to be offered starting in Year 3, following revisions to state guidelines in Years 1 and 2)	• All participating Lone Star STEM schools are offering high-quality, innovative STEM, CS, and cybersecurity coursework • Lone Star STEM coursework and STEM-focused CTE programs of study are implemented in diverse districts and schools across Texas, including in urban, suburban, and rural areas • High-need and underrepresented students are enrolling in Lone Star STEM coursework at rates proportional to their overall enrollment • Cybersecurity coursework is available in Lone Star STEM schools and districts across Texas

Goal 2: Increase the <u>number of and participation in STEM dual enrollment courses</u>, with an emphasis on CS, cybersecurity, and other in-demand STEM fields		
Objectives	**Performance Measures**	**Outcomes**
O2.1: Increase the number of schools offering STEM dual enrollment coursework, especially in rural areas **O2.2:** Increase number of high-need and underrepresented students who successfully complete college-level STEM coursework through dual enrollment **O2.3:** Promote multiple dual enrollment delivery models, including college courses taught on the college	**PM2.1:** 10% annual increase in STEM dual enrollment courses offered in Lone Star STEM schools; disaggregated by rural, suburban, and urban **PM2.2:** 10% annual increase of the proportionate representation of high-need, Black, Hispanic, female, English language learners, and economically disadvantaged students enrolled in dual enrollment STEM coursework **PM2.3:** Annual increase of 15% in the number of students earning 12 or more college credits by high school graduation	• High-need students succeed in college coursework, particularly STEM coursework • Students are enrolling and succeeding in STEM dual enrollment courses that propel them to college and career success

campus, high school campus, and/or online **O2.4:** Students and families understand education and career options in STEM fields, including CS and cybersecurity	**PM2.4:** Increase by 10% annually the number of students taking and successfully completing dual enrollment and AP math, science, and other STEM courses by high school graduation	• Students are enrolling in STEM dual enrollment courses that are aligned with credentials in STEM fields

Goal 3: Improve achievement and educational outcomes for high-need students		
Objectives	**Performance Measures**	**Outcomes**
O3.1: Increase student academic achievement as demonstrated by end-of-course (EOC) assessments **O3.2:** Increase the college- and career- readiness of students **O3.3:** Increase students' ability to take college-level STEM coursework as demonstrated by TSI† pass rates **O3.4:** Increase students' high school retention and graduation rates **O3.5:** Increase students' college-going rates	**PM3.1:** 5% annual increase in number of students in grades 9 and 10 passing STAAR‡ EOC assessments in Algebra I, English I and II, Biology **PM3.2:** 5% annual increase in the number of students earning Algebra II course credit **PM3.3:** 10% annual increase in number of students meeting or surpassing college readiness benchmarks (SAT/ACT) **PM3.4:** 10% annual increase in number of students earning industry-recognized credentials and certificates **PM3.5:** 5% annual increase in number of students earning STEM-focused industry-recognized credentials and certificates, disaggregating CS credentials **PM3.6:** 10% increase over the grant period in the number of students TSI college-ready in mathematics **PM3.7:** 5% annual increase in the number of students TSI college-ready in reading **PM3.8:** 5% annual increase in the number of students graduating high school (or on-track to graduation) after four years **PM3.9:** 5% annual increase in number of students graduating high school with a STEM endorsement **PM3.10:** 5% annual increase in number of students seamlessly enrolling in postsecondary education (including certificates and 2- and 4-year degrees) after high school	• CCRMs foster college and career readiness and success for high-need students • High-need students enter and succeed in postsecondary programs of study in STEM fields, including CS and cybersecurity • High-need students pursue and succeed in careers in in-demand STEM fields, including CS and cybersecurity

Goal 4: Build the capacity of schools to offer high-quality and innovative STEM, CS, and cybersecurity coursework, particularly rural schools		
Objectives	**Performance Measures**	**Outcomes**

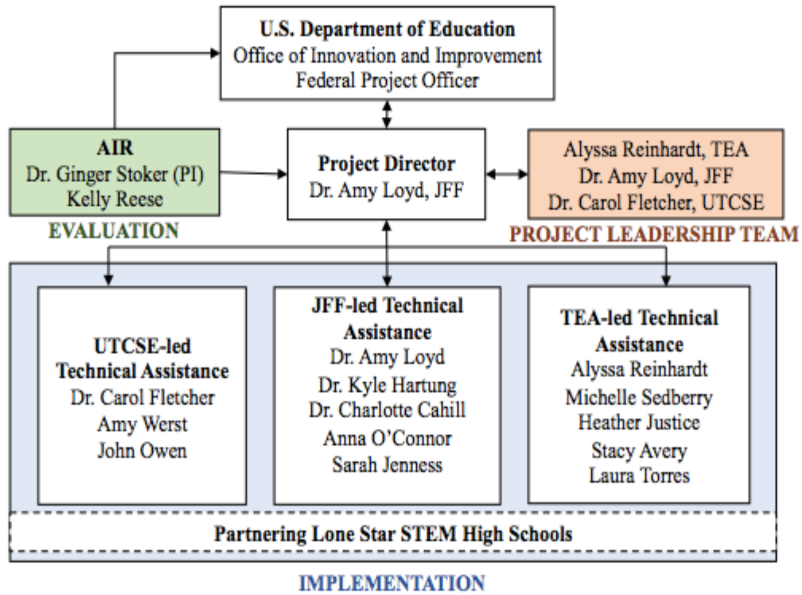
† The Texas Success Initiative tests are used to determine whether students are ready for college-level course work and for course placement by Texas colleges and universities.
‡ State of Texas Assessment of Academic Readiness

O4.1: Increase the number of teachers certified to teach CS **O4.2:** Create opportunities for schools to learn from evidence-based best practices and from one another **O4.3:** Inform and develop innovative CS and cybersecurity pathways with high-quality dual enrollment and industry certification components	**PM4.1:** Increase the number of teachers obtaining CS/cybersecurity certification annually by 20% **PM4.2:** Increase the number of rural teachers obtaining CS/cybersecurity certification annually by 20% **PM4.3:** Hold two in-person Lone Star STEM network institutes **PM4.4:** Hold quarterly virtual Lone Star STEM network meetings **PM4.5:** Share clearly defined competency maps, course sequencing, and curricular resources in CS and cybersecurity pathways for use by Lone Star STEM districts and beyond	• Texas schools in rural and non-rural settings increase their capacity to offer in-demand STEM courses, including CS • Schools utilize data-informed resources to implement high-quality STEM coursework, including dual enrollment courses, especially in CS and cybersecurity

Goal 5: Codify, disseminate, and spread Lone Star STEM best practices in high-quality, innovative coursework and dual enrollment in in-demand STEM fields to other states		
Objectives	**Performance Measures**	**Outcomes**
O5.1: Document how Lone Star STEM develops and scales entrepreneurial, evidence-based, field-initiated innovations to improve educational outcomes for high-need students **O5.2:** Share Lone Star STEM processes, practices, and findings with other states and nationally/publicly	**PM5.1:** At least three tools designed to assist other states and regions in replicating or adapting Lone Star STEM-related policies and practices **PM5.2:** At least five publications documenting Lone Star STEM successes and challenges, e.g., case studies, policy briefings, online blogs, reports **PM5.3:** Present on Lone Star STEM to at least five national conferences with a similar focus area (e.g., STEM, CS dual enrollment, early college, career pathways, CTE) **PM5.4:** Hold at least three Lone Star STEM webinars widely advertised and open to a national audience	• Lone Star STEM inspires and informs the development of related bodies of work in STEM, CS, and dual enrollment in other states • Lone Star STEM expands the evidence base about effective practices to improve the educational outcomes of high-need students, and creates actionable tools and resources for policymakers and practitioners • STEM fields are diversified and growing in rural and urban contexts, with a thriving talent pipeline

C.2 Management Plan. Lone Star STEM is a partnership among JFF, TEA and UTCSE, pursuant to which each will play a critical role in scaling STEM-focused CCRMs throughout Texas, using dual enrollment as a key lever for improving student outcomes. The organizational chart opposite (Figure 2) shows the reporting relationships for the partner organizations. Our plan is strong and sound because each partner organization is highly qualified for a clear and specific role involving execution of the goals and objectives (see Table 1) at for each activity and milestone on the project's 5-year timeline (see Table 2 below).

Figure 2. Organizatonal Chart



JFF will manage and oversee the Project and will leverage its national expertise in STEM college and career pathways development to help TEA design, implement, and refine the systems necessary to align secondary and postsecondary STEM, CS, and cybersecurity programs of study with labor market needs, engage employers in curriculum design and the provision of work-based learning opportunities, and achieve scale with both quality and equity. ***TEA*** will provide guidance, support, and accountability in relation to the Lone Star STEM CCRM competitions and other matters of state law and policy; determine and award CCRM state designations for Lone Star STEM schools; administer the Project's competitive grant process; and coordinate relationships with schools and districts, TWC, and THECB. ***UTCSE*** will lead professional learning opportunities that build the capacity of LEAs, schools, and teachers to deliver high-quality instruction in STEM, generally, and in CS and cybersecurity pathways in particular by expanding the number of teachers qualified to teach CS. ***AIR*,** the the independent evaluator, is one of the largest social and behavior research firms in the country, and currently serves as the evaluator of numerous EIR early-phase and mid-phase projects. The proposed evaluation lead, Dr. Ginger Stoker, and implementation fidelity lead, Kelly Reese M.P.P, are experts in the areas of college and career readiness, CTE, and program evaluation. Both have experience conducting evaluations of EIR projects. Dr. Stoker is a WWC certified reviewer.

Table 2: Activities, Milestones, Timeline (by Year and Quarter), and Responsibilities

Milestones	Date Due	Respon-sible Parties	Objectives, Performance Measures
Goal 1. Increase access for high-need students to innovative STEM coursework			
Activity 1.1: Administer three rounds of a competitive grant process for schools to implement one of the Texas CCRMs with a focus on STEM, including CS and cybersecurity			
Design and release RFP for three grant cycles	Y1-3/Q1	JFF, TEA	O1.1, O1.3; PM1.1, PM1.2, PM1.4
Review applications	Y1-3/Q2	JFF, TEA	
Award grants	Y1-3/Q3	TEA	
Activity 1.2: Expand innovative Lone Star STEM coursework and programming to target populations statewide, including to rural regions			
Create competitive preference for rural applicants	Y1-3/Q1	JFF, TEA	O1.2; PM1.3, PM1.5, PM1.6
Create competitive preference for high-need and underrepresented students	Y1-3/Q1	JFF, TEA	
Activity 1.3: Support development and implementation of STEM-focused CTE programs of study and cybersecurity coursework			
Conduct landscape analysis to inform planning	Y1/Q1-2	JFF	O1.1, O1.2, O1.3, O1.4; PM1.1, PM1.2, PM1.3. PM1.4, PM1.5, PM1.6, PM1.7
Create implementation recommendations	Y1/Q3-4	JFF	
Provide technical assistance (TA) to schools to implement recommendations	Y1/Q4 Y2-3/Q1-4	JFF, TEA	
Conduct site-based analysis of progress to inform continuous improvement	Y2/Q3-4 Y3/Q1-3	JFF, TEA	
Goal 2. Increase number of and participation in dual enrollment courses			
Activity 2.1: Promote multiple dual enrollment delivery models, including college courses taught on the college campus, high school campus, and/or online			
Develop and disseminate tools and resources on multiple dual enrollment delivery models	Y1/Q3-4 Y2/Q1	JFF	O2.1, O2.2, O2.3; PM2.1, PM2.2, PM2.3, PM2.4
Host informational webinar series to disseminate delivery models	Y1/Q3-4 Y2/Q1	JFF, TEA	
Activity 2.2: Create program of study maps that identify strategic dual enrollment courses aligned with credentials in STEM fields, including CS and cybersecurity			
Map STEM credentials and entry-level courses at 2- and 4-year postsecondary institutions	Y1/Q3-4 Y2/Q1-2	JFF	O2.1, O2.2, O2.3; PM2.1, PM2.2, PM2.3,
Develop program of study maps	Y2/Q2-4	JFF	

Build schools’ capacity to utilize maps	Y3/Q1-4	JFF, TEA	PM2.4
Activity 2.3: Develop communications strategy and materials that inform students and their families about the benefits and advantages of dual enrollment and promising STEM career opportunities in Texas			
Synthesize evidence on benefits of dual enrollment	Y1/Q2-3	JFF	O2.2, O2.4; PM2.2, PM2.3, PM2.4
Develop a communications strategy for districts	Y1/Q3-4	JFF	
Develop a communications toolkit and resources for use by schools and districts	Y1/Q4 Y2/Q1-2	JFF, TEA	
Goal 3. Improve achievement and educational outcomes for high-need students			
Activity 3.1: Build the capacity of Lone Star STEM schools to implement support strategies that improve student outcomes, such as: personalized learning environments, individualized student academic support plans, tutoring, advisory, and mentoring			
Analyze promising student support strategies	Y1/Q1	JFF	O3.1, O3.2, O3.3, O3.4, O3.5; PM3.1, PM3.2, PM3.3, PM3.4, PM3.5, PM3.6, PM3.7, PM3.8, PM3.9, PM3.10
Conduct focus groups with TX educators	Y1/Q2-3	JFF, TEA	
Develop best practices for student support strategies	Y1/Q4	JFF, TEA	
Provide technical assistance to Project sites	Y2-5/Q1-4	JFF	
Share best practices and resources at TEA events	Y2-5/Q3	JFF, TEA	
Share best practices and resources via website	Y2-5/Q1-4	JFF, TEA	
Reconvene focus groups to gauge progress	Y2-5/Q3	JFF, TEA	
Refine best practices and resources	Y2-5/Q4-4	JFF	
Activity 3.2: Support schools in implementing plans for TSI success, including academic preparation classes and interventions			
Develop a data analysis protocol for schools	Y1/Q1	JFF	O3.2, O3.3; PM3.6, PM3.7
Develop template implementation plans	Y1/Q1	JFF	
Provide technical assistance providers to support schools’ data analysis	Y1/Q4 Y2/Q1-4	JFF, TEA	
Monitor TSI performance data	Y1-5/Q3	JFF, TEA	
Activity 3.3: Identify and align prerequisites for dual enrollment courses			
Map prerequisites for programs of study and credentials	Y1/Q3	JFF	O3.2, O3.5; PM3.4, PM3.10
Solicit Texas educators’ feedback on maps	Y1/Q4	JFF, TEA	
Facilitate secondary/postsecondary planning	Y2/Q1-4	JFF	
Goal 4. Build the capacity of schools to offer high-quality and innovative STEM, CS, and cybersecurity coursework, particularly rural schools			
Activity 4.1: Provide online training for teachers to obtain CS certification			
Support teachers enrolled in online *Foundations of CS for Teachers* course (207 total teachers; 40 hrs)	Y1/Q2-4 Y2-5/Q1-4	UTCSE	O4.1; PM4.1, PM4.2
Provide 2 in-person 2-day certification workshops annually, study materials, and virtual support (207 total teachers;12 hrs)	Y1/Q2-4 Y2-5/Q1-4	UTCSE	
Activity 4.2: Provide ongoing in-person and virtual teacher professional development, and guidance for schools and districts, on Lone Star STEM implementation			

Support 207 teachers with online curriculum for teaching CS I – WeTeach_CS for HS	Y1/Q2-4 Y2-5/Q1-4	UTCSE	O4.1; PM4.1, PM4.2
Facilitate monthly virtual webinars and office hours supporting classroom implementation for 207 teachers (10 hrs)	Y1/Q2-4 Y2-5/Q1-4	UTCSE	
Support 207 teachers enrolled in online *WeTeach_CS for HS* instructional strategies/pedagogy course (18 hrs)	Y1/Q2-4 Y2-5/Q1-4	UTCSE	
Coordinate and deliver 3-day WeTeach_CS Summit (20 hrs) for all Lone Star STEM teachers	Y1-5/Q3	UTCSE	
Activity 4.3: Share best practices through a Lone Star STEM school peer learning network			
Convene in-person network institutes	Y3,5/Q2	JFF	O4.2; PM4.3, PM4.4
Hold four virtual Lone Star STEM peer learning community meetings per year	Y1/Q4 Y2-5/ Q1-4	JFF	
Activity 4.4: Develop resources to provide technical assistance to build the capacity of schools to develop high-quality CS and cybersecurity pathways			
Convene employers and conduct desk-based research to map CS and cybersecurity competencies	Y1/Q3-4 Y2/Q1	JFF	O4.3; PM4.5
"Backwards map" course sequences from labor market to postsecondary to postsecondary	Y2/Q2	JFF	
Develop work-based learning frameworks aligned with CS and cybersecurity pathways	Y2/Q3	JFF	
Provide TA to schools in adopting and adapting competency maps, course sequences, and frameworks	Y2/Q4 Y3-5/Q1-4	JFF, TEA	
Goal 5: Codify, disseminate, and spread Lone Star STEM best practices in high-quality, innovative coursework and dual enrollment in in-demand STEM fields to other states			
Activity 5.1: Document and codify learnings via tools and resources			
Develop and publish tools to codify best practices and support replication	Y3-5/Q1-4	JFF	O5.1, O5.2; PM5.1, PM5.2
Document successes and challenges in five publications	Y3-5/Q1-4	JFF	
Activity 5.2: Disseminate Lone Star STEM work nationally via conferences, webinars, publications			
Present on Lone Star STEM at national conferences	Y3-5/Q1-4	JFF	O5.1, O5.2; PM5.3, PM5.4
Hold Lone Star STEM webinar series for national audience	Y4/Q2-4	JFF	
Highlight Lone Star STEM and related resources on websites accessed by key national audiences	Y3/Q4	JFF	

Project Planning, Implementation, and Monitoring (see Section C.3 for more detail)		
Develop detailed Project work plan; update annually based on feedback and evaluation	Y1-5/Q1	JFF

Hold bi-weekly Technical Assistance Team meetings	Y1-5 /Q1-4	JFF, TEA, UTCSE
Hold monthly Project Leadership Team/AIR implementation review meetings	Y1-5/ Q1-4	JFF, TEA, UTCSE, AIR
Review formative evaluation conducted by AIR and use to improve implementation activities	Y2-5/Q1	JFF, TEA, UTCSE
Hold annual all-partner summative evaluation meeting	Y2-5/Q1	JFF, TEA, UTCSE, AIR
Quarterly email to all Lone Star STEM schools and partners, providing updates and soliciting feedback	Y1-5/ Q1-Q4	JFF, TEA, UTCSE, AIR

C.3 Feedback and Continuous Improvement Plan. All Lone Star STEM partners are committed to ensuring feedback and continuous improvement through (1) the Project's yearly formative evaluation structure and (2) regular communications, ongoing collaboration, and routines for and seeking and using feedback, input, and data to strengthen the Project's operations.

The JFF **Technical Assistance Team** will hold bi-weekly videoconference meetings with the TEA and UTCSE Technical Assistance teams to discuss and address project management and implementation issues. The **Project Leadership Team** will meet monthly with AIR (in person or via videoconference) to review progress towards goals, objectives, and outcomes and to make any mid-course corrections to implementation informed by formative evaluation data and Project input and feedback. The **Lone Star STEM peer learning network** will virtually convene quarterly, sharing successes and challenges and discussing feedback for improvement. Other feedback mechanisms include at least once monthly ***formal and informal inquiry processes with all Lone Star STEM schools***, seeking their feedback regarding any barriers or difficulties experienced in implementation, as well as recommendations for improvement; a ***quarterly email update to all Lone Star STEM schools and partners***, providing updates and welcoming feedback; using ***feedback surveys*** at the Lone Star STEM institutes and other professional development sessions; and ***using a "+/Δ" protocol*** after all webinars, technical assistance sessions, and formal meetings during which participants will briefly brainstorm what went well

("+") and what could be changed and improved ("Δ") to inform future work.

AIR will conduct a **formative evaluation each year** to provide the Project Leadership Team with extant data analysis to be used to determine whether the project is meeting its quantitative performance measures regarding to student participation and outcomes, as well as information regarding how schools are implementing the program. Each year's formative evaluation will create feedback that informs real-time improvements or improvements for the next implementation year. The routines for gathering feedback and deciding on improvements will be integrated into ***monthly implementation review meetings***. Each meeting will include a regular agenda item to discuss feedback and implications for improving the project's strategies and procedures, and AIR will provide updates to the project team regarding information obtained from school site visits that had been conducted. AIR will also provide an update memo for ***bimonthly impact evaluation reviews*** to discuss real-time data analysis of progress and to inform federal reporting on the Project. Finally, AIR will hold an ***annual all-partner summative evaluation meeting*** to review and discuss the annual evaluation report.

C.4. Sustainability of Project Purposes, Activities, and Benefits. This Project holds tremendous potential to thrive well beyond the five years of this grant, and to scale well beyond Texas. From the outset, we will plan, develop, and implement Lone Star STEM with a vision towards its sustainability. *TEA and UTSCE commit to incorporating the project's purposes, activities, and benefits into the ongoing work in Texas*—and *JFF commits to spreading and scaling the best practices and resources developed from Lone Star STEM across the country*.

By using TEA's existing, evidence-based, field-initiated CCRMs as the delivery vehicle for scaling Lone Star STEM's new STEM, CS, and cybersecurity coursework and dual enrollment, *TEA will continue to implement and fund the Lone Star STEM work developed* after Year Five.

This Project will also *build the capacity of Texas schools to continue to locally implement, improve, and scale the high-quality innovations developed into the future while contributing to the economic vitality of Texas and the nation*. Recently enacted Texas legislation requiring an educational focus on CS and cybersecurity will also contribute to implementing this Project's purposes, activities, and benefits well into the future. This policy has not yet been put into practice; Lone Star STEM will help Texas develop, implement, adapt, and scale locally-driven and evidence-based solutions to improving high-need student outcomes. Lone Star STEM will thus provide the entire State of Texas with a timely and coherent approach to implementing high-quality CS, cybersecurity, and STEM courses and dual enrollment across diverse geographies and demographies—which will then be implemented at scale in the years beyond this grant. This Project will also accelerate and strengthen core aspects of the new high school STEM endorsement area, which will also be replicable and sustained across all Texas school districts.

With the statewide, national, and international platforms that JFF and UTCSE both have to share Project benefits, we will showcase and share the Lone Star STEM strategies, activities, and outcomes with our respective networks of policymakers, practitioners, and researchers. All of the tools, publications, and other resources developed through Lone Star STEM will be featured and housed in publicly-accessible and frequently-visited websites (e.g., www.jff.org, www.ptopnetwork.org), and the work we do in this Project will inform our work in the future.

D. PROJECT EVALUATION

AIR will conduct an independent evaluation of the Lone Star STEM Project to address six research questions (RQs) about impact and implementation fidelity: (RQ1) What is the impact of the Project on student achievement? (RQ2) What is the impact of the Project on student college and career readiness outcomes? (RQ3) What is the impact of the Project on student retention and graduation from high school (or on-track for graduation)?[§] (RQ4) Is the impact of the Project on (a) student achievement, (b) college readiness, and (c) retention and graduation moderated by student and school characteristics? (RQ5) Is the Project implemented with fidelity? (RQ6) What obstacles inhibit, and what success factors enable, successful implementation of the Project?

D.1. Evaluation Methods Designed to Meet WWC Evidence Standards Without Reservations.

Design. These RQs will be addressed through a cluster randomized controlled trial, with schools as the unit of assignment. Based on a statistical power analysis designed to achieve an MDES of 0.20 (see Appendix G for details), the sample for the proposed RCT will include 50 schools, 25 of which will be randomly assigned to implement the Lone Star STEM Project, and 25 of which will continue to conduct business as usual.

Sample. The evaluation will investigate the impact of the Project on student outcomes in grades 9–12, following one incoming cohort of grade 9 students in 2019–20 through 4 years of high school, until the end of the 2022–23 school year, in each of the 50 schools in the study. Participating schools are expected to average at least 40 incoming grade 9 students, a number designed to accommodate rural school participation.

Data. To conduct the analyses, TEA will provide AIR with student- and school-level data from several sources, as detailed in Table 3. All student-level data files will contain encrypted student identifiers linkable across student- and school-level data files.

Table 3: Data Sources and Descriptions

Source File	Description of Data
Texas Public Education Information Management System (PEIMS)	Student-level data on enrollment; demographics (e.g., race/ethnicity, economic disadvantage, gender); special program participation (e.g., special education,

[§] Some school models implement programs that are designed for students to complete in 5 or 6 years. For students in these schools, AIR will use on-track to graduate within this time period as the outcome in analyses answering this question.

	English learner); course completion (including dual enrollment); graduation, industry certification
State of Texas Assessment of Academic Readiness (STAAR)	Student-level scores on state standardized tests, including HS end-of-course (EOC) assessments
Texas Success Initiative (TSI)	Student-level scores on state college readiness tests in reading and mathematics
College admissions testing files	Student-level SAT and ACT scores
Texas Academic Performance Reports (TAPR)	School-level data (e.g., percentage minority, geographic location, school size)

Attrition. Because the study relies on extant data collected by TEA for all public and charter schools in the state, school-level attrition from the study is unlikely unless a school closes.[**] Therefore, school-level attrition is expected to be very low. Student-level attrition may occur if students drop out of high school, move out of the state, or enroll in a private school. AIR will monitor both school- and student-level attrition (both overall and differential) throughout the study. If overall and differential attrition rates do not meet WWC standards, AIR will use WWC-approved missing data imputation methods, such as multiple imputation, to address missing data. However, we are not concerned about overly high or differential attrition because (1) rates of out-of-system transfer are very low; (2) the RCT should balance attrition propensity; and (3) the likelihood of students leaving as a function of treatment status is highly implausible.

Before conducting the impact analyses each year, AIR will assess **baseline equivalence** of the treatment and control groups. Baseline equivalence will be based on intent-to-treat (ITT) assignments. AIR will assess whether students in treatment and control conditions differ on baseline covariates and demographics using WWC standards. To increase statistical power, the analytic models will include all student baseline covariates and demographic characteristics, regardless of whether the standardized mean difference meets the WWC threshold for inclusion

[**] Since the evaluation will use extant data from TEA, it will be possible to access student-level data for all open schools, even if a school chooses to leave the program.

in the analytic models (i.e., standardized mean difference is > 0.05 but < 0.25).

D.2. Valid and Reliable Performance Data on Relevant Outcomes

Student Outcomes. All outcome measures meet the What Works Clearinghouse face validity and reliability requirements. The evaluation will assess the impact of Lone Star STEM on student success in the domains of achievement, college and career readiness, and retention and graduation, with specific outcomes and measurement years as detailed in Table 4.

Table 4. Student RCT Outcomes by Implementation Year, Grade, and School Year

Outcome Type	Outcome	Year 2 Grade 9 (2019–20)	Year 3 Grade 10 (2020–21)	Year 4 Grade 11 (2021–22)	Year 5 Grade 12 (2022–23)
Achievement	STAAR Algebra I EOC	X			
	STAAR English I EOC	X			
	STAAR English II EOC		X		
	STAAR Biology EOC		X		
College and career readiness	TSI Reading			X	
	TSI Mathematics			X	
	SAT/ACT			X	
	Dual enrollment			X	X
	Computer science dual enrollment			X	X
	Algebra II course credit				X
	College credits				X
	Industry credential				X
	Computer science credential				X
Retention and graduation	Retention	X	X	X	
	Graduation (or on-track for graduation)				X

Impact analyses. ITT analyses will be used for all impact analyses, in case crossover contamination does occur. ITT is the average treatment effect based on initial treatment assignment, regardless of the school in which a student is enrolled. Since the program is conducted at the school level but students are mobile, some amount of crossover is expected if students opt to change schools. Two-level, fixed-effects regression (continuous outcomes) or general linear models (binary outcomes), with students nested within schools, will be used to estimate the ITT treatment effects. The level-1, student-level, model for the analyses of continuous outcomes is as follows:[††] $y_{ij} = \beta_{0j} + \sum_{m=2}^{M} \beta_{mj}(COV)_{ij} + e_{ij}$ Where y_{ij} is the outcome for student i in school j and COV is a matrix of student-level covariates (e.g., prior achievement, demographics, special program participation), and e_{ij} is the random effect associated with student i in school j, controlling for the other variables in the model. The level-2, school-level, model for the analyses is as follows: $\beta_{0j} = \gamma_{00} + \gamma_{01}T_j + \sum_{r=2}^{R} \gamma_{0r}COV_j + u_j$ Where T_j is the treatment indicator designating whether a school is assigned to the treatment or the control group; γ_{01} represents the difference in average outcomes at schools in the treatment group, compared with the average outcomes at schools in the control group; COV_j is a matrix of school-level covariates (e.g., school size, geographic location, percentage of minority students); and u_j is the random effect of school j, conditioning on the other covariates in the model.

Differential impact analyses. Moderation analyses will be conducted to assess the extent to which impact is moderated by the characteristics of students (i.e., minority student status, economic disadvantage, gender, and English learner status) and schools (i.e., school size, geographic location, demographic composition). To conduct moderation analyses, the impact analysis models will be modified by adding moderators as covariate and as grand mean-centered interactions with treatment indicators.

Cost Analysis. To provide information about whether Lone Star STEM is a cost-effective investment, the AIR study team will conduct a cost analysis using the resource cost model (RCM), which AIR has used extensively.[‡‡] Focusing on both personnel and nonpersonnel costs, we will populate the RCM using the CostOut tool and generate cost-effectiveness estimates

[††] For binary outcomes, logistic regression models will be substituted for the regression models shown.
[‡‡] See http://www.air.org/topic/p-12-education-and-social-development/school-finance.

based on the cost estimates and results from the impact analyses.[§§]

D.3. Guidance About Effective Strategies for Replication

To guide future replication of Lone Star STEM in other schools with high-need students, AIR will collect and analyze implementation data gathered from school site visits, interviews with program leadership and strategic partners, teacher surveys, and documents, ensuring that program design elements are being implemented with fidelity. During Year 1, AIR will administer a survey to each school to gather initial data on the extent of program implementation relative to requirements. In *each* of Years 2–5, AIR will further assess school-level implementation by conducting site visits at half (Group A) of the participating schools and administering a program survey to the remaining half (Group B). (See Table 5 for a proposed schedule.) During site visits, AIR will conduct interviews with key program leaders, including (1) business and industry partners, to gather information about the types of work-based learning opportunities they will provide students, including job shadowing, internships, externships, and apprenticeships; (2) partnering institutions of higher education, to gather information about the courses of study they will offer to enable students to combine high school and college-level courses toward credentials and certifications; and (3) school leadership teams, to gather information about how they monitor progress, review systems, problem-solve, and apply midcourse corrections. During site visits, AIR will also observe leadership team meetings to monitor the identification and implementation of sustainability structures. Finally, AIR will conduct site-based document review to assess how schools are meeting performance measures.

Table 5. Proposed School Site Visit Schedule and Activities

Activity	Year 1 (2018–19)	Year 2 (2019–20)	Year 3 (2020–21)	Year 4 (2021–22)	Year 5 (2022–23)

[§§] A tool created by the Center for Benefit-Cost Studies in Education at Teachers College, Columbia University.

Program Survey	All Schools	Group B Schools	Group A Schools	Group B Schools	Group A Schools
Site Visits		Group A Schools	Group B Schools	Group A Schools	Group B Schools
Teacher Survey	All Schools	All Schools	All Schools	All Schools	All Schools
Document Review	All Schools		All Schools		All Schools

To further assess implementation, AIR will administer an annual survey to teachers to gather information about the training and professional development they receive to build their instructional skills. The survey will focus on rigor and on college and career readiness strategies (see Appendix G for a description of the different types of implementation data to be collected).

D.4. Data on Key Project Components and Measurable Threshold for Implementation

The implementation study will yield quantitative (i.e., surveys, attendance logs, interaction logs) and qualitative (i.e., observations, focus groups) data on key project components shown in the logic model (see page 8). Quantitative data will be analyzed using descriptive statistics, including means, frequencies, standard deviations, and participant/respondent counts, as appropriate. Qualitative focus group data will be analyzed using the NVivo software package using a Grounded Theory approach, which allows researchers to examine the data for pre-determined themes, but also for unexpected themes that may emerge organically. AIR will use these results of these to provide continuous feedback to Project leaders during monthly implementation calls and in the evaluation annual report.

With TEA, AIR will identify a **measurable threshold for acceptable implementation** before collecting implementation data. For example, for each program benchmark (i.e., School Design, Target Population, Strategic Alliances, Curriculum, Instruction, and Assessment, Work-Based Learning, and Student Support), schools might meet 70 percent of the benchmark criteria in Year 2, 80 percent in in Year 3, 90 percent in Year 4, and 100 percent in Year 5.

LONE STAR STEM NARRATIVE REFERENCES

[1] *Texas College and Career Readiness Models* (2018). Texas Education Agency. Retrieved on June 4, 2018 from: https://tea.texas.gov/ccrm/

[2] *Dual Enrollment Programs* (2017). What Works Clearinghouse, Institute of Education Sciences. Retrieved on June 4, 2018 from: https://ies.ed.gov/ncee/wwc/Docs/InterventionReports/wwc_dual_enrollment_022817.pdf

[3] Bailey, M.J., & Dynarski, S.M. (2011). *Inequality in postsecondary education*. In G. Duncan and R. Murnane (Eds.), *Whither opportunity?*. New York, NY: Russell Sage Foundation.

Murphy, K., & Topel, R. (2016). *Human capital investment, inequality and economic growth* (Working Paper 21841). Cambridge, MA: National Bureau of Economic Research.

[4] Mishel, L., Bivens, J., Gould, E., & Shierholz, H. (2012). *The State of Working America* [12th edition]. Economic Policy Institute. Retrieved on June 4, 2018 from http://stateofworkingamerica.org/files/book/Chapter1-Overview.pdf

[5] Change the Equation. (n.d.). STEM Demand. Retrieved on June 4, 2018 from http://www.changetheequation.org

[6] Fayer, S., Lacey, A., & Watson, A. (2017). BLS spotlight on statistics: STEM occupations - past, present, and future. Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics.

Rothwell, J. (2013). The Hidden STEM Economy. Retrieved on June 4, 2018 from https://www.brookings.edu/wp-content/uploads/2016/06/TheHiddenSTEMEconomy610.pdf

[7] *Computer and Information Technology Occupations* (2018). Bureau of Labor Statistics, United States Department of Labor. Retrieved on June 4, 2018 from: https://www.bls.gov/ooh/computer-and-information-technology/home.htm

[8] Ryan, C.L., & Bauman, K. (2016). Educational Attainment in the United States: 2015. https://www.census.gov/content/dam/Census/library/publications/2016/demo/p20-578.pdf

[9] Ibid.

[10] *Status and Trends in the Education of Racial and Ethnic Groups,* Indicator 24: STEM Degrees (2017). National Center for Education Statistics. Retrieved on June 4, 2018 from: https://nces.ed.gov/programs/raceindicators/indicator_reg.asp

[11] Smith, K., Jagesic, S., Wyatt, J., & Eqing, M. (2018). *AP STEM participation and postsecondary STEM outcomes: Focus on underrepresented minority, first-generation, and female students.* CollegeBoard. Retrieved on June 4, 2018 from: https://files.eric.ed.gov/fulltext/ED581514.pdf

[12] Ibid

Stipanovic, N. & Woo, H. (2017). *Understanding African-American Students' Experiences in STEM Education.* The Career Development Quarterly, 65. Retrieved on June 4, 2018 from: https://doi.org/10.1002/cdq.12092

[13] National Science Foundation (2016). Science and Engineering Indicators 2016. Arlington, VA: National Science Foundation (NSB-2016-1).

[14] Frey, W. (2018). *The U.S. will become "minority white" in 2045, Census projects: Youthful minorities are the engine of future growth*. Brookings Institute. Retrieved on June 4, 2018 from: https://www.brookings.edu/blog/the-avenue/2018/03/14/the-us-will-become-minority-white-in-2045-census-projects/

[15] *Texas Quick Facts* (2018). United States Census. Retrieved on June 4, 2018 from: https://www.census.gov/quickfacts/TX

[16] *Enrollment in Texas Public Schools 2016-17* (2017). Division of Research and Analysis, Texas Education Agency. Retrieved on June 4, 2018 from: https://tea.texas.gov/acctres/enroll_2016-17.pdf

[17] *Regional Data* (2018). Bureau of Economic Analysis. Retrieved on June 4, 2018 from: https://www.bea.gov/iTable/iTable.cfm?reqid=70&step=10&isuri=1&7003=200&7035=-1&7004=sic&7005=1&7006=xx&7036=-1&7001=1200&7002=1&7090=70&7007=-1&7093=levels#reqid=70&step=10&isuri=1&7003=200&7004=naics&7035=-1&7005=1&7006=xx&7001=1200&7036=-1&7002=1&7090=70&7007=-1&7093=levels

[18] Poverty rates for 10 poorest counties in the United States (2018). The Texas Politics Project. Retrieved on June 4, 2018 from: http://texaspolitics.utexas.edu/archive/html/pov/features/ten_counties/slide1.html

[19] Texas Education Agency (2018). 2017-2018 Economically Disadvantaged Students: Statewide Totals. Retrieved on June 4, 2018 from: https://rptsvr1.tea.texas.gov/adhocrpt/adstc.html

[20] Desjardins, J. (2017). *Map: Economic might by U.S. metro area*. Visual Capitalist. Retrieved on June 4, 2018 from: http://www.visualcapitalist.com/map-economic-might-u-s-metro-area/

United States Census Bureau. (n.d.). American FactFinder. Retrieved on June 4, 2018 from: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

[21] White, et al. (2017). *Urban Texas*. Texas Demographic Center. Retrieved on June 4, 2018 from: http://demographics.texas.gov/Resources/publications/2017/2017_08_21_UrbanTexas.pdf?mod=article_inline

[23] *Rural Schools Task Force* (2018). Texas Education Agency. Retrieved on June 4, 2018 from: https://tea.texas.gov/Texas_Educators/Educator_Initiatives_and_Performance/Rural_Schools_Task_Force/

[24] Collins, C. (2017). *The 7 most pressing issues facing rural Texas*. Texas Observer. Retrieved on June 4, 2018 from: https://www.texasobserver.org/7-pressing-issues-facing-rural-texas/

Elevating support for Texas rural and small schools. (2017). Texas Rural Schools Task Force Report. Retrieved on June 4, 2018 from: https://tea.texas.gov/WorkArea/linkit.aspx?LinkIdentifier=ID&ItemID=51539615478

[25]Ahmed, A. (2014). Early college high schools proliferate amid effort to raise enrollment. The Texas Tribune. Retrieved on June 4, 2018 from: https://www.texastribune.org/2014/03/11/early-college-high-schools-grow-hispanic-grad-rate/

Hoffman, N. & Lundy-Wagner, V. (2016). Addressing the 61st hour challenge: Collaborating in El Paso to create seamless pathways from high school to college. Jobs for the Future. Retrieved on June 4, 2018 from: https://jfforg-prod-prime.s3.amazonaws.com/media/documents/Addressing-61st-Hour-031816.pdf

[26] *Early College High School* (2018). Texas Education Agency. Retrieved on June 4, 2018 from: https://tea.texas.gov/ECHS/

Texas a Leader in Early College High Schools (2016). Texas Education Agency. Retrieved on June 4, 2018 from: https://tea.texas.gov/Home/Commissioner_Blog/Texas_a_Leader_in_Early_College_High_Schools/

[27] Berger, A., Turk-Bicakci, L., Garet, M., Knudson, J., Hoshen, G. (2014). *Early College, Continued Success*. American Institutes for Research. Retrieved on June 4, 2018 from: https://www.air.org/sites/default/files/downloads/report/AIR%20ECHSI%20Impact%20Study%20Report-%20NSC%20Update%2001-14-14.pdf

[28] Ibid.

[29] *Early College Expansion* (2014). Jobs For the Future. Retrieved from: https://jfforg-prod-prime.s3.amazonaws.com/media/documents/Early-College-Expansion-ExSumm_031414.pdf

[30] Texas Science, Technology, Engineering and Mathematics (T-STEM) (n.d.). Educate Texas and Texas Education Agency. Retrieved on June 4, 2018 from: http://www.texasccrm.org/tstem

[31] North Carolina STEM attribute implementation rubric. (2013). North Carolina Department of Public Instruction. Retrieved on June 4, 2018 from: http://www.ncpublicschools.org/docs/stem/schools/rubrics/elementary-school.pdf

[32] *Enrollment in public elementary and secondary schools, by region, state, and jurisdiction: Selected years, fall 1990 through fall 2026* (n.d.). National Center for Education Statistics. Retrieved on June 4, 2018 from: https://nces.ed.gov/programs/digest/d16/tables/dt16_203.20.asp?current=yes

[33] Edmunds, et al. (2017). *Smoothing the transition to postsecondary education: The Impact of the early college model*. Journal of Research on Educational Effectiveness, 10:2,297-325, DOI: 10.1080/19345747.2016.1191574

Berger, A., Turk-Bicakci, L., Garet, M., Knudson, J., Hoshen, G. (2014). *Early college, continued success*. American Institutes for Research. Retrieved on June 4, 2018 from: https://www.air.org/sites/default/files/downloads/report/AIR%20ECHSI%20Impact%20Study%20Report-%20NSC%20Update%2001-14-14.pdf

[34] Giani, M., Alexander, C., & Reyes, P. (2014). *Exploring variation in the impact of dual-credit coursework on postsecondary outcomes: A quasi-experimental analysis of Texas students*. The High School Journal, 97, 200-218. Retrieved on June 4, 2018 from: http://muse.jhu.edu/article/546327

[35] Struhl, B., Vargas, J. (2012). Taking college courses in high school: A strategy guide for college readiness- The college outcomes of dual enrollment in Texas. ERIC. Retrieved on June 4, 2018 from: https://eric.ed.gov/?&id=ED537253

[36] Fletcher, C., Warner, J., Garbrecht, L., & Ramsey C. (2018) *Lessons learned from developing a framework for evaluating Impact of CS teacher professional development on CS for all outcomes*. AERA Conference Presentation. Retrieved on June 4, 2018 from: https://uteach.utexas.edu/sites/uteach.utexas.edu/files/aera-2018-framework-evaluating-impact-CS-teacher-PD.pdf

[37] Taylor, Y. (2017). *No computer science education at your kid's school? $5 million from TEA is allowing UT to change that.* University of Texas. Retrieved on June 4, 2018 from: https://stemcenter.utexas.edu/tea-awards-grant-for-cs/

[38] Joiner, C. (2017). *Commentary: It's time for Texas to step up on computer science*. Austin-American Statesman. Retrieved on June 4, 2018 from: https://www.mystatesman.com/news/opinion/commentary-time-for-texas-step-computer-science/vEMoQVV2nmXOJkRUeDmGnK/

[39] *Support K12 computer science education in Texas* (2013) Code.org. Retrieved on June 4, 2018 from: https://code.org/advocacy/state-facts/TX.pdf

[40] Fletcher, C. (2014). *Building the Texas Computer Science Pipeline: Strategic Recommendations for Success.* Retrieved on June 4, 2018 from: https://www.thetrc.org/web/assets/files/pdfs/Building-the-Texas-CS-Pipeline_Fletcher.pdf

[41] *Target Industry Clusters* (2018). Texas Economic Development. Retrieved on June 4, 2018 from: https://gov.texas.gov/business/page/target-industries

Texas IT Services Industry (2015). Business in Texas. Retrieved on June 4, 2018 from: https://gov.texas.gov/uploads/files/business/it_report.pdf

[42] Cyber Seek. (n.d.). "Cybersecurity Supply/Demand Heat Map." Retrieved on June 4, 2018 from: https://www.cyberseek.org/heatmap.html

[43] *House Bill 5* (2013). Education Service Center. Retrieved on June 4, 2018 from: https://www.esc19.net/Page/199

TASA charts: HB 5 endorsement requirements (2018). Texas Association of School Administrators. Retrieved on June 4, 2018 from: https://www.tasanet.org/cms/lib/TX01923126/Centricity/domain/175/external/endorsement.pdf

[44] Ibid

[45] *Texas House Bill 8* (2017). LegiScan. Retrieved from: https://legiscan.com/TX/text/HB8/id/1625019/Texas-2017-HB8-Enrolled.html

[46] *Texas House Bill 3593* (2018). Texas Legislature Online. Retrieved on June 4, 2018 from: https://capitol.texas.gov/billlookup/text.aspx?LegSess=85R&Bill=HB3593

[47] Green, A. (2017). *Addressing the STEM teacher shortage*. Education & Human Development, Texas A&M University. Retrieved on June 4, 2018 from: http://transform.tamu.edu/news/addressing-stem-teacher-shortage

[48] Fletcher, C. (2014). *Building the Texas computer science pipeline: Strategic recommendations for success*. Texas Regional Collaboratives. Retrieved on June 4, 2018 from: https://www.thetrc.org/computer-science-pipeline/

[49] University of Texas at Austin Center for STEM Education (2018). WeTeach_CS: Impact. Retrieved on June 4, 2018 from https://www.weteachcs.org/site/wp-content/uploads/WeTeach_CS-Impact.pdf

[50] *Support K12 computer science education in Texas*. (2013) Code.org. Retrieved from: https://code.org/advocacy/state-facts/TX.pdf

[51]Yoon Yoon, S., & Strobel J. (2017). *Trends in Texas high school student enrollment in mathematics, science and CTE-STEM courses*. International Journal of STEM Education. Retrieved on June 4, 2018 from: http://oaktrust.library.tamu.edu/bitstream/handle/1969.1/160526/018.Yoon17.Trends%20in%20TX%20HS%20student%20enrollment%20in%20STEM%20CTE.pdf?sequence=1&isAllowed=y

[52] Marder, M. (2018). *Rise and fall of Texas STEM education*. The University of Texas at Austin. Retrieved on June 4, 2018 from: https://uteach.utexas.edu/sites/uteach.utexas.edu/files/marder-hb5-coursetaking-2018-march-7.pdf

[53] Green, A. (2017). *Addressing the STEM teacher shortage*. Education & Human Development, Texas A&M University. Retrieved from: http://transform.tamu.edu/news/addressing-stem-teacher-shortage

[54] Fletcher, C. (2014). *Building the Texas computer science pipeline: Strategic recommendations for success*. Texas Regional Collaboratives. Retrieved on June 4, 2018 from: https://www.thetrc.org/computer-science-pipeline/

[55] University of Texas at Austin Center for STEM Education (2018). WeTeach_CS: Impact. Retrieved on June 4, 2018 from https://www.weteachcs.org/site/wp-content/uploads/WeTeach_CS-Impact.pdf

[56] Ibid.