AUSL-NLU: Science Excellence through Residency

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A. INTRODUCTION

National Louis University, the Academy for Urban School Leadership, Chicago Public Schools and the Illinois Institute of Technology propose *Science Excellence through Residency or SER;* an innovative, research-based pathway to highly-effective science teaching in Chicago's highest-need public schools. *SER* builds on the foundation of one of the country's longest-standing and largest teacher residency programs. The pathway is comprised of two components. First, it begins with the recruitment of highly qualified candidates for the teacher residency. Next, it puts in place an innovative practice-based curriculum and technology platform during the residency and induction years enabling teachers to continuously improve their enactment of high leverage science teaching practices and the implementation of the Next Generation Science Standards (NGSS). Teaching will further be supported by the development of curricular connections to science in community and careers.

The goals of *Science Excellence through Residency* are to: 1) create a high level of integration of pedagogy, classroom practice, and teacher and faculty mentoring in the Chicago Teacher Residency; 2) build teacher and school site capacity for effective implementation of Next Generation Science Standards; 3) Maintain high levels of diversity in residency cohorts and increase diversity of candidates for science teaching; 4) build science curriculum that enacts NGSS and connects to community and college and career readiness; and 5) positively impact science achievement of K-12 students. These goals respond to Absolute Priority #2 - Partnership Grants for the Establishment of Effective Teaching Residency Programs, to Competitive Priority #1 - Promoting Stem Education and Competitive Priority #2 - Implementation of Internationally Benchmarked College and Career Readiness Elementary and Secondary Academic Standards. Furthermore, *Science Excellence through Residency* is consistent with state and local education

reforms. At the state level, Illinois was one of 26 lead states that collaborated on developing the NGSS. Chicago Public Schools has developed a Science Content Framework to support instructional planning during the transition of the NGSS. Further, the work proposed here aligns with two of Chicago Public Schools' six strategic pillars: Pillar 1, which promises to implement the Common Core Standards in all grades K-12, and Pillar 4, which aims to recruit highly talented teachers, implement evaluation systems that promote professional growth, provide on-going professional development, reward high performers and empower great leaders, and implement a loop of continuous feedback.

B. COMPETITIVE PREFERENCE PRIORITIES

CCP 1: Promoting Science, Technology, Engineering and Mathematics

This proposal responds to Competitive Preference Priority #1 through a cohesive program of high-quality preparation and professional development designed to produce effective science teaching in high need school settings. Taking place within an established residency program for teacher preparation, the project activities begin with targeted recruitment of diverse candidates with strong science capacity, and then implement a practice-based teacher preparation curriculum that allows candidates multiple opportunities to enact high leverage science practices aligned to the Next Generation Science Standards (NGSS) with coaching and feedback that examine the impact on K-12 student learning. Project partners include Illinois Institute of Technology, bringing deep expertise in science content to the design and implementation of teacher preparation and induction experiences.

CCP 2: Implementing Internationally Benchmarked, College – and Career-Ready Elementary and Secondary Academic Standards

This proposal responds to Competitive Preference Priority #2 with the implementation of the Next Generation Science Standards serving as the framework for the development of all preparation and induction activities. NGSS standards for student learning were developed from reviews of science education programs with high performance on international assessments. The NGSS approach of focusing on cross-cutting concepts of science further enacts exemplary features of those programs.

C. SIGNIFICANCE

The need to dramatically improve the outcomes of K-12 science education in the U.S. has been well-documented in recent years (National Academy of Sciences (2007); President's Council of Advisors on Science and Technology, 2010; National Research Council, 2011). Results from national testing show that less than half of tested students are performing at proficient levels, and results from international testing have consistently shown the U.S. to be "in the middle of the pack" of tested nations, and with fewer high performing students. While the National Assessment of Educational Progress (NAEP) has shown some growth in science scores at the eighth grade level for non-white and low-income students between 2009-11, a marked achievement gap still exists between those students and their white and higher income peers, even given the low proficiency shown overall (Institute of Educational Sciences, 2011). As the many reports and discussions on these results have pointed out, the next generation's need to understand science is growing. These analyses make a compelling case that effective K-12 science education must cultivate a scientifically literate citizenry and ensure that the knowledge, skills, and attitudes for effective problem solving, decision making, and action taking in a world increasingly dominated by the influences of science and technology are widely held among the population.

The international comparisons of student performance show us that significant improvement in achievement is indeed possible. While U.S. scores remained largely stagnant in recent years, achievement rose in many other locations, with high and low performing countries showing improvement. Several researchers in science education have pointed to the U.S. science curriculum as a significant contributor to the stagnant scores. In countries whose students are top performers in science, Schmidt and other researchers have found highly sequenced curricula emphasizes deep understanding of a limited number of key concepts. (Schmidt, Wang & McKnight, 2005). By contrast, the study found that the U.S. not only lacks coherence in its standards, but it also advocates teaching far too many each year. Students end up relearning more general sets of facts year after year, rather than focusing on a small number of topics and gaining full understanding. In 2010, Achieve carried out an analysis of international science standards from ten countries and found that standards organized around cross-cutting concepts of science "seem to have more benefits than discipline-based structures" (Achieve, 2010, p. 4).

The Need to Prepare Teachers to Implement Next Generation Science Standards.

A more coherent, focused approach is being put forward in the Next Generation Science Standards. The NGSS are a new set of rigorous and internationally benchmarked standards for K-12 science education. The central approach of the NGSS is learning STEM in relation to real-world settings and use of science, technology and math, in order to prepare students to be better decision makers about scientific and technical issues and to apply science to their daily lives. The innovation and applicability of NGSS are in the integration of three central dimensions: 1) the practices of scientists and engineers; 2) disciplinary core ideas; and 3) cross cutting concepts. Consistent with the focus on practice, the NGSS are written as tasks that students should be able to perform and explain, rather than as content standards.

NGSS is not a curriculum, but requires a conceptual shift for teachers. The current organization of K-12 science education by discipline does not reflect the real world interconnections in science. Teacher preparation and professional development in science education in recent years has often focused on an inquiry process; however, it has not promoted a coherent investigation of core scientific ideas across multiple years of school, or blended practices with those ideas.

With this major shift in both the content and process of science teaching, NGSS poses significant implementation challenges. In a thoughtful essay on the promise and challenges of the NGSS, science teacher and Albert Einstein Distinguished Educator Fellow, Rebecca Hite, notes that According to Horizon Research, only seven percent of teachers surveyed felt they were "well prepared" to teach engineering." As an example of science in practice, Hite goes on to note the opportunity present in the NGSS: coherent principles that are creating a "unique and exciting time in K-12 science—the teaching professionals are leading in the creation of instructional curricula that will be used nationwide" (Hite, R., 2013).

To realize that opportunity, an additional challenge will be to keep the focus on student learning during these shifts in the teaching of science. The significant changes being asked for in teachers' knowledge base and practices can, somewhat paradoxically, keep the focus on evaluating *teachers' actions* rather than on the effect of their practices on *student learning*. The work proposed in *SER* addresses these challenges in a teacher preparation program by building a trajectory of teacher learning in science that allows candidates repeated opportunities to practice and receive feedback and coaching on high leverage teaching practices designed around NGSS. A key component of the work will be the use of an innovative platform for collaborative improvement of teacher practice incorporating constant examination of formative

student assessment data, keeping the focus on how the NGSS implementation can break the stagnation of U.S. students' science achievement.

Needs Analysis: Chicago Public Schools' Capacity to Provide/Improve Science Pedagogy

Chicago Public Schools (CPS) has developed planning guides for the implementation of NGSS in the coming academic year. In considering the implementation challenges of NGSS in the context of CPS, it is the third largest school district in the country (behind New York City and Los Angeles, respectively) with 658 schools serving 400,545 students and employing 22,519 teachers. More than 85% of CPS students are of African American or Latino/Hispanic descent and 85% of students come from low-income families. While third in size, Chicago has a significantly higher population of children living in poverty (26.8%) as compared to New York City (17.5%) and Los Angeles (19.8%). More than 16,000 CPS students are homeless. What is more, the district has a mobility rate of 16 percent.

While the district as a whole has made incremental progress in student achievement over time, much work remains to raise student achievement levels to state and national standards. Just a quarter of CPS 11th graders are adequately prepared for college coursework (having scored 21 or higher on the ACT) (2014, State of Illinois). Fewer than half of the district's 3rd through 8th grade students and slightly more than a third of high school students are meeting state standards, both well below Illinois state averages. Increasing student achievement levels in STEM subjects has been encouraging but remains a work in progress. For example, the achievement gap in science between African American and white students has decreased over time—by eight percentage points over the past five years—yet a substantial gap, 24 percent, remains (2014, State of Illinois). While socio-economic factors have an undeniable impact on

school performance, data indicates that many underperforming schools suffer from a human capital deficiency: too many teachers in the highest need schools are ill-prepared, under-qualified, or lacking a functional support structure. According to the most recently available data, 1.3% of CPS teachers are teaching with emergency or provisional credentials, more than double the state average. As of 2011, 5.2% of CPS classes were not taught by highly-qualified teachers, compared to the state average of 0.8%.

Predictably, these teachers do not stay in their positions for long, disrupting a school's efforts at stability and continuity. According to a recent study by the University of Chicago's Consortium on Chicago School Research, "within five years, the typical CPS school loses over half of its teachers. Many schools turn over half of their teaching staff every three years." The study goes on to show that "about 100 CPS schools suffer from chronically high rates of teacher turnover, losing a quarter or more of their teaching staff every year. In all of these schools, the majority of the student body is low-income; in most of the schools, all students are low-income." In other words, the schools that need high-quality teachers the most are the hardest schools to staff (Allensworth, Ponisciak & Mazzeo, 2009). In the context of CPS, the implementation challenges of NGSS are thus compounded by high levels of student need and issues with the stability and quality of teaching staff.

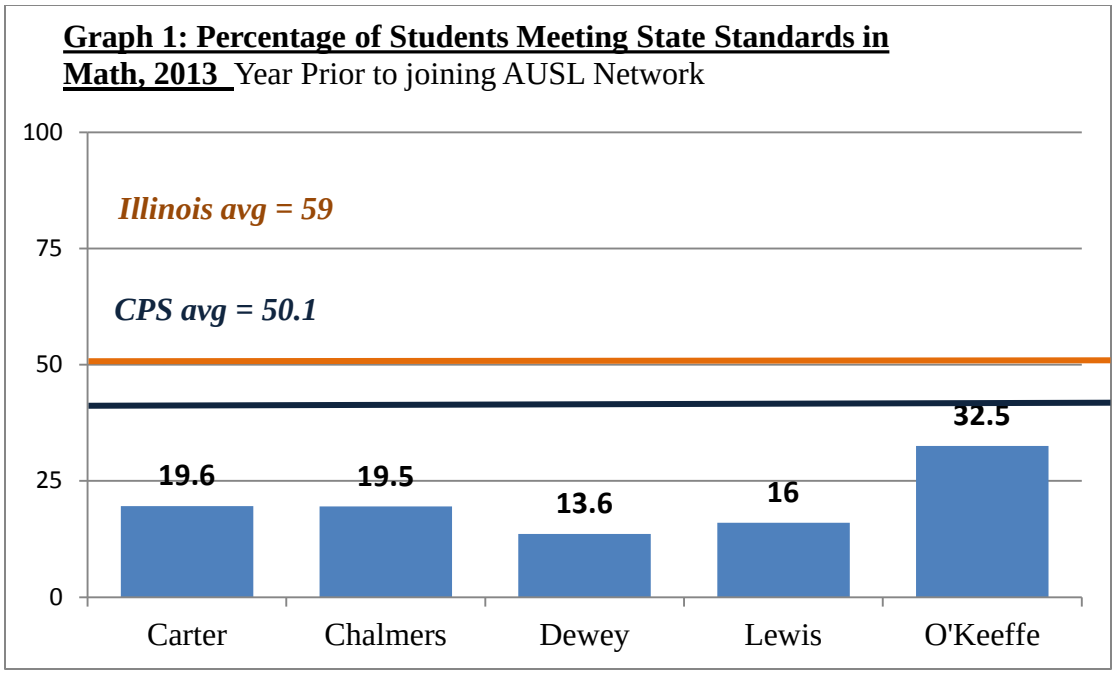
Science Excellence through Residency **and System Improvement for Chicago Public Schools**

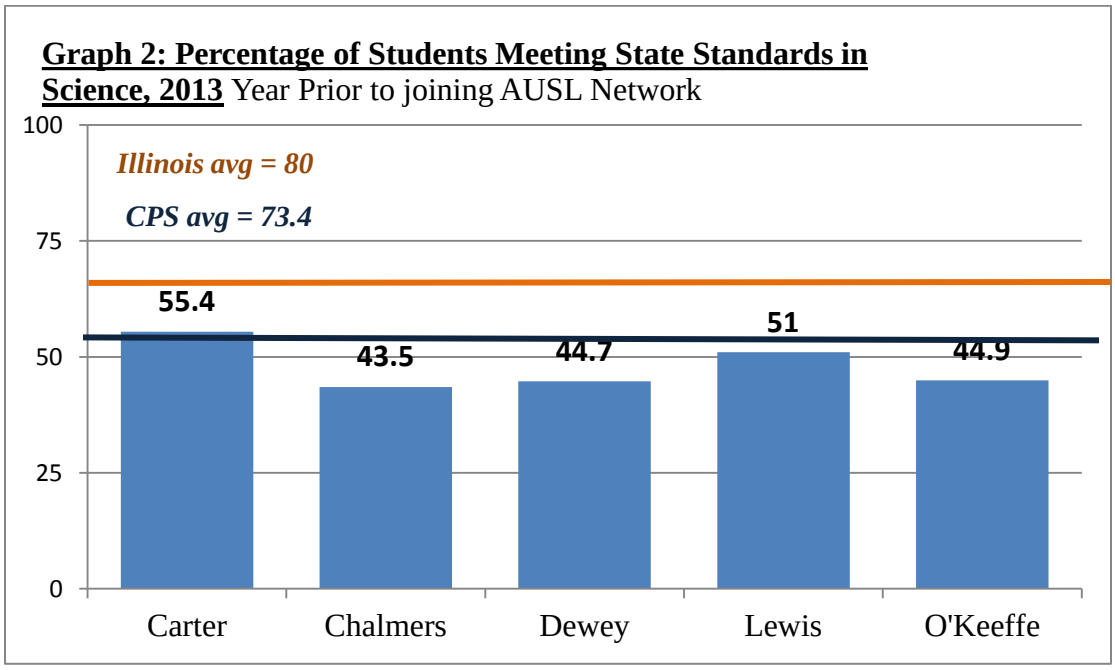
Over the past 10 years, the Chicago Teacher Residency (CTR) has worked to address issues of teacher quality and stability through innovative teacher preparation. A partnership between CPS, NLU, and AUSL, the CTR uses a clinical practice-based approach to prepare teachers to raise student learning in Chicago's highest need schools. Results indicate the

effectiveness of the residency program in addressing the issues of teacher quality and stability. The AUSL-managed CPS neighborhood elementary schools that are staffed with significant percentages of residency graduates consistently show student gains that are higher than the district's average (ISBE report card, pull cite) and 72% of all residency graduates over the past decade are still currently working in CPS.

However, a close look at the high-need schools managed by AUSL clearly reveals the need for higher quality instruction in the STEM disciplines, particularly in science. In partnership with CPS, AUSL manages a network of 32 CPS neighborhood schools serving 18,000 students, the largest public-private school management partnership in the country. Nearly all students in AUSL schools come from low-income families (95%) and nearly all are of African American or Latino/Hispanic descent (95%). These schools are representative of the schools in which CTR residency graduates are hired to teach.

In looking at the prior year performance for the five CPS elementary schools that joined the AUSL Network in the 2013-2014 school year (see graphs 1 and 2), it is evident that students in these high-need settings are performing well below their peers at both the district and state levels in STEM subjects.





As indicated above, the promise and the implementation challenges of NGSS, the context of student need and issues of teacher quality and stability in CPS, and the low science achievement of students even in CPS sites with high concentrations of effective, residency-

trained teachers point clearly to the need to develop a pathway to effective science teaching as a component of the CTR**.**

D. THEORY OF ACTION

The theory of action underlying *Science Excellence in Teaching* is: if teacher preparation programs help their candidates gain ***adaptive expertise*** in science teaching, then candidates will know how to understand and guide their own students' learning in the NGSS framework. To support candidates in developing adaptive expertise, teacher preparation programs must design learning experiences that balance efficiency and exploration, creating an *optimal corridor of adaptability*. The Chicago Teacher Residency (CTR) of NLU and AUSL is an example where optimal corridors of adaptability can flourish. Where we have begun to see the theory of action play out is in the *Adaptive Cycles of Teaching,* a practice-based teacher preparation curriculum designed by NLU that is a central component in the Project Design we are proposing. First, however, we provide the research base behind *adaptive expertise; optimal corridor of adaptability; and the Adaptive Cycles of Teaching.*

Adaptive Expertise. Adaptive expertise helps in defining effective science teaching (Darling-Hammond & Bransford, 2005; Lin, Schwartz, & Hatano, 2005). In contrast to routine experts who develop efficiency with a core set of competencies, adaptive experts continually expand the breadth and depth of their knowledge through a willingness to explore new dimensions of their work and experiment with new strategies (Hatano & Inagaki, 1986; Schwartz, Bransford, & Sears, 2005). Adaptive expertise in teaching entails systematically learning from teaching in order to share key insights and take leadership to improve student learning (Heibert, Morris, Berk, & Jansen, 2007). Furthermore, teachers need such an adaptive orientation to effectively utilize community assets in diverse school contexts and to respond to

variation in their students' prior knowledge, thinking, and conceptual learning trajectories (Duschl, Schweingruber, & Shouse, 2007; Sztajn, Confrey, Wilson, & Edgington, 2012).

Optimal Corridor of Adaptability Qualities of adaptive expertise can be nurtured through an *optimal corridor of adaptability* or the careful design of learning environments that balance both opportunities for learners to develop efficiencies and opportunities for learners to innovate (Bransford, et. al, 2005; Schwartz, Bransford, & Sears, 2005; Hammerness, Darling-Hammond, & Bransford, 2005). This careful consideration of opportunities to learn can serve as a framework for practice-based teacher preparation. Recent literature on teacher preparation forefronts the theory/practice divide and the corresponding need to help teacher candidates more effectively bridge this divide (Darling-Hammond, 2010; Wang et.al, 2010). Theoretically driven higher education coursework often represents teaching using abstractions of concepts that are hard for novice teachers to translate into effective practice (Grossman, Hammerness, & McDonald, 2009). Further, research indicates that experienced practitioner knowledge differs from theoretical knowledge in that it is highly contextualized, detailed, specific, and linked to concrete problems of practice (Hiebert, Gallimore, & Stigler, 2002). To help bridge the divide between theory and practice in teacher education, researchers have called for practice-based approaches to teacher preparation (Ball & Forzani, 2009). These approaches attempt to scaffold novice teachers toward proficient practice by decomposing high leverage practices (i.e., those that will most influence student learning) into a learnable set of tasks while simultaneously preserving the meaning and purpose of the practice (Ball & Forzani, 2009; Grossman, 2011).

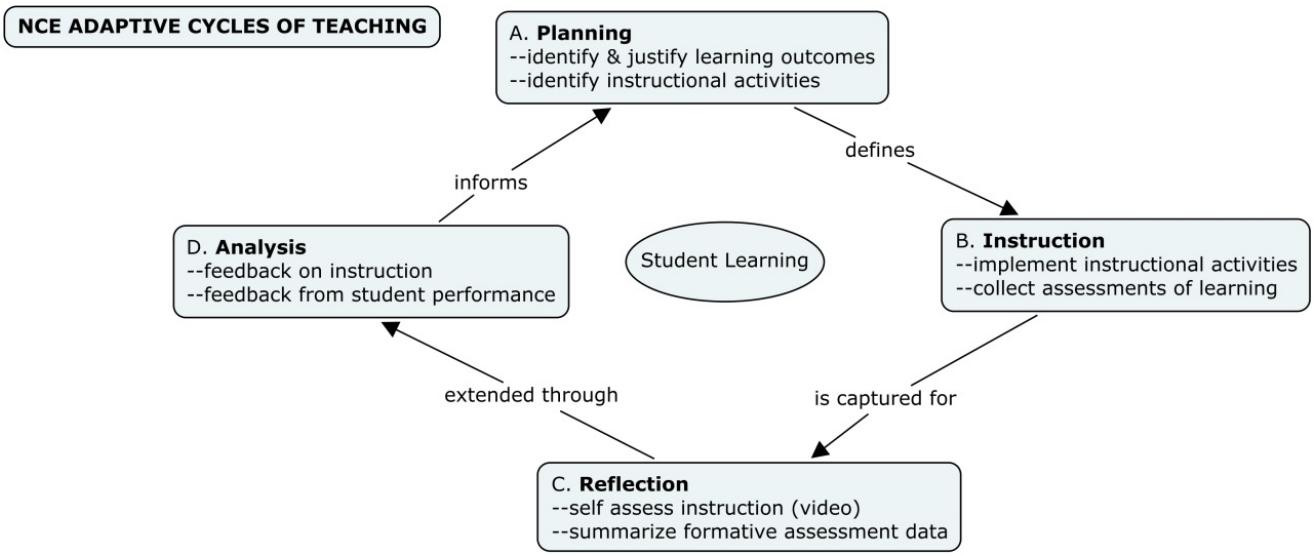
Adaptive Cycles of Teaching. NLU has developed a practice-based teacher preparation curriculum called *Adaptive Cycles of Teaching (*ACT*)* to create an optimal corridor of adaptability for novice teachers. The *ACT* integrates a consistent structure for teachers to gain

efficiency in implementing science instruction with opportunities to innovate by adapting instruction in response to features of the school/community contexts, variation in their students' learning trajectories, and different science concepts and practices as defined by the NGSS (see Figure 1). The *ACT* is an innovation that grew out of synergies between two previous NLU federal grant projects, the Chicago Teacher Partnership Program (CTPP-TQP) and the Faculty Research Residency Model, a FIPSE grant, and a collaborative partnership with Cognitive Advisors. Through the Chicago Teacher Partnership Program TQP grant, faculty collaborated in interdisciplinary teams (including teachers from partner schools) to refine content pedagogy courses and extend field learning opportunities for teacher candidates. Simultaneously, many of the same faculty members were involved in the FIPSE Faculty Research Residencies through which they implemented research in high-need schools to investigate teaching practices and refine teacher education coursework using practice-centered principles (Ball & Forzani, 2009). In the final year of each of these grants projects, NLU collaborated with Cognitive Advisors, creators of the TREK Learning Experience Manager system – a mobile cloud-based system designed to manage and track on-the-job experiential learning – to customize their technology platform for the teacher education. The Adaptive Cycles of Teaching for Literacy and Science Instruction resulted. Curriculum tools created through NLU's FIPSE faculty research residencies were incorporated into the *ACT* learning activities design. This included a science inquiry observation tool and a video reflection protocol for science inquiry teaching.

Research supporting the Adaptive Cycles of Teaching Approach. Stable learning structures within the *ACT* design were informed by practice-based theories of teacher education (Ball & Forzani, 2009; Grossman, Hammerness, & McDonald, 2009). Practice-based theory highlights the significance of *representations* of practice, *decompositions* of practice, and

approximations of practice to ensure novices can enact high leverage practices within dynamic classroom contexts (Grossman, Compton, Igra, Ronfeldt, Shahan, & Williamson, 2009). Representations provide novices with a vision for the practice as a whole. In the *ACT* design, novice teachers view video models of specific teaching practices and decompose the practice using teaching performance templates to identify its critical features. Approximations of practice entail guided practice. Within the *ACT*, core practices are learned through repeated cycles of: a) lesson planning; b) enacting the plan; c) reflecting on lesson events; and d) analyzing feedback/data from a variety of sources. Within each cycle, novice teachers review and critique their own lesson videos using teaching performance templates and receive timely focused feedback from faculty and mentor teachers using the same tools. Formative assessments have been designed to allow teachers to quickly analyze student progress toward the lesson outcomes and inform the next lesson plan. These steps within the *ACT* provide a highly structured focus that scaffolds novice teacher learning and promotes the habit of mind to continually learn from teaching (Hiebert, Morris, Berk, & Jansen, 2007). The concept map in Figure 1 depicts the *ACT* cycle and specifies the core teacher learning goals for each step.

Figure 1: Adaptive Cycles of Teaching Structure and Goals



E. QUALITY OF PROJECT DESIGN

In describing the project design, we will first describe how the *ACT* can be leveraged to improve science instruction. Next, we will discuss how AUSL, NLU and CPS currently operate the Chicago Teacher Residency. Then finally, we will detail how the residency program will be enhanced to further improve student achievement in science, along with a new partner in the process, the Illinois Institute of Technology (IIT). To this end, the remainder of the project design is divided into three sections: 1) Science Instruction and the *ACT*; 2) Current Chicago Teacher Residency Model and 3) Proposed Development of Science Excellence through Residency.

1. SCIENCE INSTRUCTION AND THE *ACT*

Systematic Variation in Science ACT Learning Paths. The *ACT* curriculum for science instruction is intended to scaffold novice teachers to engage students in science and engineering practices that lead toward their attainment of scientific literacy (AAAS, 1993; 2009; NRC, 1996, 2000; Duschl, et.al., 2007; http://www.nextgenscience.org). As detailed above, an optimal corridor of adaptability entails systematic variation in the types of problems that novice teachers need to resolve (Lin, Schwartz, & Hatano, 2005; Schwartz, Bransford, & Sears, 2005). Three different teacher learning activity paths within the *ACT* enable novice teachers to investigate critical variables in science instruction and learning: a) organization of science learning environment; b) student learning within science practices; and c) science concepts and practices. These learning paths are designed to help novice teachers develop the specialized knowledge for science teaching, including knowledge of context, learners and learning trajectories, and science content (Ball, Thames, & Phelps, 2008; Shulman, 1986, 1987) and to use this knowledge to inform specific science lessons.

Science ACT will lead to Improvements in Practice. A small pilot of the beta version of the Literacy and Science *ACT* curriculum has been completed. Analysis of the pilot results are currently underway, but initial findings indicate that teacher candidates who experienced the *ACT* approach (compared to teacher candidates experiencing the traditional methods courses) have a deeper understanding of the core teaching practices, enact core teaching practices more effectively (as measured by the edTPA), and are much more confident about implementing core practices in their own classrooms. By bringing iterations of the candidates' observable practice into the university classroom, the *ACT* offers a stronger practice-based approach that will minimize the problems of enactment that beginning teachers often exhibit in their first years of practice (Hammerness et al., 2005). This approach also requires teacher education faculty members to collaborate in new ways to identify core teaching practices across content areas that create stronger program consistency and coherence, and creates a collaborative coaching model that brings together university-based and school-based faculty. Most important, the practice-centered design and supporting technology create a tighter connection between student learning and teacher learning. The design enables teacher educators, mentor teachers and teacher candidates to focus more deeply on a smaller set of core practices, and with each, examine a key source of feedback, whether students are making progress.

The *ACT* curriculum can help realize the practice-based potential of the residency approach through the collaborative examination of resident performance and K-12 student learning. The experience of AUSL and NLU in the residency partnership points to the need for specific collaborative structures around the use and implantation of the *ACT*. Under the prior TQP grant, the strongest integration of university and school-based expertise came through specified collaborative processes, such as the faculty liaison role and the capstone portfolio panel

process described later in this proposal. To build further levels of integration around the *ACT*, we propose implementation using design-based research (DBR) teams. The DBR team approach can support the CTR partners in achieving a shared understanding of how residents improve their practice in response to student learning and systematically adjust components of the *ACT* design to support the improvement of practice, and be most effective in context of high-need urban settings (Anderson & Shattuck, 2012). In the design-based research process (Cobb, Confrey, deSessa, Lehrer, & Schauble, 2003), a partnership design team consisting of NLU faculty, AUSL science teachers and residency coaches will use the theory of action embedded in the design of the *ACT* to guide their analysis of resident and K-12 student learning.

With the well-established processes and partnership of CTR as a foundation, and the *ACT* and design-based research teams as the primary processes for the full integration of pedagogy, classroom practice, and teacher and faculty mentoring focused on teacher performance and K-12 student learning, we propose a set of activities that constitute a sustained program from the residency year through induction for the development of effective science teaching using the NGSS standards. The program incorporates the recruitment of diverse candidates with strong science backgrounds, the addition of a deep science content partner in the Illinois Institute of Technology, and the strengthening of K-12 science content through the incorporation of connections to community and careers. Next is a description of the current Chicago Teacher Residency model. Following this section, is the explanation of how this current model will be enhanced through implementation of the *Science Excellence through Residency.*

2. CURRENT CHICAGO TEACHER RESIDENCY (CTR) MODEL

The CTR model engages cohorts of new residents in rigorous, graduate-level coursework to earn a Master of Arts degree in Teaching (MAT) or Masters in Education (M.Ed.), while

undertaking a guided, twelve-month teaching apprenticeship alongside a trained and experienced mentor teacher. Graduates are then re-grouped into new cohorts and placed in AUSL-managed schools where they receive two years of support through a mandated induction program. Essential components of the CTR are described below.

***Integrating Pedagogy, Practice, and Teacher Mentoring*.** Charlotte Danielson's evidence-based *The Framework for Teaching* serves as a cornerstone of the AUSL/NLU partnership. Danielson's Framework informs the way NLU professors teach their classes and gives a common language and proven assessment tool for coaching and teacher observations. More than a list of teaching expectations, the Framework is a rubric that describes teaching practice across a continuum for each component. Each level describes specific teaching practices associated with a particular lesson or point in time. The Framework informs the content pedagogy of NLU coursework, the learning cycles of residents during their school-based training, and provides a common language and evidence-based assessment tool for coaching and teacher observations.

Engaging Residents in Rigorous Graduate-level Course Work. Residency training begins in late June/early July with a demanding summer session of coursework, attending classes at NLU from July-August, Mon.-Fri., 9am - 4pm. Residents are placed in one of four cohorts, reflecting the area of teaching they wish to pursue: 1) M.Ed. candidates; 2) MAT in Elementary Education candidates; 3) MAT in Secondary Education candidates; and 4) MAT in Special Education candidates. Throughout the residency year, residents continue their coursework at NLU. As of 2012-12, the coursework includes credits towards ELL endorsement.

***Experience & Learning alongside Experienced Mentor Teacher*.** From the first day of the academic school-year, CTR residents are paired with a mentor teacher in the same content

area/grade level four out of five days each week in one of thirteen schools that serve as AUSL training sites (seven training academy schools and six turnaround schools). The program design allows residents to immediately implement what they are learning in the NLU classroom, creating a direct and on-going link between pedagogy and practice. Residents and mentors spend the entire year together, creating a continuous process whereby the mentor contributes to both the coherence of the program and the ultimate growth of the residents. The training site curriculum is structured to give residents increased practice teaching alongside the mentor. Although teaching residents will assume some instructional responsibility from the start of the school year, the apprenticeship will involve a structured and supported gradual release of responsibility from the mentor teachers to the teaching resident. This gradual release will include regular, brief periods of lead, independent teaching that build to a takeover of at least four weeks.

Each week delivers a specific set of content, graduate degree coursework, and classroom expectations for both residents and mentors in an attempt to bridge theory and practice. Residents undertake seven, four-week-long learning cycles with a targeted pull-out week in between cycles during which residents are given live opportunities to practice newly acquired skills. Cycles include Building a Foundation for Success (Cycles 1&2); Using Data to Drive Instruction, Academic Conversations and Small Group Instruction (Cycles 3-5); Putting It All Together/Hiring (Cycle 6); Spring Academy and Turnaround Induction (Cycle 7). A complete detailed cycle schedule is included in Appendix H.

Clear Criteria for Selecting Mentor Teachers. For their duties as mentors, mentors receive a 20% stipend in addition to their regular salaries. The base qualifications necessary for a potential mentor position are possession of a Master's degree and three years of teaching experience. Principals and MRCs consider possible candidates at training sites, and MRCs

observe those teachers in their buildings in terms of strong practice, positive class date, and attitude. Once the principal and MRC have consensus on strong candidates, the MRCs make classroom observations in each other's buildings using the Danielson Coaching Tool. Applicants who are selected as mentors typically possess additional qualifications including National Board Certification and/or Golden Apple teaching award winner along with definitive experience teaching in high-need schools in urban settings. Additionally, mentors are selected based on proven teaching ability and depth of content knowledge as demonstrated through observations and student achievement data.

The selection process for potential mentors also includes an essay and a review of one of their own lessons, coaching scenario reflection, resident video observation, and interview. Potential CTR mentors also conduct a 15-30 minute resident observation and a post-observation data review. The hiring team also receives data about the potential mentor from the teacher's current school leadership team. Teachers who are chosen to be mentors receive five days of mandatory PD to hone their ability to mentor/teach adults prior to the start of the school-year as well as weekly PD during the school year from the Mentor Resident Coach (MRC).

Mentor Resident Coach. Each of AUSL's training school sites has a Mentor Resident Coach (MRC) who is a full-time, veteran teacher assigned to support that site's 10 to 20 residents and their mentors. MRCs, who do not teach students but who focus entirely on coaching residents and the school's teachers, help provide linkages between university coursework and the classroom experience for residents. They also supplement the Mentor teacher's work with additional professional development in curriculum and instruction. Each MRC is responsible for supervising the mentors, all residency activities, and facilitating and administering all professional development sessions. MRCs pair mentors and residents based on

grade level, content area, personality and expertise. Residents who are deficient in an area are paired with mentors who are strong in that area. MRCs are responsible for monitoring these crucial relationships. They also deliver bi-monthly professional development to mentors and residents.

Mentors, MRCs, and NLU faculty play significant roles in evaluating resident progress. Through the course of the year, residents are assessed a number of ways: a cycle report card based on the content of the expectations matrix, two full Danielson Framework summaries, daily coaching feedback, and monthly debriefs with their site's MRC. In the MAT programs, the traditional role of a university supervisor was replaced by a new model for supervision, the University Faculty Liaison (UFL). In this role, active faculty members in the MAT program carry out observations for all residents within a training academy. The frameworks used to discuss and develop student performance are aligned with AUSL, and the UFL develops strong working relationships with the MRCs for their training academies. This strong, active link between university and classroom frameworks is a major change and improvement from traditional models of university supervision during student teaching. In the M.Ed. program, a portfolio and defense process was instituted as a capstone assignment. M.Ed. residents prepare a portfolio of artifacts that demonstrate their growth over the residency year in areas that include impacting student learning through planning, instruction and assessment. . Residents present their portfolios at the end of the year to a 2-3 person panel made up of AUSL residency leaders and NLU faculty.

***Grouping Residents in Cohorts to Facilitate Professional Collaboration*.** Residents are placed into one of four university learning cohorts. Each cohort of residents attends the same classes at the same time for the duration of the residency year, thus strengthening the learning

community and creating a strong bond of support for colleagues with similar teaching interests. Each resident is also placed in one of thirteen training site-specific cohorts in order to create a school-based learning community. Residents participate in three distinct cohorts throughout the year: 1) an academic cohort based on their pursued degree; 2) a training site-based cohort; and, lastly, 3) a turnaround cohort, during the AUSL hiring phase in the spring.

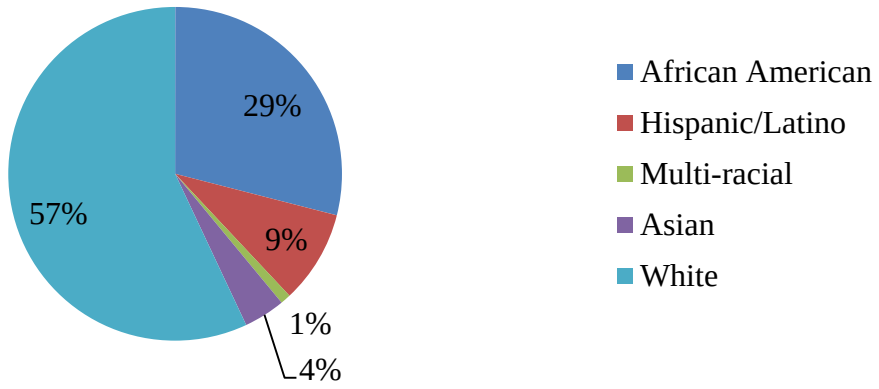
***Recruitment/Admissions Objectives and Priorities*.** The AUSL recruitment and admissions team includes eight full-time professionals who develop and implement strategies to reach prospective Chicago Teacher Residency candidates. They implement communication strategies to create Chicago Teacher Residency advocates in: University Professors, Career Services Professionals, and Student Groups/Associations. Recruitment has three distinct phases: Pre-season Preparation, In-season Recruiting, and Post-season Data Reflection. During the Pew-season (September-November & January-May), recruiters cover approximately 60 different universities and colleges, primarily in the Midwest. Recruiters attend job fairs, student organization meetings, and social service/education panels. Recruiters are in constant contact with potential candidates, school faculty, student organizations, and partner organizations.

Over the last five years, AUSL's recruiting team carried out regular analyses of data on applicants and the application processes. These analyses indicated the primacy of web searches in applicants' first contact with AUSL, and the need for highly efficient online application and contact processes. Based on that data, AUSL carried out a website redesign, implemented new software for applications and applicant contact, and developed online advertising resources. The website communicates general information about the program, video testimonials, information session registration, college visits schedule, blogs by current residents, instructions on how to apply, and personalized updates based on an applicant's status via the MyAUSL online

application process. Hobsons Connect Client Relations Management system is used to deliver a comprehensive, personalized communications plan to engage candidates with over 30 touch points throughout the application process and move them through the pipeline. AUSL uses targeted, online advertising of the Chicago Teacher Residency to reach potential candidates via: Search Engine Marketing (Pay Per Click), Google Display Network Remarketing (targets previous visitors to residency section of AUSL website), Facebook Ads, Facebook Sponsored Stories, and Twitter Promoted Tweets. Additionally, the AUSL website is fully optimized for search engines, as well as mobile devices. These extensive recruiting efforts have consistently built large pools of qualified candidates, as described further under selection processes.

Ensuring a Candidate Pool Representative of the Students to be Served. Because children in CPS high-need schools are over 90% minorities, it is a priority for the CTR to recruit, to the best of our ability, qualified teachers who reflect this diversity. Recruiting outreach is targeted to sources expected to generate a large number of qualified underrepresented applicants, including selected colleges and universities, community organizations, minority-oriented job fairs, and targeted e-mail outreach. Our growing network of schools, teachers, and staff has also resulted in a pipeline of candidates referred to us from the personal networks of AUSL staff, teachers and staff in the AUSL network of 32 schools. Over the past five years, while the annual size of the residency cohort tripled from 56 to 150, the diversity rate of graduating CTR residents has continued to hit our TQP target of 40%.

Table 1: Race/Ethnicity of CTR Residents
2009-2014



Recruiting High-Need Subject Areas. CTR's final selection decisions for residents are strictly based on credentials (e.g., GPA, test scores, transcript review by NLU) and performance in interviews and sample lesson assessments. Although our percentages of underrepresented populations remain consistent, the partnership is committed to ramping up and re-aligning the recruitment efforts of both institutions in order to meet the goal of recruiting more qualified diverse candidates for STEM teaching positions.

Induction Program for Resident Graduates Hired as Teachers of Record. Resident graduates undergo extensive interviewing and observations by CPS principals in order to be hired at a CPS school. The success of the residency process is evident in the hiring rates. Over the last three years, over 90% of graduates have been hired by CPS principals for Chicago's highest need school settings.

For induction, the goal of AUSL's turnaround coaching program is to provide each student with a top-quartile teacher through targeted, individualized, data-driven coaching support that is based in the Danielson framework, improves teacher practice and retention, and improves student achievement. AUSL's turnaround coaches play a critical role in AUSL's teacher development process, called The AUSL Way. AUSL's teacher development theory of action is:

AUSL turns chronically underperforming urban schools into models of excellence through a teacher-centric model that combines a clear and consistent framework for school management with a robust teacher preparation and an integrated Teacher Development Process.

The AUSL Way is designed to continuously improve student achievement, teacher effectiveness, and teacher job satisfaction in order to retain the highest quality teachers. The AUSL Way achieves these objectives through four key elements: 1) teacher feedback and evaluation using the Danielson Framework for Teaching; 2) consistent use of student data to inform teacher practice and assessment; 3) professional development based on AUSL's Signature Strategies; and 4) active coaching for all AUSL teachers. Coordinated management ensures that multiple sources of information are converted into knowledge and action at the teacher, school, and network levels.

The AUSL Way for coaching is built on the New Teacher Center's foundational practices and tools. In recent years, to meet the urgent needs of our students, AUSL's coaches have also looked to other programs doing similar work and adapted relevant pieces we believed would best meet the needs of a turnaround environment.

Turnaround coaches provide individualized coaching and professional development to teachers in AUSL elementary turnaround schools. Twenty-two coaches and two co-managers will serve nearly 300 teachers. All teachers in an elementary school turnaround have a coach, using either a Flexible or Standard model. Standard coaching focuses on 1st/2nd year teachers who will participate in eight week cycles of 60-90 minutes of weekly coaching during the school year. Flexible coaching is designed for veteran teachers who will participate in 8 week cycles of intensive coaching, up to three cycles per year. The 60-90 minutes of direct coaching sessions

consists of a variety of strategies including observations, co-planning, video analysis, real time coaching, and modeling by coaches.

In-service Professional Development (PD) Strategies and Activities. Professional development strategies and activities involve: 1) Signature Strategies, 2) stand-alone monthly workshops including a mandatory 5-week summer session prior to the start of school; and 3) on-going coaching. All in-service PD is coordinated and conducted by AUSL induction coaches.

***Signature Strategies*.** Signature Strategies is a toolbox of skills introduced and practiced during residency and reinforced by the coaching team during induction through embedded and customized professional development. Signature Strategies were created through research from Robert Marzano, Madeleine Hunter, the Network of Uncommon Schools, Charlotte Danielson, and other outstanding practitioners and educational researchers. Each strategy has been analyzed, clearly articulated, video-taped and presented online so teachers have immediate access or can review them together with coaches during a coaching session.

***Mandatory PD Sessions*.** During the academic year, beginning teachers are required to attend monthly PD sessions. Coaches design the workshops based on collective observation and feedback of beginning teachers and their immediate needs. The summer prior to the beginning teachers first year as teacher of record, the coaching team creates and delivers a five-week Summer Institute for each cohort of new teachers entering the newly assigned turnaround school. This summer session is vital to the team building and planning of the schools as leaders and teachers create their new school culture. Essential PD delivered during the summer includes workshops in literacy instruction, mathematics instruction, and establishment of outstanding classroom management with positive relationships, culture and climate.

Selection and Preparation of Coaches. CTR induction coaches are carefully selected based on their experience, education, and expertise in their content and/or grade level and are continually assessed.

Table 2: Alignment of State Requirements to CTR Coaching Requirements

ISBE	***CTR***
1.Must hold or have retired while holding a Standard or Master certificate, to the extent possible, be the same type of certificate held by the beginning teacher	Coaches must undergo rigorous screening and interviewing process in addition to a : • Minimum five years successful teaching experience in urban setting • Masters degree in relevant field • Demonstrated success teaching/mentoring adults • Commitment to success of ***all*** students
2.Must have a ratio of no more than five beginning teachers to each coach (this ratio is for coaches who continue to teach full time)	All coaches are full-release, full-time and assigned no more than 10-12 teachers (including new and veteran teachers)
3.Must complete training addressing: • Content knowledge • Adult learning theory • Verbal and non-verbal communication skills • Attributes and styles of positive critiques • Classroom observation skills related to assessment of performance • Strategies for providing constructive feedback and social support • Problem-solving skills • Formative assessment and self-assessment	Initial training includes: • Training in Formative Assessment System (FAS) to collect teacher data and guide coaching conversations. • Job-shadowing current coaches • Customized PD determined by management Ongoing training includes: • Monthly group sessions to share best practices and recent research (particularly around methods of formative assessment and ongoing improvement of teacher practice assessments); to collaborate with curriculum/assessment specialists, and to discuss standardized assessment tools. • Access to shared on-line coaching network and on-line toolbox.

Placement. Placement of CTR graduates is a key ingredient to the success of the beginning teacher, the turnaround school, and above all, the success of student achievement. CTR places cohorts of graduates in these schools with a specially-selected leadership team to

effect whole-school transformation. The combination of a visionary and supportive leadership team with like-minded, highly-trained teachers who are given support during 2 years of induction creates a school culture of high expectations. CTR has placed a majority of graduates in this manner starting with the class of 2008 and the results are encouraging: student achievement on the state test has increased at the four elementary schools; behavior issues have decreased; and student and teacher attendance have improved.

Table 3: Post-program Placement of AUSL Chicago Teacher Residency Graduates

	Class of 2012		**Class of 2013**		**Class of 2014**	
	Number	% of total	Number	% of total	Number	% of total
Total graduates	70	100%	149	100%	111	100%
Post-graduate placement						
AUSL – new turnaround school	54	77%	77	52%	44	40%
AUSL – other AUSL network school	12	17%	60	40%	56	50%
AUSL – total for AUSL schools	66	94%	137	92%	100	90%
Other CPS school (non-AUSL)	0	0%	4	3%	1	1%
Total employed by CPS	**66**	**94%**	**141**	**95%**	**101**	**91%**

Table 4 below shows the proportion of residency graduates who continue to work in the CPS system. The high rates of retention speak to the success of the entire residency process, from recruitment through placement, in identifying, preparing and placing personnel who are dedicated to high quality education in urban schools.

Table 4: Retention of AUSL Chicago Teacher Residency Graduates with AUSL and CPS

	All graduates (2003-13)	**Latest 5 years (2009-13)**
AUSL network school	51%	71%
Other CPS school	21%	11%
Total employed by CPS	**72%**	**82%**

Goal and Selection Criteria of Individuals as Teacher Residents. The CTR selection process of individuals as teacher residents is research-based and has evolved over the duration of the program. The goal is to admit the most highly qualified applicants based on our six success criteria: 1) commitment to achievement and results; 2) beliefs about at-risk students and children's learning; 3) impact and influence on children; 4) maturity, confidence and self-management; 5) intellect and critical thinking; and 6) collaboration and team work. These criteria are also based on research in the field, particularly Star Teachers: The Ideology and Best Practice of Effective Teachers of Diverse Children and Youth in Poverty by Dr. Martin Haberman.

In-person interviews are conducted by a team of experienced CTR employees—including principals, professors, mentor teachers and mentor-resident coaches—in order to discern each candidate's potential for long-term success teaching in a high-need urban school. Each candidate admitted into the program has had six to ten person-hours of CTR professional time invested in his/her evaluation prior to the program's June/July start-date.

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Living Stipends/Salaries During Residency. Admitted residents sign a contract which provides them with a salary of [redacted] from AUSL, plus health insurance benefits. They also receive a [redacted] training stipend, which they must pay back if they do not complete their 4-year commitment in a CPS high-need school.

Costs and Expenses of Masters Degree. Residents are responsible for all costs and expenses of NLU's program, including fees, and books. Residents are also responsible for securing financial aid, and for ensuring that any conditions for loans or grants do not conflict with the requirements of this Agreement. NLU offers a significant tuition reduction for CTR MAT candidates and is committed to maintaining this for the duration of the grant.

Commitment to Teach in AUSL/CPS Schools. In return for our investment in each resident, he/she makes a clear commitment to teach for 4 years in AUSL turnaround or other high-needs CPS schools. This is a binding contractual commitment, and requires that the resident repay the [redacted] training stipend if they fail to satisfy it. The repayment schedule for failure to meet this commitment is: full amount in first year after graduation, declining to $10,000, $8,000 and $5,000 over the subsequent 3 years.

Other Terms and Conditions Required. CTR recognizes that legitimate life events can interfere with the agreement set forth at the beginning of the residency. The contract in Appendix H outlines all terms and conditions.

Usage of Repayments. Any repayments are directed back into the residency program to pay for future residents. CTR does not currently collect interest on the re-payments, but will ensure a reasonable interest rate is collected if required by this grant.

3. PROPOSED DEVELOPMENT OF STEM TEACHER PREPARATION

CTR proposes significant innovations within its model to improve student achievement in science and to continue to build a program of collaborative, practice based teacher preparation focused on data on student learning. Each goal (see Table 5) for the work is clearly linked to Competitive Preference Priority 1, Promoting Science, Technology, Engineering, and Mathematics (STEM)

Education or to Competitive Preference Priority 2, Implementation of Internationally Benchmarked College and Career Readiness Elementary and Secondary Academic Standards.

Table 5: TQP Priorities Aligned with *SER* Project Goals & Activities

Goals of *Science Excellence Through Residency*
Goal #`1: Integrate pedagogy, classroom practice, and teacher and faculty mentoring in the Chicago Teacher Residency through Active Cycles of Teaching (*ACT*) curriculum and design based research teams for continuous improvement of candidate performance **Goal #2:** Build teacher capacity and increase training site capacity to 100% for effective implementation of Next Generation Science Standards **Goal #3:** Maintain 40% diversity in residency cohorts and increase diversity of candidates for science teaching to 35% **Goal #4:** Build science curriculum that enacts NGSS and connects to community and college and career readiness **Goal #5**: Positively impact science achievement of K-12 students

Activities Constitute a Coherent and Sustained Program of Training in the Field

***Recruitment of diverse candidates with strong science backgrounds*.** The recruitment of highly qualified candidates is the essential starting point for our continued innovation and work, and the full process of recruitment is described above. Here we describe the additional recruitment activities that will focus diverse candidates with strong science backgrounds. The recruitment of teaching candidates with backgrounds in science content and practice has historically been focused on the need for specific content areas of science expertise at the secondary level. However, changing practices in science education and the upcoming implementation of NGSS are bringing the need for deep content expertise to middle school, and to the entire K-8 years. This shift will require new approaches in identifying and recruiting science majors and professionals with the interest and initial capacity to work with younger grade levels. We will carry out recruiting activities with the goal of bringing teachers with deep science content expertise to K-8 schools, as well as filling all need for science teachers at our high schools. New Recruiting activities will include the development of recruiting materials and

advertising campaigns that are targeted towards candidates with strong science backgrounds, recruiting activities on college campuses that are focused on diverse candidates with science backgrounds. Detail on these activities is shown in Table 6:

Table 6: Recruiting Materials, Advertising and Campus Activities

Development of Recruiting Materials • Develop marketing materials that can be customized based on resident's university track and content area interests, emphasizing the importance of science education across all grade levels. • Develop profiles of current and former residents who teach science, showing the diversity of backgrounds and experiences of these individuals. These profiles would be used across all recruiting channels and formats. • Capture photography of science classrooms, curriculum, and teachers across the network for use in a variety of materials. • Recruit science educators to blog and highlight these posts across social media and traditional media outlets.
Targeted Advertising • Target additional advertising and outreach (via Google AdWords, Facebook Ads, Twitter Promoted Tweets, LinkedIn InMail, and direct mail) to individuals with a science background or interest. • Market to science teachers (for instance, through the National Science Teachers Association or the Illinois Science Teachers Association) who may be interested in -- or know of strong candidates for -- the residency program. • Connect with CPS science student teachers through an in person or online webinar, communications, or additional outreach. • Develop a custom, science-focused residency job posting for use on employment sites and engineering/science focused university's job boards.
On Campus Activities • Continue to focus on recruiting efforts at HBCUs and other university campuses, with specific outreach to science professors and science majors/minors. • Additionally, target students with majors that include essential science coursework, like kinesiology, athletic training, computer science, statistics, etc. • Explore recruiting opportunities at institutions with an engineering/technology focus (i.e. Case Western, IIT

Illinois Institute of Technology (IIT) as a project partner: The participation of IIT brings deep expertise in in science content and practice to all project activities. Three IIT faculty members will participate, one each from the departments of Biology, Chemistry and Physics. As

described in the following project activities, the faculty will take part in the project management and design-based research teams, and lead the development of an induction institute.

Development of Adaptive Cycles of Teaching (ACT) for NGSS-based science instruction in the residency: NLU has developed an innovative practice-based curriculum supported by a cloud-based technology system that enables teachers to continuously improve their enactment of high-leverage practices in response to formative assessments of students' learning and feedback from invited observers. Through the TQP grant, the *ACT* curriculum would be further developed and incorporated into the CTR residency and induction processes to build a trajectory of preparation for highly effective science teaching. Following are descriptions of activities that will: a) customize the Science *ACT* curriculum for the NGSS framework; b) further develop analytic and coaching tools in the *ACT* technology platform; c) implement the *ACT* into the CTR through using a design-based research team; d) design and implement post-residency induction support through a summer science content enhancement institute and year-long coaching support for NGSS implementation strategies; and e) design science learning activities that increase connections to community and careers. The activities are as follows:

***a) Customize the Science ACT Curriculum for the NGSS Framework*:** The pilot version of the Science *ACT* involves four learning paths or badges that support teacher candidates through their own investigation into the nature of teaching science through inquiry methods. Specifically, teacher candidates investigate features of science learning environments, complete systematic observations of students engaged in inquiry learning, and investigate a big idea in science that they plan to teach using concept mapping to guide their instructional planning and metacognitive learning. The Science *ACT* also engages teacher candidates in multiple teaching cycles in which they implement and learn from science inquiry lessons in elementary classrooms.

Under the grant, the *ACT* curriculum will be further developed in two ways: 1) the *ACT* curriculum tools will be further developed for science teaching using the NGSS framework and 2) the *ACT* Learning Environment investigation will be expanded to incorporate informal and community based science learning environments. Specific *ACT* tools and their development include: customization of the lesson planning template to incorporate NGSS components of core disciplinary ideas, cross-cutting concepts, and science practices; customization of the teaching performance feedback template to monitor science lessons; and customization of student formative assessments in science lessons.

b) Further Development of Technology Platform: Working with Cognitive Advisors, the partnership will continue to develop the technology platform supporting the *ACT*. Further development will improve the nature of the reports the TREKLEM system generates to provide more fine grained feedback on teacher instruction as it relates to student learning progress. Timely and more detailed feedback from teaching/learning events can support both teacher self-regulated learning and provide a data based structure for coaching conversations. Specific developments will also make explicit the feedback loop that can both show and/or shape a teacher's adaptiveness to student learning needs. This improvement would allow investigations of teacher improvement as a function of student learning over time. The expansion of the reporting tool would enable teachers to receive and use feedback from a variety of sources to adapt and improve their instruction. Focused use of the system to improve core practices can help teachers to develop habits of mind to continually learn through teaching. The expansion of the reporting tool could be also utilized by school leaders to view patterns between the use of specific teaching practices and student learning progress, and to identify professional development needs.

c) Implementation of ACT Through Design-based Research (DBR) Teams*:* A group comprised of NLU science education faculty, AUSL science mentors, mentor resident coaches, and *SER* project leaders will form a design-based research (DBR) team that will monitor, evaluate, and refine and expand the *ACT* implementation within the residency context. Through iterations of testing and revision within the residency context, the DBR team will improve components of the Science *ACT* for this particular context, its surrounding community and culture (Brown, 1992; Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003). The initial *ACT* pilot research and theory of action will provide the basis for studying novice teachers' growth through the *ACT* as implemented within the residency. The initial refinement and customization will focus on the lesson plan template, teacher performance feedback template, and student formative assessment tools. The proposed enhancements of the *ACT* technologies will provide a reporting and analytics tool that will facilitate the DBR process. Specifically, enhanced reporting analytics will make explicit the feedback loop that can both show and/or shape a teacher's level of adaptability to student learning needs. This improvement would allow the NLU/AUSL DBR team to investigate teacher development as a function of student learning over time. A DBR team approach can lead the NLU/AUSL partnership to build a shared local theory of learning through the *ACT* situated within a high-needs urban teacher residency context (Anderson & Shattuck, 2012). In this way, the NLU/AUSL partnership can achieve a shared understanding of how teachers learn to improve their practice in response to student learning and systematically adjust components of the *ACT* design to improve this learning.

The development of the DBR teams will require professional development for *SER* leadership, NLU faculty, and AUSL MRC's and mentors. Three professional development sessions will be scheduled through which key personnel will receive orientation to the *ACT* and

the DBR approach. Professional development time will specifically be directed toward understanding the learning theory embedded in the *ACT* design, the *ACT* components and how to use them, and their relationship to the NGSS. A DBR consultant will orient the DBR team to this research process and provide ongoing consultation as needed to help them to monitor and investigate resident and student learning through the *ACT* implementation. A Google site will be developed to provide supporting resources and tools including teaching feedback templates, formative assessments, evaluation rubrics, and key research articles informing the *ACT* practices and tools. The google site will be structured for faculty to provide ongoing observations and feedback on their use.

Using this implementation approach, the *ACT* will be incorporated into the residency in three phases. In Year 1, we will pilot with the science methods course for the middle school level science residents (six residents); in Year 2 we will implement this in the science methods course with all middle school level science residents (estimated at 10) and one section of the Elementary MAT program (estimated at 27) for an estimated 37 residents. In Year 3-5, the *ACT* will be implemented for the science methods course for all MAT students, for an estimated total of 80 residents.

d. Developing K-12 Science Curriculum Activities in Collaboration with Partners in order to Maximize Project Effectiveness. An integral component of NGSS is learning science in relation to real-world settings and the actual practices of scientists and engineers. To implement this component in high-need school settings, it is essential to find ways to connect science to students' daily experiences as a starting point and to build experiences in which science practices are concrete and relevant. The project will accomplish this through three activities, all beginning in Year 3 of the project. For all three activities, we will seek out appropriate consulting

expertise. While the level of science curriculum expertise in the CTR partnership is extremely high, we believe that the partnership will benefit from incorporating external expertise, especially as NGSS implementation experience grows. The three activities are as follows: 1) Members of the DBR and other of NLU science education faculty and IIT faculty will expand *ACT* Science Learning Environment investigations to include informal, community-based, and career/industry learning environments for their students; that team will then work with the DBR to implement this new component; 2) *ACT* curriculum will be developed to support primary teachers in involving family and community resources in science education. Models of family literacy will be used to inform this work. We believe that the active, hands-on component of science education will support high family engagement; and 3) Utilizing external consulting expertise, we will further integrate connections to active science practice and careers in the K-12 science curriculum used in AUSL network schools, and integrate preparation for teaching these connections in the *ACT*. We expect that the consulting resources will include expertise in directing students to internship and career opportunities in science fields.

Induction Support: Middle and High School science teachers will take part in a one week summer institute to be carried out at the Illinois Institute of Technology (IIT). During these summer institutes, beginning teachers will design plans for implementing NGSS cross cutting concepts in their classroom and will receive a year-long program of professional development support for implementation of those plans. Middle school-level teachers will also take part in school-based professional learning communities that will provide induction support for K-5 teachers in implementing NGSS in early grades. Details on the induction supports are as follows:

Summer Institute for Science Induction: The Illinois Institute of Technology and participating museums will co-partner with NLU and AUSL for the summer institute. The institute will be a one week program, and will be held on the participating museum sites and IIT. Institutes will focus on deepening teachers' knowledge of the cross-cutting concepts of the NGSS. The approach will be experientially based, allowing teachers to work in settings of science practice, including IIT labs and museum research centers. IIT and NLU faculty, and members of museum science education teams will all be involved in the delivery of the summer institute. We expect that the institute will start with deep immersion in the content, and then integrate the design of learning experiences. All middle and secondary level residency science graduates will attend the institute. Mentors, induction coaches, and MRC's will be invited to attend, and stipends will be made available to them to facilitate their attendance.

Develop Classroom Implementation Plans: At the conclusion of the summer institute, teachers, in coordination with project staff, will develop an initial implementation plan that describes how they will address these cross-cutting concepts in their classrooms during the upcoming year. This initial implementation plan will identify opportunities for building these concepts into their existing curriculum and potential activities, and resources to be used in infusing them into their instruction. These implementation plans will form a link between the teacher content understanding of the summer institute and their efforts to implement that new understanding in their classroom practice. The plan will ask participating teachers to: identify student learning outcomes associated with the cross-cutting concepts; define the pathways in which students will achieve those outcomes; identify lessons, materials, and resources that will guide that work; integrate museum visits/resources to support student learning; align the learning processes within a STEM framework; and pose assessment strategies for informing instruction.

Participating teachers will be supported in their implementation plans during the school year using a tailored version of *ACT*. For each teaching cycle, teachers complete and upload their lesson plans, provide a link to their teaching videos, review/self-assess their video using a teaching feedback template, and analyze student formative assessment data to begin planning further instruction. Both virtual and face-to-face exchanges between teachers and project partners will occur during the implementation phase through which teachers will share and discuss their teaching videos and interpret student learning progress based on observation and formative assessment data.

Strengthening Science Induction for k-5 teachers: The intense literacy and numeracy focus in the early grades, and the extensive summer schedule of professional development that new teachers already undergo, make the summer institute less of a fit for K-5 residency graduates. However, they share the *ACT* science training with their middle grade counterparts, and their understanding of that approach. Utilizing the K-8 structure of all CPS schools, as the middle grade teachers are supported in the NGSS implementation plans, the NLU faculty coaching them will invite K-5 teachers to the review and discussion sessions. The summer institute will also develop the capacity of mentors and induction coaches to support science instruction so that school sites are prepared for NGSS implementation. It is an intended outcome of the project that all AUSL training academies have a designated science mentor by the end of the grant period.

***SER* Logic Model.** The *SER* Logic Model (Figure 2) illustrates the connectedness of the three components just described: 1.) Science Instruction and the *ACT;* 2) Current Chicago Teacher Residency (CTR) Model; and 3) Proposed Development of STEM Teacher Preparation).

Figure 2: *SER* Logic Model

Current Inputs

Experience in practice based-teacher preparation in urban settings
Established Urban teacher residency program brought to large scale
Established IHE/School partnership for teacher preparation
Diversity rate of 40% in residency cohorts

Curricular Innovations for Science Education

k-12: NGSS Framework: internationally benchmarked, coherent standards for science

Teacher preparation: Pilot version of innovative, practice-based teacher preparation curriculum designed to support the development of adaptive teacher expertise

Implementation of Science Pathway

Building diverse candidate base for science instruction
Recruitment of diverse candidates with strong science capacity

Curricular Innovations for Optimal Learning Experiences
Integrating curricular innovations: Customizing ACT for NGSS implementation
Implementing ACT to build teacher learning environments with consistent learning structure and systematic variation
Further Development of ACT technology platform: analytics and collaborative coaching tools

Integration of pedagogy, content, classroom practice, and teacher and faculty mentoring

Integrating Partner with deep science content and practice, Illinois Institute for Technology

Design-based research teams of school and university faculty implement and improve ACT

Residents carry out multiple iterations of high leverage science practices and receive collaborative coaching from school and university faculty

Outcomes

Outcomes: Short-term

-100% of Residency Training Academies have capacity to support teachers in implementing NGSS
-Residency partnership regularly uses data on teacher performance and student learning to improve preparation for science instruction
-Residents, mentors and faculty report high levels of coherent, collaborative feedback on residents' implementation of high leverage science practices
-Residents show continuous improvement as measured by ACT
-Resident diversity rate of 35% or higher in science candidates

Outcomes: Long Term

Teacher practices
-Deep knowledge of teaching sciences through cross-cutting concepts and science practice.
-Capacity to adapt instruction to advance student learning
-Capacity for collaborative, continuous improvement of science teaching
-Increased diversity in science teachers in CPS

Student Growth in Science
-Continuous progress through NGSS learning progressions
-Increased science achievement by standardized measures
-Increased readiness for participation in college and career level science

F. SUSTAINABILITY

The sustainable foundation on which this project rests is evident in the growth of the residency program over the past five years. In 2008, the residency cohort size had an average of 56 candidates; the current entering 2014-15 cohort has 150 candidates, a number that is 65% greater than our initial TQP grant goal of 90 residents. The roots of this major expansion in cohort size are found in Year 2 of the grant, when CTR TQP faced two unexpected circumstances: the 27 percent TQP budget reduction and some leadership uncertainty in the Chicago Public Schools due to the mayoral change then taking place. In the face of these circumstances, CTR TQP leaders made the choice to continue to expand the capacity of the residency and so best serve the children in Chicago's highest need schools. Guided by the central goals of the grant, we substantially increased the size of the residency cohort while maintaining high-quality in our candidates and program, and showed high levels of curricular and institutional change at NLU. The result was the grounded, highly effective UTR encountered by the new mayoral administration, and the subsequent request to increase the number of CPS training academies managed by AUSL. The commitment of resources from each program partner above and beyond TQP resources enabled the expansion. In particular, AUSL found the funding to ensure that each candidate received a living wage stipend during the residency period and NLU committed extensive faculty and administrative time and resources to ensuring a successful expansion. This level of commitment above and beyond grant resources will continue to support the residency in successful implementation beyond the life of the grant. Financial and Operating model plans for NLU and AUSL are shown in Attachment H along with NLU's Title II State Report Card which ranks NLU's National College of Education among one of the top

teacher training programs in the State of Illinois and a table aligning current NLU and AUSL external funding which align with *SER* project goals.

G. QUALITY OF THE MANAGEMENT PLAN

The management plan is designed to: 1) achieve the objectives of the proposed development of a science educator trajectory while ensuring the continuity of the rigor, diversity and strong outcomes of the residency program; and 2) continue to build the residency as collaborative partnership focused on continued improvement through data on student learning.

The components of the management plan are advisory oversight by NLU and AUSL executive administrators, a core leadership team with oversight for the project and the residency, mechanisms supporting collaborative work in all facets of the project and residency, and the use of data on teacher and student learning, gathered through the implementation of the *ACT* curriculum, to guide continuous improvement of pre-service and induction preparation.

Quarterly meetings of the Executive Advisors and the core leadership team will focus on reviews of measurable progress towards project benchmarks and objectives, and discussion of teacher and student learning through data gathered in the implementation of the *ACT*.

The core leadership team will have oversight of project implementation and of the management of the residency, ensuring that the practice-based approach to science education is fully integrated into the residency operations. The core leadership will meet on a monthly basis to discuss progress and data to date, review any gaps in effectiveness, and suggest revised activities where appropriate. In ongoing implementation of the work, the AUSL Director of the Residency provides day-to-day direction and management of the residency, the NLU project director provides adherence to grant goals and enacts all reporting requirements for the grant, and the primary NLU faculty member leads the development and implementation of the *ACT*

curriculum. The core leadership team is supported by a project coordinator, who handles all project logistics and reviews all project invoices and billings. To maintain the climate of control that is essential to rigorous fiscal management of the grant, financial personnel at NLU and AUSL will carry out regular budget reviews and reporting. Clearly defined responsibilities within coordinated functions will create a seamless implementation to meet project goals within the established timeline and proposed budget.

The core leadership team overseeing the work of the project and the regular logistics for the residency will consist of the Principal Investigator for the *ACT*, the Grant Director, the Director of the CTR, the Director of University Partnerships, which is a joint AUSL/NLU position, and the lead MRC. This team will meet on a monthly basis through the duration of the grant to examine implementation and ensure progress towards grant goals. AUSL will provide day-to-day direction and management to ensure rigorous implementation of the residency and induction innovations and expansions.

Table 8: Roles, Responsibilities and Time Commitments

Executive Advisors Dr. Alison Hilsabeck, Vice Provost of Vice Provost of Academic Programs, Faculty Development, and Research, NLU Dr. Stuart Carrier, Interim Dean of the National College of Education, NLU Dr. Don Feinstein, Executive Director, AUSL	Leadership oversees/ensures quality of implementation; provides overall leadership and direction. **Time Commitment: 3 % in kind support from NLU for Dr. Hilsabeck and Dr. Carrier; 3% in kind for Dr. Don Feinstein**
Project Management Team Michael Whitmore, Director of Residency, AUSL Dr. Shaunti Knauth, Grant Director, NLU Dr. Scott Sullivan, Director of University Partners, NLU and AUSL Dr. Diane Salmon, Principal Investigator for the *ACT* and Director of Research, National College of Education, NLU	Oversees day-to-day project operation; ensures fiscal integrity/adherence to grant requirements and quality of professional development; manages data collection and dissemination, meets regularly with staff and partners. Shaunti Knauth has the responsibility for grant reporting and monitoring grant implementation. **Time Commitments: 25%for Michael Whitmore; 20% for Shaunti Knauth; 25% for**

Terri Gierke, Lead MRC IIT Faculty Member	**Scott Sullivan; 44% for Diane Salmon.**
Project Coordinator G. Maxx Shawlee, Project Coordinator,	25%
Finance Coordinators Amy Kitzmuller, Financial Manager, AUSL Lucille Morgan, Assoc. Director of Grants, NLU	Manages all organizational finances and fiscal reporting. **Time Commitment: 10%**
NLU Faculty Leaders ▪ Alan Rossman ▪ Eun Ko ▪ Vito DiPinto ▪ Angela Elcordy ▪ Ruth Freedman ▪ IIT Faculty members	Advises curricula revisions, provide content and pedagogy expertise and development and induction support.
AUSL Mentor Resident Coaches	Coordinate with NLU faculty the onsite implementation of project activities.

To integrate the work of all teams and oversight members, a project dashboard will be developed with support from the project evaluator; the dashboard will show project goals, objectives and benchmarks. The table showing these and aligning them with project activities is at the close of the evaluation design section.

H. QUALITY OF THE PROJECT EVALUATION

Overview. The evaluation will be carried out by Durland Consulting. Durland Consulting is an independent consulting firm with an extensive history in evaluation. Maryann Maxwell Durland, Ph.D., is the principal evaluator and has served as the lead evaluator on federal grant evaluations in STEM areas including National Science Foundation ADVANCE and IGERT grants. She has experience with assessment and measurement at the item development level working with technology and accounting, business, and other content area experts at Arthur Anderson; has taught undergraduate and graduate assessment classes; and has analyzed

assessments aligned to specific content in textbook efficiency studies. Dr. Durland is also an expert on social network analysis, which includes an understanding of partnerships, leadership, and creating strong active teams.

The evaluation will use a mixed-methods approach that informs the ongoing implementation of the project while tracking progress towards benchmark and measurable outcomes. Evaluation data will include data generated through the implementation of the *ACT*, and primary data collected by the evaluator. As befits the design-based research team approach of this project, an important function of the evaluator will be to act as a resource of measurement expertise at appropriate points in the work; for example, as described further in Evaluation Activities, the evaluator will support the review, selection and pilot of a standardized measurement of science achievement appropriate to the project. The evaluator will also convene an expert panel on sciences practices and NGSS that will review teacher candidates' performance on using high leverage science practices to implement NGSS, and the results of the integration of community and career connections into the K-12 science curriculum used in AUSL schools.

Table 7: Evaluation Questions. The evaluation is guided by questions that address the project specific goals and outcomes, and by the GPRA measures. Additionally, because the project takes a design based-research approach to implementation of the *ACT* curriculum we anticipate refining and adding questions during subsequent years as the evaluation analytics provide detailed feedback to the project. The eight sets of evaluation questions focused on project specific goals and outcomes are listed below.

Evaluation Questions

1. Has the project increased the number of teachers who are members of underrepresented groups and who have science backgrounds?
2. In what ways does the implementation of the *ACT* integrate pedagogy, university curriculum and classroom practice?
3. What is the impact of *ACT* on residents' enactment of NGSS? On their enactment of high leverage science teaching practices?
4. In what ways does the design-based research team support the implementation of the *ACT*? What supports and challenges the functioning of the team?
5. What is the impact of the induction processes on graduates' level of preparedness to effectively teach science using the NGSS framework? Do the different induction methods have differing impacts?
6. Are program graduates prepared to effectively teach science using the NGSS framework?
7. Do K-12 students taught by program graduates show increased science achievement by standardized measures? Does student performance on the *ACT* formative assessments relate to performance on other measures? Do AUSL-managed schools show a rise in science achievement?
8. Do 6-12th grade students show increased readiness for participation in college and career level science?

To address these questions, provide interim and summative data, and provide measurement expertise, the following major evaluation activities will be carried out:

1. Provide consultation on selecting instruments to measure student and resident learning and performance (Y1-Y3):

Selection of standardized measure(s) of science achievement by K-12 students: The Chicago Public Schools do not currently implement a standardized measure of science learning in all grades. With the adoption of NGSS, new instruments are emerging that are in alignment with NGSS. The evaluator will support the project participants in selecting an instrument by providing a review of current instruments, taking part in the selection process, and providing feedback on piloting of the instrument.

***Selection and Development of measures of program participants' science teaching*:** The *ACT* will provide strong analytics on residents' capacity to enact high leverage science practices in an NGSS framework, and to adapt instruction to advance student learning. The

evaluator will synthesize this data for interim and annual reports and support the selection and development of measures of related capacities for science teaching, particularly of pedagogical content knowledge.

2. Survey Design and Administration:

Annual survey of residents and inductees (Y1-5): The survey, administered electronically, will be of all current residents and first year inductees. The instrument will focus on current pre-service and first year classroom practice, how well the residency is preparing/prepared them for their teaching assignments, their views of their mentors and their NLU coursework and their understanding of and preparedness to teach science using the NGSS framework.

Annual survey of residency mentors (Y1-5): The instrument will ask about the type of support give to mentees, and the mentor's experience with the practice-based approach of the residency. The data will allow for comparison of responses between who are and who are not involved in using the *ACT* as one tool supporting their residents' growth.

3. Interviews:

Interviews with design team members (Y1-5)*:* The instrument will focus on the supports and challenges encountered by the DBR and by individual members in the implementation and improvement of the *ACT*.

Interviews with samples of residents (Y1-Y5)*:* The instrument will also seek to determine the experience of the residents using the *ACT*, and their understanding of high leverage science practices and the enactment of NGSS. In Y1, all of the pilot group (N=6) will be interviewed; in Y2-Y5, a stratified random sample (N=10), with selection across grade levels, will be interviewed.

4. Evaluation of Summer Institute:

Years 2-5: Surveys of participants and measurements of participants' learning will be developed. The surveys will focus on the institute activities. The measures of participant learning will be aligned with the measures of program participants' science teaching that will have been selected and developed as described above.

5. Analysis of student achievement data:

Years 2-5: Analysis of *ACT* data and standardized measures will examine overall levels of learning and achievement, progress towards college readiness, and the relationship between the implementation of *ACT* and student learning.

6. Coordination of Expert Advisory Panel:

In Y3 and Y5, the evaluator will coordinate a panel of NGSS and science education experts to act in an advisory role to the project. The panel will review and give feedback on the residents' and inductees' enactment of NGSS as shown in the *ACT*, project processes, the integration of college and career connections in the K-12 curriculum and evidence of student learning.

7. Reporting on GPRA measures:

The evaluation will coordinate with program partners on maintaining data to address all GPRA measures. Those measures will be computed annually for inclusion in the Annual Performance Report to the DOE, and for inclusion and commentary in the Annual Evaluation Report.

Table 8 specifies the project objectives by goals and related activities, the benchmarks and milestones the evaluation will track, and aligns the related evaluation activities. This table

represents the beginning document that project staff and the evaluator will use to coordinate activities.

Table 8: *SER* Goals Aligned with Activities, Benchmarks and Milestones

Science Excellence Through Residency Project: Goals, Objectives, Activities and Timeline				
Goal #1: Create a high level of integration of pedagogy, classroom practice, and teacher and faculty mentoring in the Chicago Teacher Residency through *Active Cycles of Teaching* (*ACT*) curriculum and design based research teams for continuous improvement of the *ACT* implementation and candidate performance				
Project Objectives	**Related Project Activities**	**Benchmarks/Milestones**	**Evaluation Activities**	**YR**
1. Full implementation of *ACT* for science teaching in residency by 2016-17 (Y3 of TQP grant)	Customization of *ACT* curriculum for preparing teachers for effective NGSS implementation Further Development of technology platform analytics and coaching tools	1. NLU/IIT Faculty team carries out initial customization of *ACT* for NGSS	*ACT* data analysis survey interview	Y1 Y1-Y3
2. Design-based research teams composed of school-based and IHE personnel carry out regular improvement cycles on residents' science teaching and technology use Monthly Partnership Meetings incorporate reviews of data on candidate	Implementation of *ACT* through design based research teams Implementation of signature strategies	1. Cognitive Advisors complete all analytic and coaching tools enhancements 2. Design teams formed and receive PD on *ACT* 3. Design-based teams carry out implementation of *ACT* 4. Expert consultation on design-based research informs processes and results interpretation 5. Iterative curriculum improvements based on findings of design-based research teams	*ACT* data analysis Survey Interviews	Y1-Y3

Science Excellence Through Residency Project: Goals, Objectives, Activities and Timeline				
performance and student learning generated through *ACT*				
Advisory Panel on NGSS Implementation	Advisory Panel on NGSS Implementation		Coordinate	Y3 & 5
Goal #2: Build teacher and school site capacity for effective implementation of Next Generation Science Standards				
Project Objectives	Related Project Activities	Benchmarks/Milestones	Evaluation Activities	**YR**
Build PCK in residency and high leverage practices All residency graduates show NGSS capacity and understanding in instruction NGSS Science Mentors at all Middle and Secondary training academies	Implementation of *ACT* through Design based Research teams New Induction processes to support science teaching: Summer institute, coaching for implementation plans and PLC's for K-5 teachers	Mentors in place Coaches in place Coordinated management	*ACT* data Survey Interviews	Y2-5
Goal #3: Maintain high levels of diversity in residency cohorts and increase diversity of candidates for science teaching				
Project Objectives	Related Project Activities	Benchmarks/Milestones	Evaluation Activities	**YR**
Maintain 40% diversity rate in candidates and graduates and in science mentors	Recruitment activities Management team review	Recruitment activities completed	Data analysis of *ACT* for GRPA and other measures	Y1-5
Goal #4: Build science curriculum that enacts NGSS and connects to community and college				

Science Excellence Through Residency Project: Goals, Objectives, Activities and Timeline				
and career readiness				
Project Objectives	Related Project Activities	Benchmarks/Milestones		**YR**
Curriculum as reviewed by advisory panel gives high marks by Y3 (advisory panel coordinated by project evaluator) In induction Y 1-2 science teachers and K-5 teachers report family and community connections	Development of curriculum	Curriculum Reviewed by Panel	Coordinate panel Survey data, *ACT* data	Y3 Y1-2
Goal #5: Positively impact science achievement of K-12 students				
Project Objectives	Related Project Activities	Benchmarks/Milestones	Evaluation Activities	**YR**
Rise in achievement as shown by standardized scores.	1. Annotated list of standardized student achievement in science instruments by evaluator; measure selected for pilot	Selection of standardized instruments and measures Implementation of instruments	Student assessment consult on selection of assessment Student assessment analysis	Y1-5