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A. SIGNIFICANCE

1. Extent to which the proposed project would implement a novel approach.

Research indicates that the most effective STEM education models infuse classroom instruction, based on a rigorous curriculum, with frequent exposure to applied learning through lab work, workplace activities, and supportive technology (Hanover, 2011). While most schools have adequate theoretical knowledge of how STEM is best incorporated into the classroom, instructors face difficulty executing meaningful applied learning experiences due to barriers of time, conceptually dense content, student resistance, large class size, and facility constraints (Henderson, 2011). Our proposed project addresses these national needs and *Absolute Priority 3: Improving STEM Education; priority area (a) redesigning STEM course content and instructional practices to engage students and increase student achievement.* Unlike traditional school settings, our program, *12 for Life*, is a novel approach designed to provide students with daily access to applied learning activities aligned with rigorous STEM curriculum through state-of-the-art labs and workplace technology, supervised and supported by professionals working in the STEM field. ♦**History:** Like many districts across the nation, Carroll County Schools (CCS), which serves over 14,000 students in 24 schools in rural and suburban Georgia, has a history of low graduation rates (67.5%), high dropout rates (4.8%), and the majority of our students (54%) are economically disadvantaged (GADOE, 2011-12). Seeing this high-level of need, our local business partner, Southwire—a leading manufacturer of electrical wire and cable in the Southeast—developed the *12 for Life* program in partnership with CCS, as a novel approach to applied, work-based learning in 2004 (Southwire, 2013). After a three-year research, planning, and construction period, the *12 for Life* facility, a modern, fully-equipped manufacturing plant and learning community, began serving students in 2007. Our classes and apprenticeships feature low teacher-student (1:10) and supervisor-student (1:12) ratios. This highly personalized environment has allowed our students to earn 2,500 credits and 30 students to dual-enroll in post-secondary studies, producing 635 graduates (77.8% graduation rate) at our facilities since our

inception (*12 for Life*, 2013). We currently serve 160 students from six high schools, across two counties (Carroll and Heard County School Systems), with the capacity to double our reach to serve 320 students (at any one time) over a three-county region through i3 funding. ♦**High-Need Students:** The *12 for Life* program is designed to provide very high-need students with a unique opportunity to hold paid apprenticeships while continuing their education, serving as both a STEM-focused secondary school program and a student-staffed Southwire satellite plant (UGA, 2011). Research finds participation in targeted courses greatly increases through an enrollment identification process based on multiple criteria (Kyburg, Hertberg-Davis, & Callahan, 2007). Since socioeconomic disadvantage is a key factor that positions students at a greater risk for dropping out (Jerald, 2006) and studies find that the choice to continue or leave school is impacted by a variety of compounded, contextual factors (Rumberger, 2011), our staff enrolls program applicants demonstrating the greatest level of need using a selection rubric (*Appendix J*) to assess individual risk for dropout based on attendance, behavior, financial need, age, and credits needed to graduate. The fact that students must apply for acceptance into our program ensures their full engagement. The demographic profile of our program is diverse and inclusive; allowing us to serve student groups (females, minorities, students with disabilities) traditionally under-represented in STEM-focused post-secondary study and careers (Bayer, 2010). Of the 160 students currently enrolled, 43% are female, 35% belong to a racial minority group, and 21% are classified as students with disabilities. <u>All students (100%) served are economically disadvantaged</u> and 50% are financially self-supported, with little or no assistance from guardians with the costs necessary for daily subsistence (food, shelter, etc.). *12 for Life* provides the opportunity to earn money and begin a STEM career while attending school, allowing high-need participants to address the financial concerns that research identifies as a frequent disruption to the educational pursuits of economically disadvantaged students, while simultaneously working to obtain a high school diploma and develop STEM career skills (Rumberger & Limb, 2008). ♦**Novel Approach:** Although work-based learning occurs in settings across the country, our

model offers a novel approach with national significance for four reasons: ❶ We offer a high frequency of exposure to STEM coursework and career training through multiple classroom and work shift options, centralized at a single facility from 8 AM to 9:30 PM, five days per week, year-round; ❷ Our curriculum and coursework are directly linked to hands-on duties within the manufacturing plant, enabling students to experience STEM applied learning in a real-world setting; ❸ We provide support services, including tutoring, mentoring, and work supervision, using a strengths-based approach to address high need students' academic and interpersonal barriers (Lopez, 2011); and ❹ We target students with the highest level of risk for dropping out, who often face extraordinary personal challenges (parental abandonment, adolescent parenthood, behavior and/or learning difficulties). Based on our review of research from over 300 STEM education programs across the nation, we believe the frequency and intensity of exposure to applied STEM learning offered by *12 for Life* is unmatched (Bayer, 2010; Hanover, 2011; National Research Council, 2011). Our students are true apprentices, performing duties under the guidance of seasoned Southwire staff, using STEM principles to trouble-shoot and problem-solve on the plant floor, to develop the technical and leadership skills needed to secure employment in today's highly competitive labor market. The innovations of our project will enhance our program's strengths, allowing for curriculum revision to draw direct correlation between STEM course content and work within the facility's labs and manufacturing floor, fully aligned with Common Core Standards. *12 for Life* instructors and staff, along with district lead math and science teachers, will receive STEM professional development to support cutting-edge pedagogy. These interventions will be enabled by new equipment and technology, to bolster access, engagement, and achievement. Through i3, *12 for Life* will evolve from a high-quality work-based learning program, to become the gold standard for full STEM immersion education.

2. Contribution to the development and advancement of theory, knowledge, and practice.

12 for Life has already begun the work of developing and advancing theory, knowledge and practice in Georgia and nationally. ♦**Regional Impact:** Through support from a 2010 Georgia

Innovation Fund grant, *12 for Life* began serving students from Heard County, a smaller, yet demographically similar district to CCS, in which a majority (69%) of the 1,998 students served are economically disadvantaged (GADOE, 2011). As a function of our i3 model, we will expand our program to include additional participants from Heard County and another neighboring school district, Haralson County Schools, to broaden program practice and impact. Haralson County Schools has a lower graduation rate of only 57%, and 66% of their 3,496 students qualify for free or reduced meals (GADOE, 2011). Through i3, new students from these districts can be accommodated, thereby advancing STEM education practice across three counties in the West Georgia region. In 2013, our model was replicated on a smaller scale through three local businesses, Carroll County Water Authority, Carroll EMC (an electric co-op), and the HON Company, a furniture manufacturer in Polk County. An employment agreement for *12 for Life* graduates was also forged with Sugar Foods in Villa Rica, GA. These developments are evidence that model replication and post-secondary success for our students has moved from vision to reality. ♦**State Impact:** *12 for Life* is engaged in a groundbreaking partnership with the Georgia Department of Community Affairs (DCA) (GPP, 2013). Based on a 2011 research study from the University of Georgia demonstrating the success of our program, DCA developed the Great Promise Partnership (GPP). GPP replicates our model on a limited, statewide scale, offering students age 16 and older the opportunity to attend high school while working with businesses in their local area, through manufacturing and non-manufacturing pathways, including: DCA, Technical College System of GA, Atlanta City Hall, GA Student Finance Commission, Department of Juvenile Justice, and Department of Corrections. Though i3, we will deepen our partnership with DCA to further disseminate information about our program model to enhance knowledge, inform practice, and promote replication throughout Georgia. ♦**National Impact:** In 2009, a second *12 for Life* facility was opened in Alabama, serving Florence City Schools. Based on the success of this expansion, we have begun dissemination of our model and outcomes nationally via a targeted media campaign, reaching representatives from the US Departments of

Labor and Education, and receiving national exposure, including coverage by CBS Evening News and recognition for excellence through a White House briefing. Additionally, our program was recently selected to participate in a case study by Harvard University. It is clear from these early expansion efforts that *12 for Life* has national significance – meeting needs of students in differing regions and business settings. ♦**Evaluation Impact:** *12 for Life* will further theory and knowledge of STEM education through ongoing, independent evaluation, using a multiple-cohort quasi-experimental design to compare 300 *12 for Life* students with a matched sample of 300 non-participant students to gauge program efficacy. These cohorts will be compared annually to analyze differences in outcomes, addressing the following questions: ❶ To what extent does *12 for Life* impact student academic performance? ❷ To what extent does *12 for Life* impact student behavior? ❸ To what extent does *12 for Life* influence students' future education and career goals? ♦**Contribution to the Field of STEM Education:** To enable widespread replication, through i3 funding, we will develop a *12 for Life* Curriculum and Replication Guide, providing best practices and a formalized applied-learning STEM curriculum that are scalable to the needs and capacity of any public-private partnership settings (healthcare, environmental industries, etc.), informed by ongoing program evaluation. To ensure quality replication of our best practices, we will fully describe our model's structure and strategies, with indications allowing flexibility specific to the capacity of individual public-private partnerships. Our logic model will be integral to the Curriculum and Replication Guide. For each program element we will detail: ❶ service delivery according to frequency, intensity, and duration; ❷ content, procedures, and activities subsumed under each; and ❸ roles, qualifications, and function of staff responsible for service delivery. Evaluation based on clearly defined goals and objectives (*Table 5*) will offer timely and meaningful feedback to inform decision-making. If *12 for Life* produces our expected outcomes, these measures will promote external validity by providing guidelines for replication. Using our novel approach to work-based, applied STEM learning through curriculum redesign, supported by technology enabled pedagogy, professional

development, and applied learning supports, we will disseminate an innovative, evidence-based, model and curriculum, to advance STEM education theory, knowledge, and practice nationwide.

3. Extent to which the project will substantially improve on the outcomes achieved.

12 for Life has begun to substantially improve student outcomes for CCS, evidenced by the current graduation rate for our participants (77.8%), which is over 10 percentage points higher than the district rate (67.5%), and reflects the accomplishments of students at the highest risk of dropout prior to entering our program (GADOE, 2012). Further quantitative evidence of improvement from a quasi-experimental study conducted by the University of West Georgia found that after two years of enrollment, one cohort of *12 for Life* students earned more credit hours (13.68 (4.8) v. 10.5 (6.2); $F(1, 126 = 9.97, p<.05)$; had higher GPAs (2.56 (.57) v. 2.15 (.46); $F(1, 73) = 10.19, p<.05$); were more likely to pass state science high school graduation tests (85% v. 43%; $F(1, 15) = 5.73, p<.05$); and were more likely to graduate high school (44% v. 22%; $F(1, 130) = 6.04, p<.05$), compared to a well-matched comparison group (Ogletree, Hancock, & Chibbaro, 2009). Qualitative data also indicated that *12 for Life* exceeded initial goals for decreasing dropout, finding through direct feedback that many students would have left school had they not been selected for our program. The University of Georgia conducted a separate study in 2011 identifying key strengths and benefits of the program using data gathered through focus groups, interviews, and observations of *12 for Life* participants and staff, providing anecdotal evidence of quality outcomes such as improved graduation rates (77.8%), and high rates of local employment (40%) and post-secondary enrollment (35%) after graduation. The final report revealed four key factors contributing to the program's success, as listed in *Table 1*.

***Table 1*. Existing Success Factors of *12 for Life* Identified Through Research**	
1. Community Partners' Shared Vision	**2. Youth-Centered Environment**
• Focus on student needs and strengths • Use of strengths-based approach • Removal of obstacles to graduation • Leadership takes ownership of the vision	• Promotes teamwork among students • Provides meaningful, work-based tasks that are safe and accomplishable, yet challenging • Offers access to mentors and tutors
3. Access to Caring Adults	**4. Reciprocal Benefits for Partners**

***Table 1*. Existing Success Factors of *12 for Life* Identified Through Research**	
• Supervisors serve as positive role models • *12 for Life* graduates serve as role models • Tutors/mentors provide academic/life skills	• Students earn academic credits and wages • Students become highly-skilled employees • Student workforce has raised production

The existing strengths of our program and the proposed i3 strategies are recognized as critical to improving student outcomes. The National Science Resources Center recently issued five tenets of quality science education reform, noting that many of our nation's most successful STEM education programs incorporate a research-based, hands-on curriculum; ongoing teacher professional development; centralized material support; assessment of student learning; and quality administrative and community support (Bayer, 2010). A separate 2010 study of successful STEM-focused business and education partnerships discovered a shared set of best practices, many of which are cornerstones of our current program, including: a hands-on approach to learning delivered through real-world experiences; ongoing professional development; outreach to underrepresented populations; connection to STEM mentors; and access to state-of-the-art technology and equipment (Bayer, 2010). Through i3, *12 for Life* will preserve and enhance existing programmatic strengths by adding four additional strategies to produce the measurable outcomes listed in *Table 2*. Details on the level of impact anticipated for each outcome can be located in *Table 5*, which fully outlines the goals and objectives for our i3 project. All strategies are grounded in current, STEM focused research (*Appendix D*) in applied and problem based learning (Roth & Van Eijck, 2010) using "purposeful design and inquiry" within a "real-world" setting (Sanders, 2009), with a strengths based approach (Lopez, 2009).

***Table 2*. i3 Strategies, Outcomes, and Impact**		
Key i3 Strategies	**Anticipated Outcomes**	**Quantifiable Measures of Successful Impact***
1. **STEM Curriculum Redesign** aligned with Common Core Standards to maximize access to applied and work-based learning opportunities	• Redesigned *12 for Life* STEM Curriculum • Creation of a Curriculum and Replication Guide • Dissemination of the model state and nationwide	• Number and location of schools receiving the Curriculum and Replication Guide • Number and location of replication sites

Table 2. i3 Strategies, Outcomes, and Impact		
Key i3 Strategies	**Anticipated Outcomes**	**Quantifiable Measures of Successful Impact***
2. **Technology Enabled Pedagogy** necessary for implementing a high-quality STEM curriculum	• Enhanced student engagement • Increased student achievement • Increased student capacity to succeed in STEM college and careers	• Decreased behavioral incidents/suspensions • Improved academic achievement • Increased graduation rates • Increased postsecondary enrollment • Increased post-graduate employment • Hours of professional development attended
3. **STEM professional development** for educators and staff	• Improved STEM and applied learning pedagogy	
4. **Applied Learning Supports** for our high-need students	• Enhanced applied learning • Enhanced student engagement • Increased student achievement	
*After removing evaluation and learning lab one-time investments, *12 for Life* costs less than $2,000/student/year. Compared to the lifetime cost to our nation of one high school dropout, estimated at $260,000 (Alliance for Excellent Education, 2007), our program is clearly more cost effective and will have a lasting impact on students and the field long after grant funds expire.		

Our documented history of success implementing STEM strategies with positive results, coupled with the addition of new interventions developed and guided by strong theory and best practices in STEM education, provides a firm foundation from which we will achieve improved outcomes.

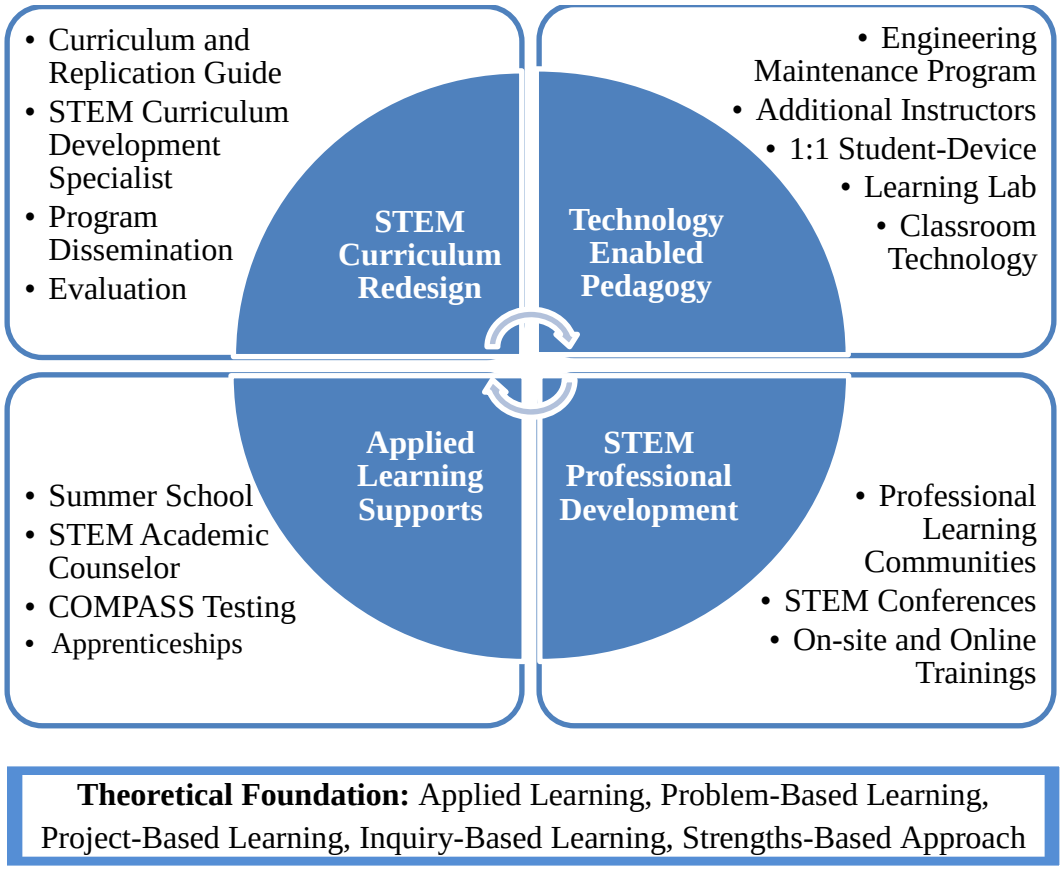
B. QUALITY OF THE PROJECT DESIGN

1. Extent to which the project addresses *Absolute Priority 3: Improving STEM Education*.

Our proposed project fully addresses *Absolute Priority 3: Improving STEM Education; priority area (a) redesigning STEM course content and instructional practices to engage students and increase student achievement.* Our i3 model is focused on the refinement and dissemination of a formalized STEM curriculum, redesigned to incorporate rigorous course content with applied instructional practices, provided in a "real-world" setting. Our efforts will be supported by skilled staff and instructors with ongoing access to STEM professional development and supportive technology, delivered at a high rate of frequency to engage students and increase their academic achievement. Our program will be thoroughly evaluated to inform our practice and aid in the replication of best practices in STEM education on a national level. Key project strategies

and activities, supported by a strong theoretical foundation, are summarized in *Figure 1*.

Figure 1



Our four i3 strategies and all activities are fully aligned with *Absolute Priority 3*, described as follows. ♦**Redesigning STEM Course Content:** *Strategy 1—STEM Curriculum Redesign*: Students who participate in career-focused programs that relate schooling to careers achieve higher levels of educational attainment and better labor market outcomes (Bridgeland, Balfanz, Moore, & Friant, 2010). Our course content redesign will enhance the rigor and coherent connection to work-based learning, increasing the depth and functionality of students' STEM knowledge and linking it to future STEM careers. We will revise our curriculum to include applied learning activities as 25% of the instructional content for each course. This approach is a natural next step in our continuous improvement, as advised by a study of best practices of STEM schools across the US (National Research Council, 2011). Content redesign will be facilitated by a STEM Curriculum Development Specialist, who will align courses with STEM activities in our manufacturing setting and Common Core Standards as described in *Table 3*.

***Table 3*: Overview of Courses, Standards and Resources to be Aligned through i3**		
Courses	**Common Core Standards***	**Applied Learning**
Mathematics III/Advanced Algebra & Trigonometry	*Math*: Number and Quantity; Algebra; Functions; Modeling; Geometry; Statistics and Probability	• *12 for Life* Facility Equipment • Raw Materials Warehouse • Classroom Science and Computer Labs • Quality Assurance Lab • Quality Control Testing Equipment • Engineering Maintenance Program • Extrusion Line Learning Lab • Electronic Facility Operations Monitoring System • Tablets, Laptops, Digital Content • Classroom Technology
Mathematics IV/ Pre-calculus		
Chemistry I	*Chemistry*: Matter; Atomic and Kinetic Theory; Periodicity; Reactions; Empirical Formulas; Acids and Bases; Solutions	
Chemistry II		
Physics	*Physics*: Kinematics; Energy and Transformation; Electricity; Wave Properties	
Scientific Research III	*CTAE*: Manufacturing; Environment; Technology; Equipment; Materials; Engineering; Cost Analysis; Time and Motion; Product Testing; Efficiency; Shipping; Production; Operations	
Scientific Research IV		
Manufacturing & Materials Science		
Production Enterprises		
Robotics & Automated Systems		
Reading and Language Arts	*Language Arts*: Key Ideas and Details; Craft and Structure; Integration of Knowledge; Range of Reading; Text Complexity	
**Source: GA Department of Education: GeorgiaStandards.org*		

While many *12 for Life* students are already making informal connections between classroom-based studies and their apprenticeships, curriculum redesign will allow the interdependent relationships between course content and manufacturing to be more clearly expressed, and more easily replicated to promote higher levels of fidelity and better outcomes for students nationwide. This new curriculum will be implemented by our existing teaching staff and three new, full-time onsite instructors in Math, Science, and STEM Literacy. Providing this additional support will allow our students to receive all course instruction in our STEM focused *12 for Life* setting with full access to our unique applied and work-based learning activities. Like many high-need students across our nation, our participants struggle with reading comprehension. Experts in STEM education agree that students who experience difficulty with reading face incredible

roadblocks to learning in any subject, but especially with STEM-related content (Reardon, Valentino, & Shores, 2012). The addition of a Reading and Language Arts course and dedicated STEM Literacy Instructor will fill this gap within our existing program. This instructor will work with students to build word recognition, equip them to decode elements within text, and improve processing skills, leading to greater understanding and comprehension of both basic and advanced text. ♦**Redesigning Instructional Practices**: *Strategy 2—Technology Enabled Pedagogy*: Research indicates that continuous exposure to real-world STEM activities increases STEM engagement and learning (Bayer, 2010), and that development of real-world skills is essential for success throughout work and life (Dynarski, et al., 2008). Our students currently use integrated knowledge to manage the Raw Materials Warehouse, which houses fabrication supplies for all Southwire manufacturing sites (exploring distribution, inventory, and accounting concepts) and operate our Quality Assurance Lab to test the integrity of fabricated wire (incorporating STEM and manufacturing knowledge). Intensity and frequency of hands-on STEM learning will increase through a new Extrusion Line Learning Lab, a micro-installment of the equipment used at Southwire, serving as a learning tool allowing students to develop hands-on experience with copper wire fabrication, to complement classroom STEM studies. The lab is comprised of a Wire Processing Manufacturing Cell and a Cabler and Jacketing Extrusion Line used to merge bare copper wire with PVC compound coatings to produce insulated electrical wire and cables—exposing students to chemistry, physics, and mathematics principles. We will also institute an Engineering Maintenance Program, offering students hands-on experience with the function, usage, and repair of industrial equipment, led by an Industrial Maintenance Engineer, who will join *12 for Life* full-time, to teach students using problem and inquiry-based instruction techniques, which are shown to be highly effective in developing STEM knowledge (Roth & Van Eijck, 2009). Access to software and technological devices will be increased to support real-time professional development, credit recovery, and hands-on learning proven to increase engagement, productivity, and efficiency for students and educators (Shepard & Reeves,

2011). Students will use tablets to complete coursework and access learning resources, anywhere, anytime, and to monitor activities related to their apprenticeship, such as hours worked, warehouse inventory, and production units, through a soon-to-be installed electronic facility operations monitoring system. Instructors and staff will use technology to aid instruction through on-line professional development and teaching tools. Technological interventions have been identified as particularly effective in assisting high-need students and STEM instructors (Kennedy & Wexler, 2013). *Strategy 3—STEM Professional Development*: Studies show that providing high-quality, ongoing professional development to educators is vital to ensuring the success of any STEM education program (Hanover, 2011). Our professional development efforts, provided in *Table 4*, will focus on STEM, providing traditional and "just-in-time" training, which offers virtual support, when and where they need it, via online tools and training programs. A new weekly STEM Professional Learning Community (PLC) will include teachers and Southwire staff to ensure classroom learning is linked to hands-on work experiences.

***Table 4. 12 for Life* Professional Development Plan**

Proposed Content	Potential Providers	Method
• Infusing Common Core Standards into STEM education • Increasing content knowledge • Use of applied learning strategies (i.e. problem and project based learning, purposeful design and inquiry) • Linking classroom content to work-based learning • Using innovative practices in STEM instruction • Addressing barriers faced by students traditionally underrepresented in STEM • Technology (tablets, equipment, digital content)	• STEMTech • ASQ: Advancing STEM Conference • USA Science and Engineering Festival • Georgia Councils for Math and Science • National Math and Science Associations	Conferences
	• MyLivePD: online training and tools to support Algebra instruction • Vimeo: tutorials for creating Content Acquisition Podcasting (CAPS) • Khan Academy: virtual learning and teaching resource • Microsoft: tablet and software training	Online/ "Just-in-Time"
	• Southwire: quarterly work-based training and weekly PLC to link classroom learning with hands-on work experiences	Hands-on

♦**Supports for High-Need Students**: *Strategy 4—Applied Learning Supports*: High-need students face complex barriers to accomplishing their academic and career goals (Rumberger &

Limb, 2008). Providing support to address barriers early-on can make a positive difference in the lives of economically disadvantaged students (Kennelly & Monrad, 2007). We currently lack an on-site professional to monitor our students' individual academic performance and advise them on how best to achieve their goals. Students and staff rely on the guidance of off-site Graduation Counselors located at each student's school of origin, with which there is often minimal contact due to large caseloads and geographic distance. While existing staff work diligently to fill this gap, a full-time STEM Academic Counselor is needed to assist our students in overcoming the unique challenges they face. Our Academic Counselor will monitor the academic and work performance of participants, discuss students' aspirations, and assess their individual progress in meeting educational and career goals. This type of personalized, STEM-focused academic and career support has proven successful in keeping students engaged, on-track for graduation, and better prepared for advanced study or careers in STEM (Schmidt, et al., 2010). We also offer academic programming during the summer, as research shows that many high-need students disengage from STEM pathways during the summer months (Afterschool Alliance, 2011). Our year-round approach maximizes students' time and investment in the program. Finally, through partnership with West Georgia Technical College (WGTC), all participants receive COMPASS testing (on-site, free-of-charge) twice; once to assess academic skills and needs, and again after tutoring is provided. Results are used to determine eligibility for dual enrollment through *Accel*, a Georgia-based education grant program that provides financial support for tuition and ensures all credits earned are transferrable within the state's university system. COMPASS scores are also used in lieu of SAT or ACT scores to grant admission to WGTC after graduation.

2. Clarity and coherence of the project goals and a plan to achieve its goals.

Our three overarching goals are: ❶ Formalize and enhance our STEM focused applied learning model for replication; ❷ Increase student engagement and achievement in STEM learning; ❸ Ensure that students graduate with the skills necessary to succeed in STEM careers or college study in STEM. The logic model in *Figure 2* below illustrates our plan for achieving these goals.

Figure 2: 12 for Life i3 Logic Model

EXISTING INPUTS

Key Personnel
- *12 for Life* Administration
- Instructors
- Mentors
- Student Supervisors
- Plant Manager
- Graduation Counselors

Key Partnerships
- Carroll County Schools
- Heard County Schools
- Florence County Schools
- Southwire Corporation
- West GA Technical College
- Department of Community Affairs
- *12 for Life* Board

Facility
- On-site Classrooms
- Quality Assurance Lab
- Raw Materials Warehouse

i3 STRATEGIES

STEM Curriculum Redesign
- STEM Curriculum Development Specialist
- Curriculum & Replication Guide

Technology Enabled Pedagogy
- Math & Science Instructors
- STEM Literacy Instructor
- Maintenance Program
- Learning Lab
- Industrial Maintenance Engineer
- Expand to Haralson County
- Devices and Technology

STEM Professional Development
- STEM Conferences
- "Just-in-Time" Training
- PLCs

Applied Learning Supports
- STEM Academic Counselor
- COMPASS Testing
- Summer Programming

SHORT-TERM OUTCOMES

- Decrease Student Dropout
- Increase Student Engagement & Attendance
- Enhance STEM & Applied Learning Instruction
- Disseminate Curriculum & Replication Guide

LONG-TERM OUTCOMES

- Improve Academic Achievement
- Improve Graduation Rate
- Increase Enrollment in Postsecondary Institutions
- Increase Graduate Employment
- Replicate Model in GA and the US

IMPACT

- **Increase Students' Capacity to Succeed in STEM, College, and Careers**

KEY

Process

Outcome

i3 PROJECT GOALS:

1. Formalize and enhance our STEM focused applied learning model for replication
2. Increase student STEM engagement and achievement
3. Ensure students graduate with the skills necessary to succeed in STEM careers or college

3. Clarity, completeness, and coherence of the project goals and plan to achieve them.

The *12 for Life* i3 logic model provides a visual representation of our implementation plan. It demonstrates a clear conceptual framework, linking key components hypothesized to be critical to achieving the required i3 performance measures and our goals and outcomes listed in *Table 5.*

***Table 5. 12 for Life* i3 Project Goals and Outcomes**
Goal 1: Formalize and enhance our STEM focused applied learning model for replication
Objective 1a. A *12 for Life* Curriculum and Replication Guide will be created by the end of Year 1 and disseminated to at least 5 school districts and/or businesses in each of Years 2-4.
Objective 1b. 100% of *12 for Life* instructors will participate in at least 10 hours of professional development (online or in-person) related to STEM in each of Years 1-4.
Objective 1c. By end of Year 1, at least 70% of *12 for Life* instructors will self-report that PLC participation has helped them to integrate students' hands-on experience with their classroom instruction, increasing by 5 percentage points each project year or until 85% of instructors report that PLCs were of benefit.
Goal 2: Increase student engagement and achievement in STEM
Objective 2a. Incrementally increase *12 for Life* enrollment each year from 2013 baseline of 160 students to serve 320 students by the end of Year 4.
Objective 2b. The average GPA of *12 for Life* students will exceed the average GPA of a well-matched non-*12 for Life* comparison group by .1 points by end of one year of participation, and by .2 points at the end of two years of participation, or until the difference in GPA between the two groups reaches statistical significance in the intended direction.
Objective 2c. The average suspension rate of *12 for Life* students will be lower than that of a well-matched non-*12 for Life* comparison group by .5 incidents by the end of one year of participation, and 1 incident by the end of two years of participation, or until the difference in suspension rates between the two groups reaches statistical significance in the intended direction.
Objective 2d. The average dropout rate of *12 for Life* students will be lower than that of a well-matched non-*12 for Life* comparison group by 2% after one year of participation, and by 4% after two years of participation, or until the difference in dropout rate between the two groups reaches statistical significance in the intended direction.
Goal 3: Ensure students graduate with the skills to succeed in STEM careers and college
Objective 3a. The percentage of *12 for Life* students enrolling in at least one dual enrollment course will increase by 2 percentage points each year or until the Year 1 baseline is exceeded by a total of at least 5 percentage points.
Objective 3b. Each project year, at least 90% of new *12 for Life* students will take the COMPASS exam to assess their skill level and eligibility for dual enrollment.
Objective 3c. The percentage of eligible *12 for Life* students graduating will increase by at least 2 percentage points per year from the Year 1 baseline, in each of Years 2-4.

Objective 3d. The percentage of *12 for Life* graduates enrolling in postsecondary education or securing a job during the first year following graduation will increase by 3 percentage points from Year 1 baseline, in each of Years 2-4.
Measures—*Administrative*: professional development roster, meeting minutes, Curriculum and Replication Guide, GPP records, instructor and student surveys; *Academic*: GPA, COMPASS testing, dropout, suspension, dual enrollment, graduation & postsecondary rates

♦**Potential Risk and Mitigation:** Our program is designed to serve high-need students who face complex barriers and are typically underrepresented in STEM education and careers. To address this challenge we have tailored *12 for Life* to accommodate the exceptional needs and individual circumstances of our students. This highly personalized environment is noted in STEM-focused research as vital to the success of STEM programs seeking to improve outcomes for marginalized students (Museus, et al., 2011; Clark & Ernst, 2008; Ma, 2011). We have identified and addressed threats to the success of our program and replication as detailed below.

***Table 6*. Risk Mitigation**

Potential Barrier	*12 For Life* Solution
Financial needs for daily subsistence	The opportunity to earn money and begin a career while completing high school graduation requirements
Time to work and attend school	Three classroom and work shift options (4 hour blocks), offered at a single facility, open from 8 AM to 9:30 PM, five days per week
Scheduling difficulties	Select courses may be taken online, throughout the day, via program provided assistive technology and digital content
Need for individualized instruction	Low teacher-student (1:10) and supervisor-student (1:12) ratios; COMPASS testing to assess needs; tutoring to support needs
Non-academic needs (housing, health care, childcare, basic needs)	*12 for Life* currently employs an on-site Community Liaison to assist students and coordinate community-based services that address personal barriers to participation
Academic supports and monitoring	*12 for Life* will hire a STEM Academic Counselor to provide individualized assistance in selecting courses and career pathways that fit the needs, strengths, and dreams of each student

C. QUALITY OF THE MANAGEMENT PLAN

1. Extent to which the management plan articulates the details needed to monitor goals.

Table 7 illustrates the milestones, targets, responsibilities and objectives (with corresponding metrics in *Table 5*) that we will use to monitor whether our project is achieving its goals.

Table 7. 12 for Life i3 Project Management Plan			
Milestones	**Start**	**Responsibility**	**Objective(s)**
Goal 1: Formalize and enhance our STEM focused applied learning model for replication			
1. Convene quarterly Advisory Board meetings	1/14	Advisory Board, Project Director (PD)	1a. – 3d. (All)
2. Hire STEM Curriculum Development Specialist (SCDS)	3/14	Advisory Board, Project Director (PD)	1a.
3. Solidify Professional Development Plan (*Table 4*)	3/14	SCDS, PD	1b., 1c.
4. Schedule/document professional development attendance	3/14	SCDS, Instructional Facilitator	1b., 1c.
5. Solidify and enact i3 evaluation and data collection plan	4/14	PD, The Evaluation Group	1a. – 3d. (All)
6. Complete revision of *12 for Life* curriculum	6/14	SCDS	1a.
7. Begin ongoing curriculum refinement meetings	7/14	SCDS, *12 for Life*, CCS Instructors	1a.
8. Begin weekly STEM-focused PLCs	8/14	SCDS, *12 for Life* Instructors and Staff	1c.
9. Begin quarterly hands-on PD with Southwire	8/14	SCDS, *12 for Life* Instructors and Staff	1b., 1c.
10. Finalize Curriculum and Replication Guide	11/14	SCDS	1a.
11. Begin model dissemination, continue for Years 2-4	1/15	SCDS, DCA, Replication Specialist	1a.
12. Begin sharing evaluation findings with all stakeholders	1/15	PD, The Evaluation Group	1a. – 3d. (All)
Goal 2: Increase student engagement and achievement in STEM			
1. Research, purchase, distribute assistive technology	2/14	SCDS, Instructional Facilitator	1b., 2b., 2c., 2d.
2. Install Extrusion Line Learning Lab	6/14	Southwire, PD	2b., 2c., 2d.
3. Hire Math, Science, and STEM Literacy Instructors	7/14	*12 For Life* Board, PD	2a. – 3d.
4. Hire Industrial Maintenance Engineer (IME)	7/14	Southwire, PD	2a. – 3d.
5. Implement revised *12 for Life* curriculum	8/14	*12 for Life* Instructors and Staff	1a. – 3d. (All)
6. Institute Engineering Maintenance Program	8/14	IME	2b., 2c., 2d.
7. Expand enrollment access for Heard County	8/14	*12 for Life* Board, PD	2a. – 3d.
8. Begin using Extrusion Line Learning Lab for instruction	10/14	IME, *12 for Life* Instructors and Staff	2b., 2c., 2d.
9. Expand enrollment access to Haralson County	1/15	*12 for Life* Board, PD	2a. – 3d.
Goal 3: Ensure students graduate with the skills to succeed in STEM careers and college			
1. Conduct summer academic programming for students	6/14	*12 for Life* Instructors and Staff	2a. – 3d.
2. Hire STEM Academic Counselor	7/14	*12 For Life* Board, PD	2a. – 3d.
3. Provide on-site academic monitoring and advisement	7/14	STEM Academic Counselor	2a. – 3d.
4. Expand COMPASS tests to new Heard County students	8/14	West Georgia Technical College, PD	3b.
5. Expand COMPAS tests to Haralson County students	1/15	West Georgia Technical College, PD	3b.

2. Extent of the commitment of key partners critical to the project's success.

Our i3 project will be supported by four key partners, Southwire, Haralson County Schools, West Georgia Technical College, and Georgia Department of Community Affairs as evidenced through letters of commitment (*Appendix G*), detailed as follows: ❶ **Southwire** will continue as our primary partner in the creation, development, and dissemination of *12 for Life*. The company currently underwrites numerous aspects of the program including costs related to the facility, several staff salaries (Plant Operations Manager and Shift Supervisors), and the Raw Materials Warehouse and Quality Assurance Lab. Southwire has worked diligently to promote replication of the model regionally, statewide, and across the nation. Their contribution will expand through i3 to include support for the addition of an Engineering Maintenance Program and an Extrusion Line Learning Lab, a micro-installment of the manufacturing equipment used at Southwire headquarters, serving as a learning tool allowing students to develop hands-on experience with the process of copper wire fabrication, to complement classroom-based STEM studies. ❷ **Haralson County Schools (HCS)** will the join *12 for Life* partnership, extending services to select students within their district. The school system will also provide access to academic records to support project evaluation through a quasi-experimental study of the efficacy of our interventions in improving student outcomes. Leadership from HCS will serve as new members of our *12 for Life* Board of Directors, to ensure that the district is provided with regular opportunities to share feedback for improved implementation and development. ❸ **West Georgia Technical College (WGTC)** will continue to provide COMPASS pre- and post-testing to all students enrolled in *12 for Life*. Qualifying students will benefit from dual high school and college course enrollment opportunities. Select participants may take advantage of a post-secondary enrollment agreement with Southwire, which accords students support in transitioning to post-secondary study by providing part-time employment at the main plant while they obtain an Associate's degree at WGTC. ❹ **Georgia Department of Community Affairs (DCA)** will maintain their commitment to disseminating the *12 for Life* model across the state, enhanced

through the development of a Curriculum and Replication Guide. All partners are committed to providing long-term support for *12 for Life*, with high quality of return on their investments. Southwire will benefit from the creation of a young, highly-skilled work force and increased production rates; HCS will receive access to the unique services of *12 for Life* to reach their highest-need students; WGTC will cultivate relationships and enhance the knowledge of its future student body; and DCA will access an enhanced STEM curriculum for dissemination, to improve student outcomes across the state.

3. Adequacy of procedures to ensure continuous improvement of the project.

12 for Life is led by an Advisory Board, comprised of leaders from 14 community based organizations, including the above mentioned partners and other representatives from local businesses, government agencies, nonprofits, and financial institutions. The *12 for Life* Board will provide program oversight to support quality evolution of the project, guided by our i3 Logic Model (*Figure 2*), Project Management Plan (*Table 7*), Goals and Objectives (*Table 5*), and findings from evaluation. Through an open and competitive procurement process, we have identified The Evaluation Group (TEG), an experienced firm specializing in federally funded education initiatives including three i3 grants, to conduct an ongoing, independent evaluation of *12 for Life* and i3 strategies. This evaluation will be guided by our logic model (*Figure 2*) which details the key program components and mechanisms that will lead to our intended outcomes, to examine the program's theory of change, asking what worked, what did not, and why, creating a feedback loop for supplying essential information to program leaders (University of Wisconsin, 2003). Using this feedback, the board will meet on a quarterly basis to review the status of project implementation, consider evaluation findings, develop any corrective action needed, and plan for advancement and replication. Any augmentation of the model will be implemented through curriculum refinement by the STEM Curriculum Development Specialist, incorporated into practice during curriculum planning, and monitored for progress during weekly STEM Professional Learning Community meetings.

D. PERSONNEL

1. Adequacy of the project's staffing plan.

♦**Existing Infrastructure:** Management of *12 for Life* will be overseen by our Advisory Board, led by Southwire's Executive Vice President of Human Resources and including representatives from Southwire (Plant Operations Manager, Supervisors); CCS (CTAE Director, Director of Teaching and Learning); HCSS (Assistant Superintendent); Georgia Department of Community Affairs, and West Georgia Technical College. Meeting quarterly, the Advisory Board will: oversee implementation, coordinate with the Project Director to implement project strategies, share promising practices, monitor fiscal matters, guide project evaluation, and make strategic decisions to ensure successful implementation. Employed by CCS, our full-time Project Director, Dr. Doug Wright, will staff our Advisory Board, ensure fidelity of implementation, monitor whether objectives are being met, coordinate professional development, oversee replication planning, and team with partners for implementation. Dr. Wright has served in this capacity for nearly five years, leading program growth from a 71 student cohort to serve a current student body of 160 participants and growing. He holds a Doctorate in School Improvement from The University of West Georgia, and has more than 17 years of service with CCS, with 7 years directing CTAE apprenticeship programs, including *12 for Life*. He supervises all day-to-day activities and a current program staff of eight full-time professionals. The combined efforts of Dr. Wright and the Board have resulted in quality program implementation and growth via securing and managing a state Georgia Innovation Fund grant. This grant facilitated expansion to provide a Raw Materials Warehouse and Quality Assurance Lab; personnel to support and extend services Heard County Schools; and staff to disseminate knowledge of the program model across the state. Existing full-time staff dedicated to the implementation of our program includes: Southwire Plant Operations Manager, Southwire Student Shift Supervisors, Replication and Sustainability Coordinator, STEM Instructors, an Instructional Facilitator, and a Community Liaison. ♦**i3 Staffing Structure:** Dr. Wright will serve as the Project Director, supported by the

addition of a STEM Curriculum Development Specialist, three full-time instructors, Southwire Industrial Maintenance Engineer, and a STEM Academic Counselor as illustrated in *Table 8*. With key staff currently in place, we will begin this critical work upon award. Resumes of staff and job descriptions for new positions are located in *Appendix F*.

***Table 8. 12 for Life* i3 Staffing Plan**			
Availability	**Position**	**Individual**	**Funding**
1/14	Project Director	Dr. Doug Wright	CCS
	Community Liaison	Elena Schulenburg	
	Operations Manager	Blair Parker	Southwire
	Shift Supervisors (4 Professionals, Full-time)	Various	
	Instructional Facilitator	Bonnie Robinson	State and Other Sources
	Science Instructor	Rachel Sayer	
	Math Instructor	Allen McGuire	
	Instructional Support (Tutors, Substitutes, etc.)	Various	
	Replication and Sustainability Coordinator	To Be Announced	
	i3 Project Evaluators: The Evaluation Group	Dr. Monica Oliver	i3 Funding
		Dr. Heather Scott	
3/14	STEM Curriculum Development Specialist	To Be Determined	
7/14	Additional Math Instructor		
	Additional Science Instructor		
	STEM Literacy Instructor		
	STEM Academic Counselor		
	Industrial Maintenance Engineer		

♦**Qualifications of i3 Personnel:** Our i3 project will require the professionals implementing program strategies to possess the minimum qualifications provided as follows: ❶ *STEM Curriculum Development Specialist:* a minimum of three years of experience in STEM related curriculum design, development, and implementation; a valid Georgia Teaching Certificate, training in STEM instruction (certification preferred), familiarity with Common Core Standards, demonstrated knowledge of applied learning techniques; three years of experience serving high-need youth, Master's degree preferred; ❷ *STEM Math, Science, and Literacy Instructors*: a valid Georgia Teaching Certificate, training in STEM instruction (certification preferred), familiarity with Common Core Standards, demonstrated knowledge of applied learning techniques; three years of experience serving high-need youth, Master's degree preferred. ❸ *Industrial*

Maintenance Engineer: Licensure in at least one maintenance area (i.e. electrical, millwrighting, etc.), high school diploma, ten years of field experience and five years of supervisory experience required; prior work with youth and bachelor's degree preferred; ❹ *STEM Academic Counselor:* licensed by the State of Georgia, minimum of a Master's degree in counseling from a program accredited by the Council for Accreditation of Counseling and Related Educational Programs or equivalent, and have at least three years of experience providing academic counseling in a high school setting, with experience serving high-need populations. ♦**Qualifications of i3 Project Evaluators:** The Evaluation Group (TEG) has experience conducting large-scale evaluations with districts in the Southeast, which has well-positioned them to conduct an independent evaluation of *12 for Life*. TEG is presently evaluating our Georgia Innovation Fund grant program and is also conducting independent evaluations for three i3-funded initiatives in other districts. This highly-trained evaluation team will consist of two lead evaluators (Dr. Scott and Dr. Oliver), a data analyst, and a data manager. Dr. Scott has ten years of experience, serving as the lead evaluator on the Georgia Innovation Fund grant program and as a supporting evaluator on an i3-funded project. Dr. Oliver has ten years of experience in evaluation research, including acting as technical advisor to an i3-funded post-secondary education attainment initiative.

E. QUALITY OF THE PROJECT EVALUATION

1. The clarity and importance of key questions and methods of the project evaluation.

Our independent evaluator will develop and conduct a formal i3 project evaluation plan that will address the questions: ❶ To what extent does *12 for Life* impact student academic performance? ❷ To what extent does *12 for Life* impact student behavior? ❸ To what extent does *12 for Life* influence students' future education and career goals? ♦ **Methods to Address the Evaluation Questions:** Analysis of student outcomes will focus on an annual comparison of the *12 for Life* participant group to a non-participant group, which will involve several dependent measures, including GPA, and graduation, suspension, and dropout rates. Standardized test scores are not included as a source of data for the comparison and treatment groups due to changes beginning

in the 2011-2012 academic year in testing structures, requirements, and reporting in the state of Georgia. Student GPA will therefore serve as the indicator for establishing baseline equivalence between the comparison groups. Benchmarks are specified through our performance measures, which allow us to identify progress and areas for improvement. For the process component, data sources will include surveys (student, teacher professional development), student focus groups, and administrative records. Survey and interview data are examined to ascertain changes in student attitudes, behavior, and aspirations; as well as teachers' perceptions of professional development. Both quantitative and qualitative data will allow us to have timely and regular program feedback and multiple methods of assessing our progress toward reaching goals.

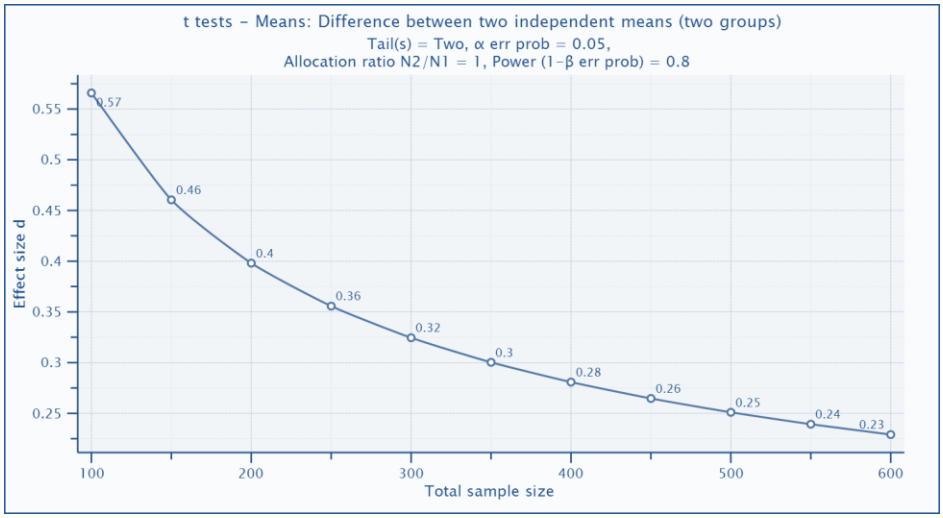
2. Extent to which the evaluation plan includes a clear and credible analysis plan.

♦ **Evaluation Informed by Unique Program Design:** Students who have earned sufficient credits to enter into the 10th grade may apply for enrollment in *12 for Life*. Selected participants then earn credits toward graduation at their own pace, through a combination of classroom and on-line courses. Both new student enrollment and graduation occurs on a quarterly basis. Due to the unique and personalized nature of our program, quarterly student admission and graduation cohorts can vary in size. Our program design also results in a varied length of enrollment for each student based on their individual credit deficiencies at entry and credit earning pace as they participate in the program. Based on our current strategic plan and interest from students across participating districts, we anticipate growing our capacity to serve over 320 students during any given quarter by the end of 2017. For the purposes of our project evaluation, all *12 for Life* students will be considered as eligible for graduation upon admission to the program. ♦ **Evaluation Plan:** *12 for Life* will use a multiple-cohort quasi-experimental non-equivalent group design (QED) to compare *12 for Life* students with a matched sample of non-participant students from our partnering school districts, to gauge program efficacy. The first cohort of 200 *12 for Life* students and 200 non-*12 for Life* students will be tracked from Year 1 until they complete the program or through Year 4; the second cohort of 100 *12 for Life* students and 100 non-*12 for*

Life students will be tracked beginning in Year 3 until they complete the program or through Year 4. Selection of comparison group students will match the identification criteria for our *12 for Life* students: credit deficiencies, chronic absences, low socioeconomic status, and discipline record. *12 for Life* and comparison students will also be assessed through a survey for comparability in their motivation and post-secondary observations at the outset of program participation. Combined data from the two cohorts will allow for assessment of a two-year treatment effect on the pooled sample of 300 treatment and 300 control students. The program and non-participant cohorts will be compared annually to analyze differences in the following outcomes: GPA and graduation, suspension, and dropout rates. The minimum detectable effect size needed for the study based on a pooled sample size of 300 *12 for Life* participants and 300 non-participants (total = 600 students), alpha = .05, and power = .80 was calculated as 0.23. Detail regarding the minimum detectable effect size can be found in *Table 9* and *Figure 3* below.

***Table 9:* Results of Minimum Detectable Effect Size Analysis**					
***t*-tests -** Means: Difference between two independent means (two groups)					
Input:	Tail(s)	= Two	**Output:**	Noncentrality parameter δ	= 2.81
	α err prob	= 0.05		Critical t	= 1.96
	Power (1-β err prob)	= 0.80		Df	= 398
	Sample size group 1	= 300		**Effect size d**	**= 0.23**
	Sample size group 2	= 300			

***Figure 3*: Minimum Detectable Effect Size Required for Different Sized Samples**



TEG will use both descriptive (i.e., means, standard deviations, frequencies) and inferential statistics (i.e., t-test, chi-square) in the treatment of quantitative data. Confirmatory analysis will use OLS Multiple Regression (on interval-level outcome variables; Hedges' g for effect size) and logistic regression (on dichotomous-level outcome variables; odds ratio for effect size) (Hedges, 1981). The Benjamini-Hochberg procedure will be used to adjust for multiple comparisons with the same outcome domain (Thissen, Steinberg, & Kuang, 2002). Results from our quasi-experimental study will be reported on an annual basis, and interim reports will serve to provide real-time information back to the program for any appropriate adjustments.

3. Extent to which the evaluation plan articulates the key components and outcomes.

Our evaluation will examine fidelity of implementation to the program model through an implementation matrix, which will capture data for key implementation variables focusing on: service delivery according to length, intensity, and duration; content, procedures, and activities under each aspect; roles and qualifications of staff; and characteristics of our target students. Capturing both fidelity and impact data will enhance external validity and allow for adequate guidelines for replication. We will ensure that we have sufficient information for detailing the structure of the program by collecting data on the program dosage, such as the frequency and duration of lab sessions, as well as data on how the program is staffed and administered. We will set thresholds of implementation for key components of the program through the development of a fidelity index, which is a composite score that captures the extent of *adherence*, *dosage*, and *reach* of the key program components as explicated in the logic model. To calculate the score, we will: 1) identify fidelity criteria for each key component, 2) suggest thresholds for each criterion, and 3) quantify as a score. We will document critical program activities by considering both the content and the execution of the activities to chronicle the recruitment and selection process and inform materials for the creation and refinement of a replication guide. Finally, we will assess the quality and dynamic of key partnerships and examine the implications of the program's operational context for successful national replication to advance the field of STEM.