Annual Report to NSF

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Interdisciplinary Science and Engineering Partnership (ISEP) with Buffalo Public Schools

Year 1: 2011 – 2012

Section 1: Activities and Findings

Interdisciplinary Science and Engineering Partnership (ISEP) with Buffalo Public Schools

Year 1: 2011 – 2012

1. Introduction and Summary of Management Planning

This Activities and Findings report from the first year of ISEP program focuses on five major activities central to the mission of ISEP as described in the Strategic Plan:

i. ***School based Wrap Around Support***: the introduction of STEM Ph.D. graduate assistants and undergraduate service learning students to support science, technology and special education teachers in twelve schools in the Buffalo City School District (aka Buffalo Public Schools, BPS),
ii. ***Teacher Professional Development***: the development of school based focus areas for STEM education in each school and recruitment and placement of teachers from all twelve schools in summer interdisciplinary research,
iii. ***Professional Learning Communities (PLC)***: the development of networks that focus on middle and high school teachers working on content development and alignment across the STEM fields, with special focus on linking feeder middle schools to high schools, inclusion of parents into the PLC, defining the roles and participation of ISEP faculty and graduate students for support,
and
iv. ***Research on Teachers and STEM Graduate and Undergraduate Students***: Development, validation and implementation of tools for data collection, collection of baseline data and research into key questions outlined in the 5 year strategic plan

The reports of activities will focus on the MSP five key features, Partnership Driven, Teacher Quality, Quantity and Diversity, Challenging Courses and Curricula, Evidence-Based Design and Outcomes and Institutional Change and Sustainability.

Separate files are submitted for the Sections 2 through 5, the Management Report, Financial Report, Evaluator's Report and Partnership Response, and Implementation Plan for 2012-2013.

2. Development of School Based Wrap-Around Support

a. Graduate and Service-Learning Undergraduate Students: Recruitment, Placement and Training

After official notification of the grant award, we set out to recruit full time graduate fellows that would work directly with the principal and coordinating teachers. The PI met with department chairs in natural science, engineering and the School of Medicine and Biomedical Sciences basic science departments. Recognizing that our envisioned recruitment and training programs would have to be individualized in the first year of ISEP, we interviewed graduate assistants that were nominated by Department Chairs and referred to us by the UB Ecosystem Restoration through Interdisciplinary Exchange (*ERIE*) IGERT program director, Professor Alan Rabideau. The ERIE IGERT program stresses service to K-12 outreach as a requirement for IGERT Fellows, and is tightly aligned with STEM themes identified in many ISEP schools. Despite the fact that graduate assistants were already two weeks into the semester, students, faculty and Department Chairs worked to identify STEM graduate assistants with K-12 outreach interest or experience, and we were able to bring graduate assistants into seven schools initially. These were the two ISEP pilot schools, School 19 the Native American Magnet School and the Math Science and Technology Preparatory School at Seneca, which had been continuously participating since 2005 in ISEP through pilot funding, three new middle schools, the Science Magnet School 59 at the Museum of Science, School 72 Lorraine Academy and School 93 Southside Academy, and two new high schools, East High (which had participated in early stages of the pilot program) and Bennett High. Students were identified from Environmental Science and Engineering (Shannon Seneca and Michael Gallisdorfer), Geology (Jonathan Malzone), Geography (Alex Ticoalu) and Chemistry (Susan Mackintosh) through connections from ERIE IGERT, Chemistry (Sarina Dorazio, Michelle Marchany), Biology (Amy Zelinski) and Physics (Nicolas DeMeglio, Thomas Scrace and James Parry). During the Fall semester, additional graduate assistants were identified by nomination from the Department of Pharmacology and Toxicology in the School of Medicine and Biomedical Sciences (Ekue Bright Adamah-Brassi and Shannon Clough), Biology (Katie Hofer) and Computer Science and Engineering (Lavone Rodolph).

Each school was supported by one full time graduate assistant, committed to 16-20 hours/week in the school working with teachers, classes and the principal, and meeting at Common Planning time to facilitate all teachers participating in wrap around support, including science, technology, mathematics and special education. Additional part time graduate assistants and undergraduate students were appointed so that each middle school had one full time Ph.D. student and at least one undergraduate student and each high school at least one full time Ph.D. student, one part time Ph.D. student and one part time undergraduate. Part time students were supported for six hours/week in the school. Part time undergraduates were identified from previous service-learning course experiences in ISEP.

Service-learning undergraduates have been recruited through a course developed by the PI, and plans are to expand this through the partnership with the Western New York Service Learning Coalition (WNY SLC), a supporting partner on the grant. For this year, the PI's undergraduate service learning course, through the Honors College at UB, was expanded via a grant from the American Academy of Colleges and Universities (AACU) Bringing Theory to Practice program and a focus on providing a sophomore seminar for UB Academies program. Collaboration with the Academies in service learning brings students from this residential college program registered in specific theme areas, presently, Civic Engagement, Global Perspectives, and Research Exploration. Additional themes are being introduced next year, including Sustainability. This doubled the participation in service-learning at the undergraduate level from 20 students/year to 40. In addition, several experienced undergraduates from Buffalo State College were identified through our core partner leadership.

This allowed staffing of every school with in-class and after school staff of students, and in three schools, School 19, MST and Burgard, was complemented by staff from our initial corporate partner, Praxair. New Corporate Supporting Partners, VWR Science Kit came on board in the fall, and provided professional staff at School 93, Southside Academy, and we are currently finalizing agreements with new supporting partners, Life Technologies and Computers for Children to coordinate their staff's participation at East High, Riverside High and South Park High. (see management report below)

Selected graduate assistants who were new to the program and undergraduate students participated in extensive training through the service-learning course, including in mentoring, K-12 education, introduction to the Buffalo Public Schools and other topics. Five graduate and undergraduate students from Buffalo State with backgrounds in STEM education assisted at Riverside HS, Hutch Tech HS and Lorraine Academy, particularly contributing to Conceptual Physics course development at Riverside and the Academic Fun Night at Lorraine.

b. In-class and After School programs

With the placement of graduate and undergraduate students, new opportunities were developed in-class and additional after-school programs were developed. At least three to four teachers in each school had access to in class help. We are still assessing the impact of the students on the classes. After school science programs at School 93, Southside Academy were instituted immediately in September, and our regular programs at School 19 (Thursday afternoons, 2:30-4:30) and MST (Praxair support of Science Olympiad teams) were up and running from September through April. Bennett High began a pilot afterschool program in biological science which has run from May to early June.

c. Informal Science Activities

A number of schools organized science nights for parents; School 19 held the annual Science Fun night March 21st. This event drew approximately 300 participants at a school with an enrollment from K-8 of 450 students. Research surveys of participants at the event are reported by Professor Liu and his student, Brooke Grant (below). School 93 Southside Academy held a Science Family Night on March 14th, and School 72, Lorraine Academy held their Science Night on May 17 with considerable Buffalo State faculty involvement, drawing over half of the Lorraine student families.

On June 5th, the Museum of Science held an open STEM career event for all ISEP High school students and their parents. Following the information sessions, students and parents can use the observatory to view the transit of Venus.

The ability for schools to schedule field trips was a major change made possible by the ISEP award. Field trip costs have been unavailable in Buffalo Public Schools since 9/11 cutbacks. Immediately upon announcing the award, several schools began planning field trips, sometimes walking with students to the Museum of Science events. The program leadership negotiated effective discounts to maximize participation of students at middle and high schools. Particularly attractive for schools was a Leonardo da Vinci exhibition in September and the CSI exhibition in the winter. Further, field trips to UB laboratories and to additional community educational facilities (Tifft Nature Farm and the Buffalo Zoo) were accessed. A total of 5 high school field trips and 13 middle school field trips were funded by ISEP this past year.

d. Summary impact

The recruitment, placement and retention of graduate assistants, undergraduates and corporate partner staffing for wrap around service support allowed the development of new opportunities and programs in-class and after school. Additional Informal Science activities in the evenings and in collaboration at the Buffalo Museum of Science also were made possible. These outcomes of the Wrap Around Services are ***partnership driven*** as UB, Buffalo State, the Museum of Science collaborated in planning with the BPS, as core partners, and supporting partners Praxair and WNY SLC have been engaged in recruitment of participants. Buffalo State faculty have been engaged in training programs for the mentoring and in-school orientation. The work of these students allows for teacher implementation of ***challenging courses and curricula*** providing a means to overcome the limitations of large class sizes and limited funding to implement laboratory, field, inquiry based experimental work and new class content that aligns across middle and high school. Using ***evidence based design and outcomes*** is the basis for the wrap around support, but extensive research work focused on these students is the work of one of the science education graduate assistants, Brooke Grant, directed by Professor Xiufeng Liu (Co-PI, head of the research team). Her current work is discussed below. Finally, embedding and aligning the ISEP program within other on-campus curricula at UB and Buffalo State, where strong experience and results in service learning contributes to both ***institutional change and sustainability.*** Thus, four of the five key features are central to this area of the ISEP program.

3. Teacher Professional Development

a. School Based STEM Themes, Planning and Teacher Recruitment

Members of the leadership team (PI Gardella, Co-PI MacIsaac, BPS Science Supervisor Kelly Baudo, Project Manager Karen King, Project Liaison Brian Kawaler, Museum of Science Educator Karen Wallace, leadership from other supporting partners where appropriate) led by the PI met with each school's principal and science teachers and followed up with teacher meetings in common planning times for science, technology and special education at every school during the year. Besides presenting on the ISEP program, and educating participants about the goals and programs of ISEP, each school began coordinated planning to design and build or reinforce school based STEM themes/programs. These are listed in Table 1. This is an ongoing aspect of implementing ISEP management at all levels.

For example, the high schools have been exceptionally active at planning utilization of ISEP programs. At South Park High, Principal Teresa Schuta and Science Supervisor Kelly Baudo have convened regular monthly meetings to build a program in environmental studies, with STEM components, but service-learning, social science, art and English language arts teachers contributing to developing an in-school academy. MST planning under Principal Rose Schneider and Ms. Baudo is also regularly scheduled to plan the move into the newly completed MST reconstructed building, which opened on Tuesday May 29th, for Fall 2012. Development of major programs for all students in this College Board school, designing new programs to take advantage of new infrastructure (on campus environmental field laboratory, new tablet based textbook and science experiments using the laboratories, etc.) are part of the regular planning at MST. Principal Casey Young at East High developed a partner collaborative breakfast meeting to link various partners in collaborations. ISEP and the NY State Education Department Liberty Scholars program are collaborating at East High. Teachers in common planning time at Bennett High began programs to collaborate on the implementation of the high school biology expansion of the popular middle school hands on science programs utilized in many of ISEP middle schools, from UC Berkeley's Science Education for Public Understanding Program (SEPUP) program. At Bennett, a group of Buffalo Retired Science teachers volunteer in collaboration with recruitment by Coordinating Teacher Tanya Johnson. At Riverside, implementation of two new core courses for the Medical Career Academy, a Conceptual Physics class and Anatomy and Physiology were planned to request specific summer research experiences aligned with the new course development. At Hutch Tech high school, teachers utilized common planning time and organization with ISEP leadership to begin planning on modernization of the school's historic engineering major program, and update physics and technology teaching, while increasing content in the biochemistry major. Burgard High teachers were also active in planning with implementing a more engineering approach to linking physics to the successful Auto Technology program and developing a biomedical program with some engineering content. Planning at the middle school level has developed thinking about alignment with ISEP high school themes.

This planning process has been important to identify school-based programs, but also to prepare teachers for their applications and proposals for the summer 2012 PD program. Riverside faculty common planning session comments also contributed to the Buffalo State summer course development. These outcomes of the development of School based themes are ***partnership driven*** as UB, Buffalo State, the Museum of Science collaborated in planning with the BPS, as core partners, and supporting partners Roswell Park Cancer Institute and Hauptman Woodward Research Institute have been engaged in aligning potential outreach programs to follow up on research to the high schools. One goal of ISEP in-school planning is to improve retention of teachers at the high needs schools in Buffalo, responsive to the key theme of ***Teacher Quality, Quantity and Diversity.*** Engaging teachers in real common planning times to align courses and strategizing in developing the school's program may build loyalty and collaboration in the school. Examination of this hypothesis must be evaluated in ISEP. The work of this planning allows for teacher implementation of ***challenging courses and curricula*** to implement laboratory, field, inquiry based experimental work and new class content that aligns across middle and high school. Using ***evidence based design and outcomes*** is the basis for school based planning, but extensive research work focused on this planning is the work of one of the science education graduate assistants, Yong Hee Lee, directed by Professor Xiufeng Liu (Co-PI, head of the research team). His current work following ISEP teachers is discussed below. Finally, embedding and aligning the in school themes within other on-campus curricula at UB and Buffalo State, contributes to both ***institutional change and sustainability.*** Thus, all five key features are central to this area of the ISEP program.

b. Teacher Placement for ISEP Summer PD 2012

ISEP summer PD appointments are currently nearing completion for Summer 2012. Following multiple recruiting visits to each school 61 applicants from all 12 schools submitted proposals for the 65 available funded opportunities. The process of evaluation for the first year deviated from the initial plan envisioned in the 5 Year Strategic Plan. The original process was to involve interdisciplinary topic based subcommittees of the Executive Committee to review and classify teachers in various programs. Since the recruitment of faculty participants was ongoing, the first year applicants were advised to develop a short proposal linking UB2020 Strategic Research Strengths (http://ub2020.buffalo.edu/strengths/) to potential course and school based implementation plans. Members of the leadership group (PI Gardella, Co-PI MacIsaac, BPS Science Supervisor Kelly Baudo, Project Manager Karen King, Project Liaison Brian Kawaler, Co-PI Alexander Cartwright (Vice President for Research and ISEP engineering liaison) and CEC Director Dr. Mara Huber) met twice to screen and organize the proposals. Sixteen teachers were selected for the two week Buffalo State College summer course, PHY594/TED594: Physics and Engineering for Teachers. Three of these teachers were also selected to do additional two week projects. One applicant declined the course, as she is expecting a child. Forty three additional teachers were offered specific research experiences in various laboratories. The planning for the 46 research opportunities is ongoing presently. The twelve Coordinating Teachers were supported for longer programs, from 6-8 weeks of their 10 week year round commitment. One coordinating teacher will assist instructing the Buffalo State summer course. Table 1 shows the subject areas that have resulted and the classroom subject areas that are represented by teachers, along with the number of teachers.

Table 1: Teacher Research Placement Summary

Group Name, Subject Area	Course areas represented	Number of Teachers	UB2020 Strategic Areas and Faculty Departments
Environmental Science, Social Science and Engineering	Chemistry, Earth Science, Living Environment (Bio), Middle Schools	16	ERIE IGERT, Chemistry, Geology, Geography
Genetics	Living Environment	6	Biological Sciences, Pharmacology and Toxicology
Anatomy and Physiology	Living Environment, Medical Careers, Middle Schools	5	Physiology and Anatomy and Pathology (Basic Medical Sciences)
Cancer Research	Living Environment, Middle Schools	4	Roswell Park Cancer Institute, Hauptman Woodward Institute
Materials Chemistry	Living Environment, Chemistry	3	Chemistry, Physics
Extreme Events	Earth Science	4	Civil, Structural and Environmental Engineering, Geography, Mechanical and Aerospace Engineering
Computer Science/Engineering	Engineering, Technology	1	Computer Science and Engineering
Bioengineering	Living Environment	2	Bioengineering
Physics	Physics, Technology, Engineering	5	Physics, Praxair

Each teacher was asked to develop and co-sign a Memorandum of Understanding documenting the assignment and detailing the specific responsibilities for the teacher and placement host (faculty members). For the research assignments, teachers were asked to meet with their placement host, and draft a one page attachment to the MOU that detailed the research project, teacher schedule, supplies needed and implementation plan for the teacher's classroom projects. The development of the teacher placement has created the opportunity to develop middle/high school collaborations and teacher collaborations in nine different areas. This planning process has been important to identify placements but also to identify those faculty committed to the ISEP program. More than enough faculty volunteered to host teachers from our meetings at the Department level. The Buffalo State course program enrolled more than the twelve teachers envisioned in the strategic plan. This first year experience sets a basis to identify partner faculty, develop procedures for recruitment of teachers and for applications and MOUs. We expect the placement process to be that described in the strategic plan for the subsequent years of ISEP.

These outcomes of the development teacher recruitment and placement are ***partnership driven*** as UB, Buffalo State and the BPS leadership collaborated in planning, as core partners, and supporting partners Praxair, Roswell Park Cancer Institute and Hauptman Woodward Research Institute have been engaged in aligning proposed ideas to placements in their laboratories. Again, one goal of ISEP teachers professional development is responsive to the key theme of ***Teacher Quality, Quantity and Diversity.*** These major professional development opportunities, as aligned with school based themes may build loyalty and collaboration in the school. Examination of this hypothesis must be evaluated in ISEP. The work of the PD must allow for teacher implementation of ***challenging courses and curricula*** to implement laboratory, field, inquiry based experimental work and new class content that aligns across middle and high school. Using ***evidence based design and outcomes*** is the basis for professional development, but extensive research work focused on this planning is the work of the research team, directed by Professor Xiufeng Liu (coPI). His current work following ISEP teachers is discussed below. Finally, embedding and aligning the research opportunities within other on-campus curricula at UB and Buffalo State, contributes to both ***institutional change and sustainability.*** Thus, all five key features are central to this area of the ISEP program.

4. Professional Learning Communities (PLC's)

a. Initial Conceptions: Partnership Driven

The developmental goals of the ISEP Professional Learning Communities (PLCs) include a partnership driven structure designed to foster collaboration between all of the various ISEP partners. Building from the more traditional conceptions of PLCs ((DuFour & Eaker, 1998, DuFour, Eaker and DuFour, 2005, Fullan 2001), ISEP proposed expansion of the PLC to include additional participants. The primary role of PLC's will be to cultivate mentoring partnerships between middle and high school teachers, but to add in the PLC, parents and students; UB and BSC STEM and Education faculty; UB and BSC undergraduate and graduate students and volunteer STEM professionals. Thus, a clear understanding of parent involvement and parent participation was considered in PLCs, (along with other areas), following the Epstein models for parent participation (Epstein, 1986, 1987, 2001, 2006).

The MSP will achieve broader impacts through this expanded PLC approach – reaching beyond master teachers mentoring other teachers to include graduate and undergraduate students who mentor middle and high school students; teachers who mentor graduate students in pedagogical methods; graduate students who mentor teachers in science content; and university faculty and volunteer STEM professionals who mentor BPS teacher and students. STEM professionals from Praxair Corporation, Roswell Park and Hauptman Woodward will also participate in the PLC's. Teachers involved in the summer research will identify other science and mathematics teachers within their school building to participate.

A significant broader impact is a concerted effort to increase parent participation in the direction of the program, to foster an understanding and interest in the children's science education. The targeted schools enroll a majority of minority and low-income students, providing a means to broaden the participation of under-represented students in STEM fields. This structure and implementation will foster not only teacher quality, quantity and diversity; it will also create an inclusive learning community for parents and other community partners. Mentoring at all levels will focus on increasing interest in STEM fields. Results will be disseminated throughout the district via well-organized science teachers network; regionally and statewide using NYLearns.org; through a project website; and through presentations at regional and national meetings. The PLC structure and implementation as well as the learning outcomes achieved will foster institutional change and sustainability.

b. Evidence- Based Design and Outcomes

In two previous ISEP pilot projects (detailed in the grant proposal), professional learning communities (PLC's) were established at School #19 and Seneca MST (including BPS students and teachers, community volunteers, UB graduate and undergraduate students and UB faculty). The PLC's also included STEM employees from Praxair, participating in labs on blood typing and other subjects and helping students to prepare for a Science Olympiad. The PLC's at School #19 involved UB Honors undergraduates and graduate students who mentored BPS students. Teacher Heather Maciejewski played a leadership role and was mentored by UB faculty at the Center of Excellence in Bioinformatics, utilizing her new knowledge to enrich environmental sciences/engineering curricula. In addition, fifth and sixth grade teachers, Mary Ellement and Kathleen Cercone (who were not science specialists) are now fully participating in the ISEP.

c. Partnership Driven, Challenging Course and Curricula, Intuitional Change and Sustainability

During the summer professional development program, UB graduate fellows will be paired with BPS teachers with closely aligned research interests to develop inquiry teaching and learning activities for the following school year. University STEM faculty will be linked with graduate students and BPS physical science and technology teachers, utilizing interdisciplinary research to enhance middle and high science curricula.

The ISEP pilot program had engaged parents via school-based efforts at School #19 and Seneca MST. Using the Epstein model of six levels of parent involvement (Epstein, 1986, 1987, 2001, 2006) as a framework, leadership met regularly with parent groups at each school, crafting events to involve parents at all levels. At Seneca MST, a vigorous Parent Teacher Organization met with the PI once per semester. Parent events were designed collaboratively to maximize parent involvement. At School #19, where historically parent involvement had been difficult, ISEP has sponsored an annual, well-attended parent night. It should be noted that there are significant differences in parent involvement between participating schools, as well as schools throughout the Buffalo district. Parents will actively participate in the pilot PLC during the summer 2012, as well as the school based PLC's throughout the school year.

d. Revised Approach

The ISEP project manager, Karen L. King, was hired on November 1, 2011. One of her primary objectives is to design and implement the PLC's, including conducting a series of focus groups with the parents of students who were currently attending on of the 12 schools included in the grant. Initially my intension was to jump in and immediately schedule parent focus groups to determine what parents expectations were with regard to PLC's. After numerous meetings with our ISEP partner, the District Parent Coordinating Council (DPCC) and attending numerous DPCC sponsored meetings within the district, Ms. King determined that it was necessary to establish a solid and consistent relationship with the DPCC leadership in order to earn their trust and respect. The relationship needed to be developed over a period of time. However, it has been immensely helpful that PI, Dr. Gardella has a well-established and mutually respectful relationship with DPCC membership and leadership. His relationship with the DPCC and the District helped to pave the way for Ms. King's entrée into the parent network.

What became clear from conversations with the DPCC leadership and district parents was that what they really wanted was a way to connect with what their children were learning in the classroom. Based on these insights, developing a pedagogical content knowledge (PCK) research based pilot PLC with parents, BPS teachers, UB and graduate students, STEM faculty and STEM professionals would help address some of parent's needs and expectations.

Additionally, setting up face to face meetings with the group would be the best way to advance this project. Many parents in the district do not have direct access to computers and internet access. While a variety of communication platforms will be explored and piloted including various versions of social networks and blogs; initially PLC's will utilize a face to face, group meeting mode of communication.

e. Moving Forward

The pilot PLC will include a diverse cluster of BPS elementary, middle and high school teachers across various science based disciplines. The Environmental Science, Social Science and Engineering (Env Sci/Eng) Group (Table 2) will be working with a diverse group of STEM faculty, doctoral students and corporate partners. Parents from some of the schools represented within this academic cluster will also participate in the pilot PLC. This Pilot PLC will center on content knowledge. The participating BPS teachers, STEM faculty and doctoral students will discuss their respective research focus with parents as well as collaborate with parents on effective ways both parents and teachers can support and engage their students/children with content based lessons during the 2012-2013 school year.

Table 2: Environmental Science, Social Science and Engineering (Env Sci/Eng) Group

Teacher Name	School	Subject	Faculty Collaborator(s)	Graduate Assistants
Perka Kresic	MST	Chemistry	Valerie Frerichs, Luis Colon	
Karen Beck	Hutch	Chemistry	Valerie Frerichs	
Michelle Zimmerman	MST	Living Env.	Lara Hutson	
Amy Brackenridge	Museum 59	Living Env.	Joe Gardella	Shannon Seneca
Sue Wade	Southside 93	Living Env.	Joe Gardella	Angelina Montes
Mary Ellement	NAMS 19	5th grade	Joe Gardella	Angelina Montes
Charles Harding	MST	Earth Sci		Jonathan Malzone
Christen LaBruna	MST	Earth Sci		Jonathan Malzone
Adam Hovey	South Park	Earth/Env.		Michael Gallisdorfer
Dave Morrealle	South Park	Social St/Env	Ling Bian	Alex Ticoalu
Carl Bish	Bennett	Aquaponics	Joe Gardella	Angelina Montes
Karl Wagner	Riverside		Diana Aga	Susie Mackintosh
Deanna Rizzo	Hutch	Living Env.	Diana Aga	Susie Mackintosh
Carlo Casolini	Southside 93		Joe Gardella	Michelle Marchany
Donna Heavey	Southside 93	6th grade	Joe Gardella	Angelina Montes

We will conduct several focus groups with parents including those that participated in the pilot PLC in addition to parents that did not participate but have students in the schools represented within the environmental cluster in early September 2012. Additionally we will conduct focus groups with parents with students in all 12 schools across all research clusters throughout the early fall. The grant's external evaluator , Miami of Ohio Evaluation and Assessment Center will also be designing and administering an instrument for parents to access what their expectations are with regarded to participating in school based PLC's in early September 2012.

PLC Start Up Schedule:

- Communication/Technology Platform discussion/decision meetings: Summer 2012
- Pilot PLC: Env Sci/Eng- Group*, STEM Faculty*, Doctoral Students*, Parents-Summer 2012
- Focus Groups (Parent Groups): September 2012
- Roll Out of Expanded PLC's: Fall 2012

Table 3: Overview of Pilot Professional Learning Community

Timetable	Participants	Responsibilities	Issues/Concerns
July, 2012 through 2012-2013 school year	• Participating BPS teachers in Summer Research • UB doctoral students • UB STEM faculty • BPS Parents • ISEP Corporate Partners	Meet weekly to exchange ideas regarding best practices, pedagogical appraoches	Access to technology for parents

5. Research Report

a. Research on Teachers

On Jan. 1, 2012, Yong-Hee Lee, a doctoral student in Second Language Education with an undergraduate education background in materials engineering, was hired to assist in research on teachers. Given the large number of teachers involved in the project and the great potential for contributing new knowledge and educating future science education researchers, the project leadership decided to create a post-doc research associate position to enhance the research on teachers. The position was advertised nationally through HR networks and an announcement distributed to the NARST (a world-wide organization for promoting science teaching and learning through research) listserv. Seven applications were received. Vanashri Nargund-Joshi, who is completing her PhD in Science Education from Indiana University (degree expected in June 2012), has been offered the position for two years and will start on July1, 2012.

The overall goal of research on teachers is to understand the processes and conditions in which science teachers develop interdisciplinary science inquiry knowledge, and how this knowledge may be translated into interdisciplinary science inquiry pedagogical content knowledge (PCK) that ultimately improves student science learning. Following the *Strategic Plan*, specifically the first-year implementation plan, we have focused on identifying participating teachers' conceptions of interdisciplinary science inquiry and interdisciplinary science teaching PCK. Based on the principle of *Evidence-based Design and Outcomes*, we have interviewed eight lead-teachers from eight of twelve schools; interviews with the remaining four lead-teachers have been scheduled. We have also observed 1-2 lessons taught by the seven of the eight teachers. As part of teachers' applications for summer research, we also included a question asking teachers to describe their conceptions of interdisciplinary science inquiry. Analysis of the above collected data is ongoing. Based on the data analyzed so far, we have obtained the following preliminary findings:

(1) Participating science teachers have diverse conceptions of interdisciplinary science inquiry.

Teachers' conceptions of interdisciplinary science inquiry can be categorized into the following four types:

- **Partnership**: It is educational partnership between the school and university, local businesses and industries.

- **Interdisciplinary learning**: It is integrating the variety of different disciplines such as reading, math, and computers into science in order to better teach students.

- **Inquiry**: Students learn scientific skills, ask questions and make connection to their everyday life through active participation in their learning process.

- **Interdisciplinary science inquiry**: It is linking math, literacy, technology and engineering to enable students to apply their knowledge effectively in thinking, reasoning and solving problems.

(2) Participating science teachers have a very limited knowledge of interdisciplinary science inquiry teaching.

The term PCK is new to almost all the teachers. Despite this, they know intuitively that PCK is the integration of subject matter, instructional methods, and learner characteristics, and so on. The following aspects were identified related to science teachers' interdisciplinary science inquiry teaching PCK.

- ***Characteristics***

  - "A teacher has to be highly motivated and motivating to others with regard to content knowledge of science, reflecting on teaching practices, and working with other science teachers"
  - "Increasing teachers' content knowledge, introducing different science disciplines to students, managing classrooms, and knowing students
  - "The inherent nature of science bridges all STEM subject areas. In addition, it enhances the science focus of a school and motivates the student body to develop and maintain a shared love of inquiry based on education in STEM"

- ***Beliefs***
  - to develop students' critical and scientific thinking: "It is hands-on learning because its get students to think and use scientifically."
  - to connect science concepts that students learn to their real life: "My idea is for students to understand science and why it's important from them because everything is science in their lives"
  - to make student enjoy learning science: " Students should enjoy learning science in a positive classroom through making mistakes with a teacher's high expectations"

- ***Understanding of the science curriculum emphases***
  - Most teachers do not consider the science curriculum emphasis at the grade level of their current teaching
  - Most teachers consider the basic science concepts and skills as general curriculum emphasis.
  - A teacher stated that curriculum emphasis is not clearly given from the state of curriculum, but in fact, there is a strong emphasis on interdisciplinary science inquiry.

- ***Assessment***
  - Most teachers use a variety of assessment techniques: tests, quizzes, formal and informal questions, and homework.
  - Few teachers used performance-based assessments or student portfolios that potentially better demonstrating student interdisciplinary science learning and changes overtime
  - Teachers will need to know how they assess students' interdisciplinary science inquiry learning. They currently have little idea about how they assess it.

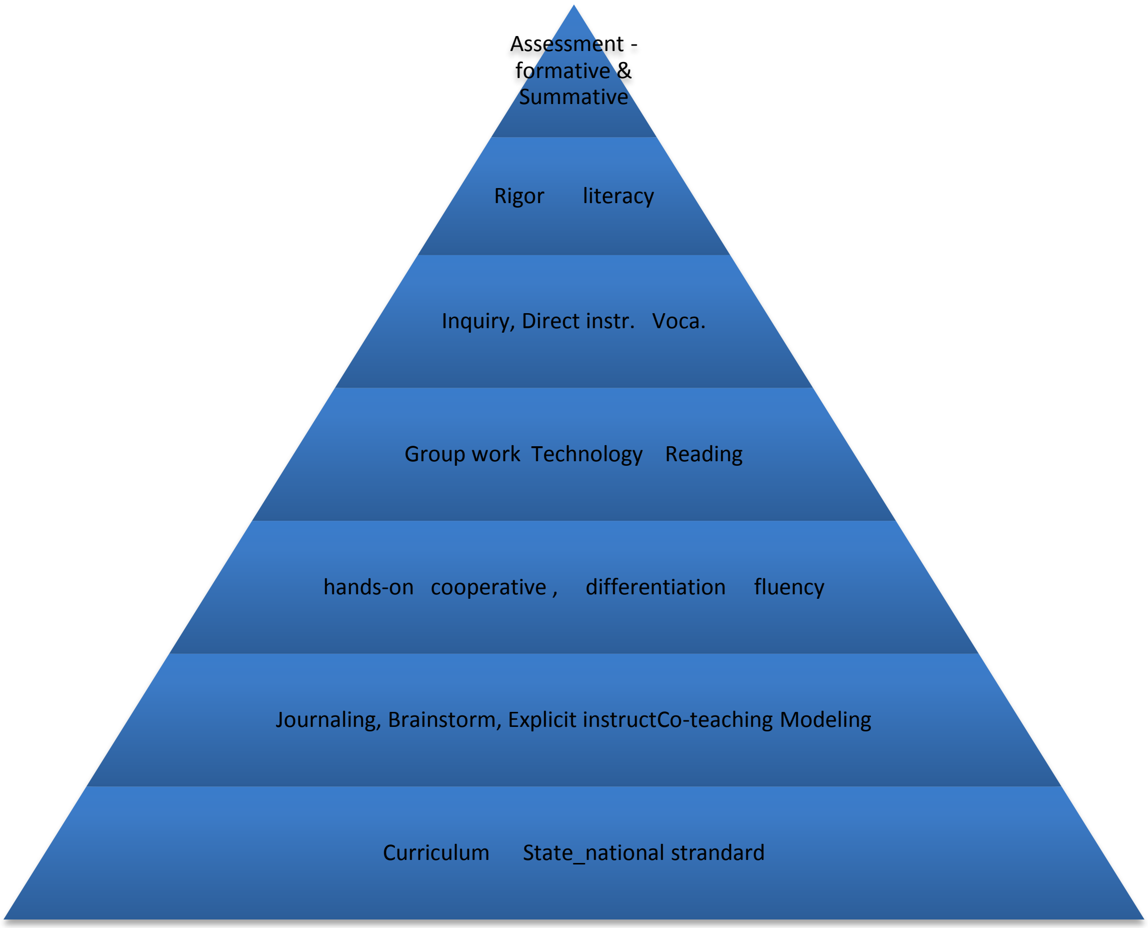
- ***Student difficulties***

  - Students have difficulties in learning science due to the lack of computer, math, reading, reading and other basic literacy skills
  - Students just want teachers to give them correct answers without reasoning and critical thinking
  - Students have little motivation to learn science due to the lack of unfavorable family and social environments.

- ***Teaching strategies***
  - Most teachers used a variety of teaching methods to teach science.

  - Explicit instruction
  - Cooperative learning
  - Project-based learning
  - Inquiry-based learning
  - Hands-on activities
  - Interdisciplinary inquiry

We asked teachers to draw a diagram to demonstrate their conceptions of interdisciplinary science inquiry PCK. We found that all teachers drew different diagrams with different components and combined them differently. Here are a few examples:


Assessment -
formative &
Summative
Rigor literacy
Inquiry, Direct instr. Voca.
Group work Technology Reading
hands-on cooperative , differentiation fluency
Journaling, Brainstorm, Explicit instructCo-teaching Modeling
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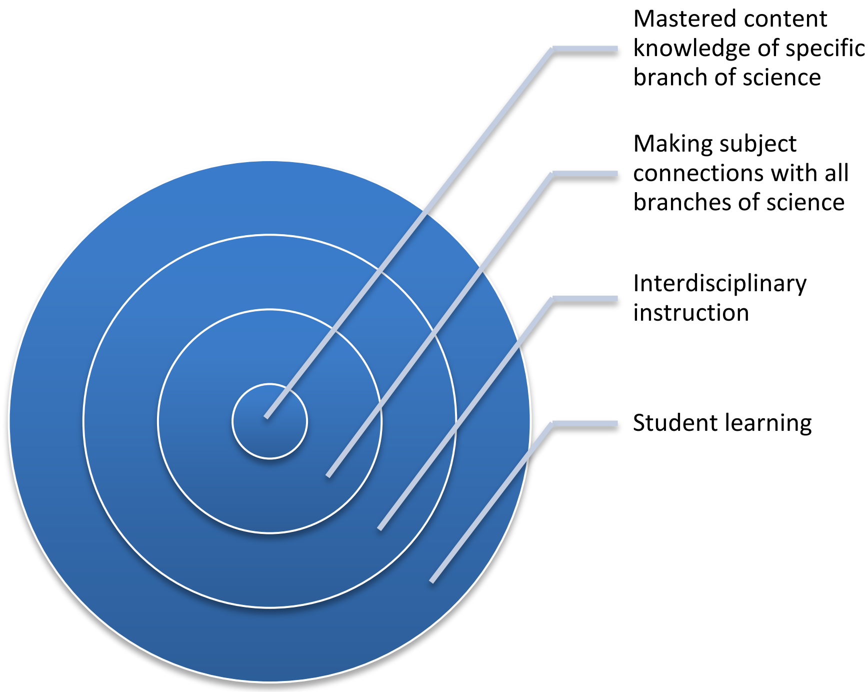
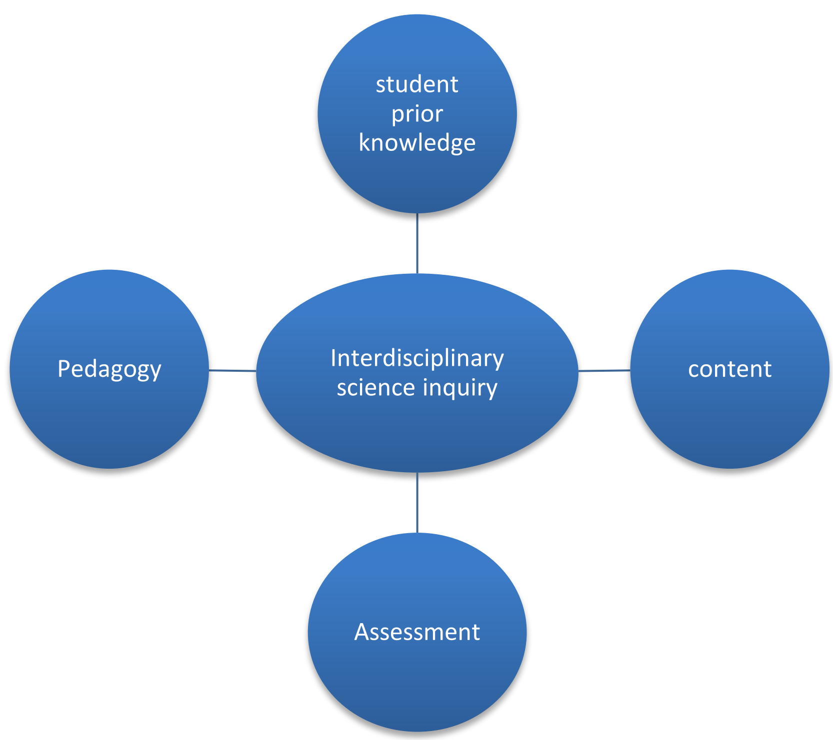

Mastered content knowledge of specific branch of science
Making subject connections with all branches of science
Interdisciplinary instruction
Student learning

c.


student prior knowledge
Pedagogy
Interdisciplinary science inquiry
content
Assessment

(3) There is a discrepancy between teachers' conceptions of interdisciplinary science inquiry expressed during interviews and that demonstrated during their teaching.

- Among the teachers observed in the classrooms, three teachers used very traditional teaching methods (e.g., worksheet review), three teachers used some elements of science inquiry (e.g., step-by-step lab activities), and one teacher used interdisciplinary inquiry teaching. The observed interdisciplinary science inquiry lesson involved taking students to the science museum and asking students to work through solving various problems as part of an exhibition of "CSI: The experience", which integrated biology, chemistry, math, and English writing and other disciplines.

b. Research on STEM graduate and undergraduate students

Research on STEM graduate and undergraduate students is a new component added to the project per the NSF award letter. This research component focuses on the processes of STEM students developing understanding of interdisciplinary science inquiry and abilities to communicating science to middle and high school science teachers and students. Brooke Grant, a doctoral student in social studies education with teaching experiences in urban and rural schools, was hired on Sept. 1, 2011 to assist research on this component.

Following the *Strategic Plan*, specifically the first-year implementation plan, we completed the following activities:

<u>STEM Undergraduate Students</u>

- Observation of the undergraduate academy seminar, *Continuing Undergraduate Academies Experience Seminar*, taught by PI (Gardella), in both the fall and the spring semesters. STEM undergraduate students enrolled in this course were also placed in Buffalo Public School classrooms. Observations of the students in BPS classrooms were also made.
- Artifacts from the course were collected including personal reflection journals and presentations.
- All students enrolled in the course were given a survey at the end of each semester regarding their preparation, experiences, perceived values of UB/BPS ISEP, Self-Efficacy in Communicating Science, and Background
- Surveys were analyzed using descriptive statistics.
- Nine students were interviewed regarding their perceptions of interdisciplinary science inquiry, science communication, and their experience in working in the Buffalo Public Schools.

<u>STEM Graduate Students</u>

- Observation of STEM graduate students who were placed in participating Buffalo Public Schools. On-line interviews were conducted pre-observation and post-observation

- Students were given the same survey as undergraduate STEM students regarding their preparation, experiences, perceived values of UB/BPS ISEP, Self-Efficacy in Communicating Science, and Background. Surveys were analyzed using descriptive statistics.
- Seven students were interviewed regarding their perceptions of interdisciplinary science inquiry, science communication, and their experience working in the Buffalo Public Schools.
- Meetings of graduate students were observed and artifacts collected.
- Parent nights, organized in part by the graduate students, were observed, with surveys being given to presenters and parents in attendance.

Analysis of data collected from the above is ongoing. The following preliminary findings have been obtained:

<u>Preparation</u>

- Overall, the undergraduate students felt that they received more preparation than the graduate students surveyed.
- The undergraduate students felt that they received the least preparation in the areas of teaching and communication, and they received the most preparation in the areas of teamwork, mentoring, culture and diversity, and urban education.

<u>ISEP Experiences</u>

- The most common experiences that the undergraduate students had were assisting in conducting labs, leading small groups in class and doing demonstrations.
- The most common experiences that the graduate students surveyed had were doing demonstrations and helping to find resources for teachers.
- Many of the UB students also mentioned that much of their time was spent addressing interruptions and keeping kids on task.
- The UB students generally had high expectations of themselves and of the students. However, while they felt that the students had the ability to comprehend and demonstrate most concepts in science, they realized that they had to begin with the most basic concepts that many students are missing.
- UB students often discussed college, careers, and future aspirations with the students.
- When it came to questions about content, UB students often cited the importance of not giving students the quick and easy answer.
- Many UB students felt that their experiences were limited due to the short amount of time that they are in the classrooms.

<u>Perceived Values/Benefits of ISEP</u>

- Students are involved in the ISEP program for a variety of reasons.

- The most common reasons cited by the students were to have new experiences, particularly in teaching, to connect with students, and to enhance their cv or resume.
- The STEM undergraduate and graduate students also cited that they wanted to share their STEM knowledge.
- The UB students reflected fondly on their experiences and felt that being involved in the ISEP program had benefitted them in a wide variety of ways.
- In the survey data, most undergraduate students felt that they benefitted by working on a team.
- Most STEM undergraduate and graduate students felt that the program benefitted them in the area of teaching.
- The program increased most of the students' interest levels on a variety of topics.
- For the STEM undergraduate and graduate students, the program increased their interest in influencing policy on STEM education.

Efficacy in Science Communication

- Most of the UB students felt that they could assist teachers in teaching, particularly by communicating information to students in a way that may be easier to understand.
- Most also felt that they could assist teachers in labs, work with small groups of students, and tend to individual student needs.
- According to the surveys, graduate students generally felt more confident communicating science to students.
- There are three basic principles in science communication: define your audience, develop your message, and explain science. In general, the students seemed to be most confident in explaining science.
- Most students felt that the best way to communicate science information to students is through hands-on activities.
- In working with adolescents in science, most citied that support from the BPS teachers were necessary

We also observed the parent night organized in school 19th in March. Survey of both parents and university STEM student presenters were conducted. The following preliminary findings were obtained:

Parents:

- When asked about the objective of the night many parents stated that it was to motivate their child's interest in science and to help learn and understand science.
- The reason for most of the parents attending the science night is because they wanted to know more about science and they wanted their child to come.
- When asked about how the stations benefitted their child, most of the parents surveyed answered positively. They felt that the stations helped their child to understand the science involved, helped to motivate their child to know more about science, and increased their child's interest in science. To a lesser extent, yet still a positive, 58.8 percent of parents felt that the stations will help to inspire their child to study science in college.

- When asked about which stations they enjoyed the most, the three most popular stations were the lava lamps, slime, and liquid nitrogen.

Presenters:

- When asked about the objective of the night many presenters stated that it was to encourage extracurricular activities in the arts and sciences, to get kids interested in and involved in science, and to involve parents in the learning of science.
- In reflecting on their station, presenters all agreed that the students and parents enjoyed the station and most agreed that the activity increased students' interest in science. However, half were unsure as to whether or not the activity actually helped students understand the science involved. Seventy-five percent agreed that their activity could help students learn science in class and sixty-four percent agreed that the activity motivated students to know more about the topic. Overall, most presenters evaluated their station as excellent.
- Presenters were then asked about different aspects of their station, and what they might do differently if they were to do their station again. For the most part, the presenters stated, "No Change". Of the aspects that they would change, many suggested things that had to do with the objects, materials, and equipment that they used in their station.
- At the end of the survey, presenters were invited to give their comments. Most of the comments shared reflected on a positive night, while some suggested improvements to their stations.

c. An Implementation Plan for the Coming Year: Research 2012-2013

i. Research on teachers

One post-doc research associate (Vanashri Nargund-Joshi) and two doctoral student research assistants (Erica Smith and Bhawna Chowdhary) will join the project to assist research on teachers starting July 1, 2012. Planning on different research foci and coordination among the three is currently underway. Among the possible foci are scientists' and engineers' conceptions of interdisciplinary science inquiry and engineering design, teachers' orientation and enactment of interdisciplinary science inquiry in the classroom, student reactions to teacher implementation of interdisciplinary science inquiry in the classrooms, and contextual factors impacting teacher development of interdisciplinary science inquiry PCK. Following the *Strategic Plan* and the principle of *Evidence-based Design and Outcomes*, the following activities will be conducted during the 2012-2013 academic year:

- Participant observation of teachers conducting research at university research laboratories and industrial partner sites during the summer 2012;
- Interview of teachers and hosting scientists and engineers on their conceptions of interdisciplinary science inquiry and engineering designs during the summer 2012;
- Observation of teachers implementing interdisciplinary science inquiry in their classrooms during the academic year of 2012-2013;
- Supporting teachers in implementation interdisciplinary science inquiry through a monthly seminar during both the fall and spring semesters;

- Periodic interviews of teachers on their changing conceptions of interdisciplinary science inquiry teaching;
- Working with the external evaluator to develop standardized measurement instruments on science teachers' interdisciplinary science inquiry content knowledge and pedagogical content knowledge.

The post-doc research associate will write (i.e., lead author) at least two articles and each doctoral student research assistant will write (i.e., lead author) at least one article suitable for research conference presentation and/or scholarly journal publication. A collection of cases in interdisciplinary science teaching and engineering design will also be assembled.

ii. Research on STEM graduate and undergraduate students

Brooke Grant will continue assisting the research on STEM students. Following the *Strategic Plan* and the principle of *Evidence-based Design and Outcomes*, the following activities will be conducted during the 2012-2013 academic year:

- Completing gathering school information as baseline data;
- Participant observation of STEM graduate students conducting research with teachers during the summer 2012;
- Interview of STEM graduate students on their conceptions of interdisciplinary science inquiry and engineering designs during the summer 2012;
- Observation of the undergraduate academy seminar during the fall and spring semesters on preparation of STEM students to work in schools;
- Organizing graduate student orientation sessions to prepare them to work in schools;
- Interview of STEM graduate and undergraduate students on their experiences and perceptions of communicating science to students and teachers;
- Continuing validation of the measurement instrument on STEM student science communication, and developing a draft instrument related beliefs and valuing in professional learning communities (PLC).

The doctoral student research assistant will write (i.e., lead author) at least one article suitable for research conference presentation and/or scholarly journal publication. A collection of useful resources on communicating science in schools will also be assembled.

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Please see Exhibits below (implementation and goal matrices) which summarize and synthesize our efforts over Year 1 (described above) with ratings of perceived progress and corresponding explanations.

Section 2: Management Report

University at Buffalo/ Buffalo Public Schools ISEP

Year 1: 2011 – 2012

Overview

The grant was awarded September 1, 2011, and our first activities were focused just as the new school year was beginning in BPS. Initial activities included establishing all aspects of the management structure organization chart (Figure 1, below). Critical to the startup was the search and appointment of Ms. Karen L. King as Project Manager, which was concluded with her appointment on November 1, 2011. Ms. King is a Ph.D. candidate in Educational Leadership and Policy at the University at Buffalo (UB) Graduate School of Education, with her Ph.D. conferral expected in Fall, 2012, following a masters degree in Student Personnel Administration at Buffalo State College (BSC). She has extensive experience at programmatic leadership, training, diversity and teaching at both UB and BSC, the two higher education core partners. Secondly, a rapid recruitment of STEM Ph.D. students at the beginning of the semester allowed appointment of seven students in the Fall to cover the two ISEP pilot schools and five new schools. The remaining five schools were supported in the spring semester in January 2012. Thirdly, meetings in each school led by the Principal and ISEP PI/CoPI and Project Manager began by the identification of a coordinating teacher for the program, and additional participating science, technology and special education teachers interested in the program. The development of STEM themes or majors for each school, in concert with leadership from the BPS Science Department Director, Ms. Kelly Baudo.

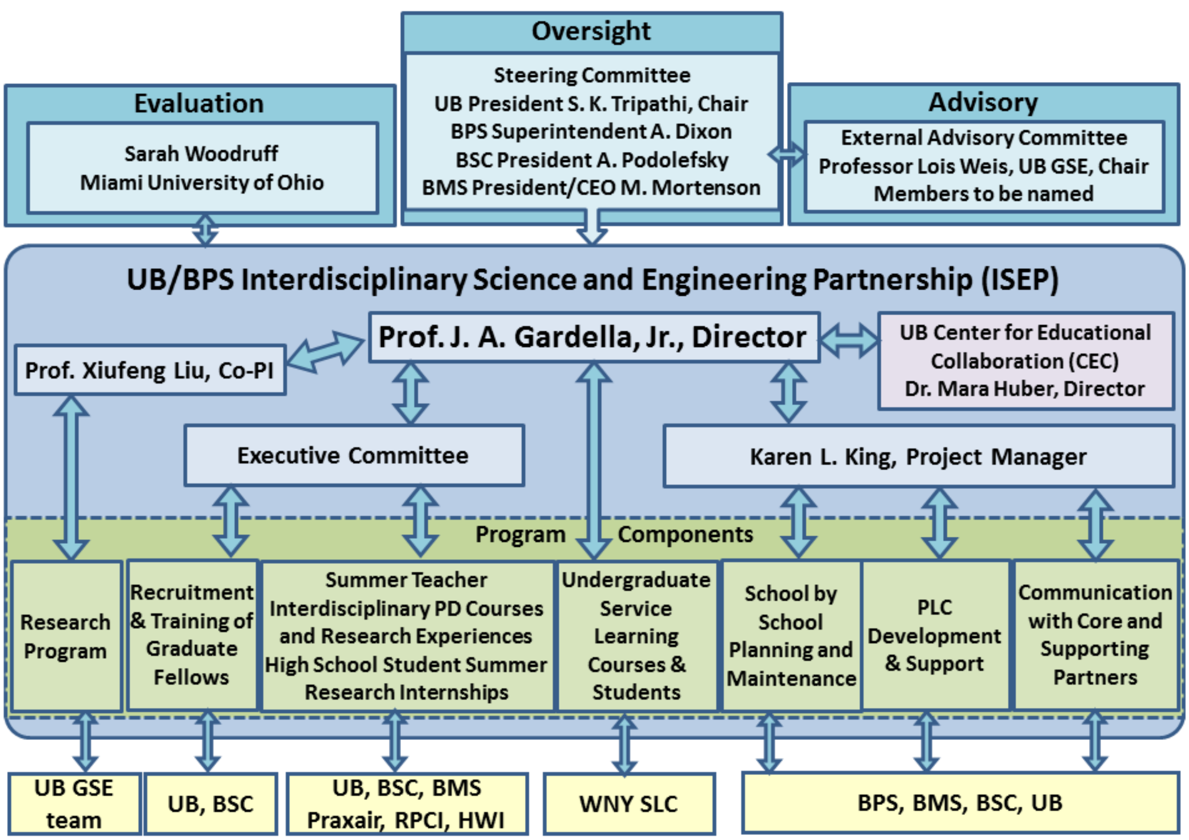

Figure 1: ISEP: Current Organizational Chart

Table 1 summarizes school leadership from year 1. Results of the school based theme development are discussed in Activities and Findings.

Management and operations began with initial meetings with all partners, highlights included establishing clear lines of communication with Core and Supporting Partners; beginning with extensive planning and participation of BPS district leadership at multiple levels, recruitment of new corporate partners, several substantive meetings with the District Parent Coordinating Council for help in engaging parent participation at all levels and initiation of the Executive Committee, Steering Committee, External Evaluator and WNY Service Learning Coalition. The Five Year and First Year Strategic Plan was developed with leadership of CEC Director Dr. Mara Huber. The Undergraduate Service Learning Courses and Students included UB and BSC students, and obtained a 1 year expansion grant from AACU Theory to Practice Program to expand courses offered at UB by the PI. PLC planning and implementation was directed by Project Director Karen King. We are just beginning to organize the High School Student Summer Internship programs with leadership from Dr. Huber.

Core Partner Management and Coordination

Core partner participation in all activities followed the identifications described in Figure 1. In particular, leadership and faculty from UB and BSC worked together regularly on every aspect of higher education participation, regular meetings with the Buffalo Museum of Science leadership occurred to plan programs as described in the Strategic Plan. While we have had just one full meeting of the Executive Committee, and one meeting of the Steering Committee, core partner leadership communicates effectively through the Program Manager, as envisioned in the Strategic Plan. The Program Manager has created email lists for all categories of participants.

Program leadership has held two meetings of the Principals, Coordinating Teachers and Graduate Assistants from all twelve schools, and besides establishing connections necessary for the PLCs, these meetings have created networks of coordinating teachers and initiated communication between district science leadership and principals on ISEP related topics.

Collaboration with BPS

Monthly meetings were held between the ISEP PI, Joseph Gardella and Interim BPS Superintendent Amber Dixon (Ms. Dixon was the special projects assistant to the Superintendent, (EXECUTIVE DIRECTOR FOR PROJECT INITIATIVES) and helped develop the original ISEP MSP applications. Basic operational issues such as district staff time in support of the ISEP program, school by school planning initiatives and identification of strategies to engage New York State Department of Education Race to the Top initiatives are discussed monthly. Ms. Dixon serves as a member of the Steering Committee, representing the leadership of all core partners.

Partnership collaboration between the BPS Science Department leadership and ISEP activities was a major focus of Ms. Kelly Baudo, Supervisor of Science. Ms. Baudo participated in all planning efforts, and served on the Executive Committee. She met with UB and Buffalo State ISEP leadership at every school-based meeting. Initial meetings at each school introduced the expanded structure of ISEP, and opportunities for the graduate student in each school; service learning students and summer opportunities for teacher professional development were described. Meetings included principals, teachers to be considered for the position of ISEP coordinating teacher and other science, special education and technology teachers. Ms. Baudo advised additional information about informal science activities such as field trips and other off campus activities. Follow-up meetings during common planning times were scheduled at each high school, and school based STEM themes have been developed for student recruitment and connections to middle school students. Ms. Baudo worked in the development of standard forms and approval processes for requests for field trips, purchasing and other resources for teachers and principals. A process of consultation with the Science Department, and development of criteria for alignment of requests to learning goals and standards produced a clearer means for teachers to justify requests for ISEP funding in support of these activities. Ms. Baudo participated in all reviews of teacher applications for summer research PD, and provided input on the background and previous PD work of all teachers to help decide about selection of teachers for the Buffalo State course, and other related initiatives, such as selection for Praxair summer positions. Based on her recommendations, several teachers revised their proposed research requests to align with school-based initiatives or coordinate better in PLC development.

As support for the ISEP program and other district wide STEM initiatives, a full time STEM Project Administer, Ms. Serena Restivo has been hired to support Ms. Baudo's efforts. As part of her overarching responsibilities, she helps to coordinate details with ISEP programs. Ms. Baudo will remain the point person for all teacher selection processes and decision-making.

Supporting Partner Development

As noted in the introduction, ISEP has been approached by a number of companies to develop further corporate partnerships, in addition to our established corporate partner, Praxair. These include:

- Life Technologies division on Grand Island, NY, for staff support of high school programs, offering field trips and summer financial support of teachers,
- Lab Aid, Inc., for support of SEPUP development during the summer, donation of SEPUP kit materials
- VWR Science Kit, Tonawanda and Rochester, NY, for staff support of middle school programs and a discount on supplies and equipment.

We are presently developing a MOU format for these corporate partnerships with our Vice President for Research.

Supporting partners for research development, Praxair, Roswell Park Cancer Institute and Hauptman Woodward Institute have committed to teacher professional development support as described in the Strategic Plan. Further, Roswell leadership has indicated an interest in developing cancer genetics and cancer biology classroom materials and directing these to one of the high schools as a themed program.

Coordination with supporting partners for program development, the Western New York Service Learning Coalition and the District Parent Coordinating Council (DPCC) has been excellent. Multiple meetings with DPCC at regular monthly meetings, a featured presentation at a yearly parent forum, sponsored by DPCC (400 parents attending), regularly shown on local city cable access TV for six months, and collaboration side by side at several school based parent nights shows the immediate support from DPCC for the ISEP program. DPCC participation is at three levels; leadership participation on the Executive Committee, school based participation through parent organizations in each of the twelve ISEP schools, and project participation for parents in the PLC development. As evidenced by the participation of a parent in our team at the annual NSF MSP Learning Network Conference: Framing Effective Teaching in STEM, our collaboration with DPCC has emerged as a major strength.

These outcomes of the Core Partner management and Supporting Partner Development are obviously ***partnership driven.*** Using ***evidence based design and outcomes*** as developed by the Joyce Epstein models of parent involvement, outlined in our ISEP proposal, guiding participation at all levels. Finally, effective collaborations contribute to both ***institutional change and sustainability*** .

Table 1: ISEP Schools, Research Themes, Coordinating Teachers & STEM Graduate and Undergraduates (Yellow Highlighted began Spring 2012), Persistent Low Achieving (PLA) schools under Race to the Top funding are indicated by the PLA designation in the left column under school name. These schools have School Improvement Grants and are subject to various turnaround plan models as dictated by Race to the Top.

School Name (Grades Served)	Coordinating Teacher	STEM Themes	STEM Graduate Students	STEM Undergraduates	Other Partner Resources
Native American Magnet 19 (K-8)	Heather Maciejewski	Environmental Science, Forensics, Anat/Physiol	Shannon Seneca	Jasmine May, Jake Ross, Emily Warren	Praxair
Harriett Tubman 31 (K-8)	Steven Indelacio	Biomedical, Environmental Science	Ekue Bright Adamah-Brassi		Roswell Park Cancer Institute
Science Magnet 59 (K-8) PLA	Amy Brackenridge	Biomedical and Environmental Sciences	Thomas Scrace	Krista Coleman, Destynee Oakley	Museum of Science Buffalo Zoo Computers - Children
Lorraine Academy 72 (K-8)	Sharon Pikul	Medical Careers	Sarina Dorazio	Andrew Burstein	Mercy Hospital, Trocaire College
Southside Academy 93 (K-8)	Susan Wade	Environmental Science, Link to South Park High	Nicholas DeMeglio	Derek Kelly	VWR Science Kit
MST Seneca 197 (Grades 5-12)	Michelle Zimmerman	Environmental Science and Engineering	Jonathan Malzone Susan Mackintosh	Philip Tucciarone	Praxair
Bennett High 200 (Grades 9-12) PLA	Tanya Johnson	Biomedical, Pharmaceutical Sciences	Alex Ticoalu	Matthew Goehrig	Retired Teachers
Riverside Tech 205 (Grades 9-12) PLA	Bradley Gearhart	Medical Careers	Shannon Clough	Hillary Bird	Medaille College, Life Technologies
South Park 206 (Grades 9-12) PLA	Kathleen Marren	Environmental Science and Social Sciences	James Parry Michael Gallisdorfer		Computers for Children
Burgard 301 (Grades 9-12) PLA	Sarah Kszanak	Auto Technology,Physics	Katie Hofer, Lavone Rodolph	Darcy Regan	Praxair
Hutch Tech 304 (Grades 9-12)	Jill Jakubowicz	Engineering, Physics, Biochemistry	Ben Wang, Lavone Rodolph, Meghan Kern	Alyssa Cederman	
East High 307 (Grades 9-12) PLA	Pat McQuaid	Bioinformatics, Forensics	Amy Zelinski	Destiny Johnson	Life Technologies

Section 3: Financial Report

Interdisciplinary Science and Engineering Partnership (ISEP) with Buffalo Public Schools

Year 1: 2011 – 2012

1. Status

Spreadsheet projections (below) show just less than 18% of award will be left at end of the year (August 31st, 2012).

We had a 10% shortfall in costs budgeted for teacher participation. We had support available among our grants and additional support for 65 teachers. We had 61 applicants, rejected one applicant, and offered 60 positions. 58 teachers accepted the offers, about a 10% shortfall from our available resources. As noted earlier in the report, one offer was declined due to pregnancy, and the other because the teacher is out on Workmans Comp with no return date scheduled. We would like to carry over these funds to expand teacher participation next year to 70 teachers.

Our major shortfalls are in four categories, which we would request to carry over to 2012-2013. These are:

- Graduate Student support,
- Undergraduate student support,

and within the yellow highlighted Participant Support costs,

- support for our summer/academic year middle/high school student research programs, both for high school student stipends and
- grad student mentoring for middle/high school students.

2. Background related to shortfalls and justification for use of carryover to 2012-2013.

Our plan to hire doctoral students to support the 12 schools was carried out from September, 2011 to January, 2012. We appointed seven graduate assistants in September, 2011 and six additional doctoral students were added in January, 2012 during the spring semester. Originally we had hoped to have all 12 schools on board during the fall, 2011 semester but we could not recruit in the manner we expected in the grant after two weeks of UB's academic calendar had started. When the additional schools were added to the program in January, 2012, we hired the additional doctoral students as well as several service undergraduate interns.

Since we began so quickly in September, we were not able to recruit the full contingent of graduate assistants and enough paid undergraduates for the year, and thus have a shortfall which we would request to carry over.

We plan to add additional part time graduate student support for implementation of new materials and laboratories in the high schools, as we are supporting large, coordinated contingents of teachers in each high school. We anticipate using the carry over funds to make a big, first year push on implementation in the fall. To do this, we intend to bring on board additional paid graduate and undergraduate students.

We now have a cadre of experienced undergraduates who have participated in internships and the service learning course, to staff all 12 schools.

With respect to the middle high school student programs, the project envisioned year round support for high school students, starting in the summer and carrying through the following academic year. We have started with five programs, two middle school programs for students in science (organized by Buffalo State College) and engineering (the UB Buffalo Engineering Awareness for Minorities (BEAM) program), and three focused on high school students, a DNA and genetics program, a medical imaging science program and an advanced engineering preparatory program for high school students. All of these initiate with a summer experience, and then follow on during the academic year. Since 2012 is our first summer, we have established support and recruitment for all five programs and the carry over in both categories would be used for the following fall program. With approved carryover funds, we will increase the intensity of the academic year component with more attention to individual middle and high school mentoring and parent support. We propose to expand the parent participation work in this area by funding higher numbers of parent stipends for supporting and participating with their children.

Finally, we have hired a postdoctoral fellow for the research program to take a leadership role with regard to qualitative research and collection of data.

Details of the expenditures are in the spreadsheet in categories utilized in the NSF budget. These are based on our best projection of costs for summer, 2012.

We request that our carryover be supported by the Program office, and look forward to any discussions we can have to answer any further questions.

Summary Proposal Budget

Category	Funds Budgeted	Funds Expended	Summer 2012 Committed Funds	Total Expected to Expend	Projected Carryover Funds
Faculty Salaries	$41,502.00	$0.00	$41,502.00	$41,502.00	$0.00
Staff Salary	$3,517.00	$3,410.41	$0.00	$3,410.41	$106.59
Graduate Students	$398,000.00	$228,812.00	$134,869.37	$363,681.37	$34,318.63
Undergraduates	$64,000.00	$13,966.97	$8,000.00	$21,966.97	$42,033.03
Fringe Benefits	$70,954.00	$38,316.60	$32,637.40	$70,954.00	$0.00
Participant Support Costs					
Stipends					
Teachers	$282,000.00		$254,750.00	$254,750.00	$27,250.00
Middle/High school students	$84,000.00		$35,000.00	$35,000.00	$49,000.00
PT grad assistants	$48,000.00		$11,000.00	$11,000.00	$37,000.00
Parents	$1,800.00		$5,000.00	$5,000.00	-$3,200.00
Travel	$48,000.00		$9,000.00	$9,000.00	$39,000.00
Supplies	$72,000.00		$65,000.00	$65,000.00	$7,000.00
Supplies including Field Trips	$38,400.00	$15,508.00	$22,057.04	$37,565.04	$834.96
Tuition	$12,876.00	$38,208.00	$0.00	$38,208.00	-$25,332.00
Travel	$0.00	$4,284.38	$510.00	$4,794.38	-$4,794.38
Total UB Direct Costs	$1,165,049.00			$961,832.17	$203,216.83
					17.40%

Section 4

a: Evaluator's Report
b: Response to Evaluator's Report

Interdisciplinary Science and Engineering Partnership (ISEP) with Buffalo Public Schools

Year 1: 2011 – 2012

Ohio Evaluation & Assessment Center

MATHEMATICS • SCIENCE • EDUCATION

Evaluation of University at Buffalo/Buffalo Public Schools (UB/BPS) Interdisciplinary Science and Engineering Partnership

Annual Report 2011-2012

Miami University
408 McGuffey Hall
Oxford, OH 45056

Phone: 513-529-1686
Fax: 513-529-2110
Website: http://ohioeval.muohio.edu

Please cite as follows:

Woodruff, S. B., & Li, Y. (2012). *Evaluation of University at Buffalo/Buffalo Public Schools (UB/BPS) Interdisciplinary Science and Engineering Partnership: Annual report 2011-2012.* Oxford, OH: Miami University, Ohio's Evaluation & Assessment Center for Mathematics and Science Education.

Distributed by Ohio's Evaluation & Assessment Center for
Mathematics and Science Education
Sarah B. Woodruff, Director
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Miami University
Oxford, Ohio 45056

Introduction

Ohio's Evaluation & Assessment Center for Mathematics and Science Education (E & A Center) is the project evaluator for the University at Buffalo/Buffalo Public Schools (UB/BPS) Interdisciplinary Science and Engineering Partnership (ISEP) project. The UB/BPS ISEP project is funded through a Mathematics and Science Partnership (MSP) grant from the National Science Foundation (NSF). Dr. Sarah Woodruff, Miami University, is the Principal Investigator for the evaluation, and Yue Li is the Senior Statistician and Project Manager for the evaluation.

Project Description

The University at Buffalo/Buffalo Public Schools Interdisciplinary Science and Engineering Partnership project is a National Science Foundation (NSF) Mathematics and Science Partnership project to establish and sustain a comprehensive partnership targeting middle and high school science and technology, with a focus on strengthening teacher professional development (PD) during the critical transition from middle to high school. This project addresses the critical need (documented nationally and locally) for improved student learning in standard areas of science by enhancing science inquiry knowledge and skills, enabling the implementation of interdisciplinary inquiry-based science teaching across all content standards, and supporting the BPS vision for inquiry-based science and engineering curricula.

The ISEP project has six major goals:

GOAL 1: Improve middle school science teachers' knowledge and skills related to science inquiry through interdisciplinary science research and engineering design with university STEM faculty.
GOAL 2: Increase science teacher quantity, quality, diversity, and retention in urban schools.
GOAL 3: Develop and sustain professional learning communities in urban schools, based on mentoring models, with help from university STEM faculty and graduate students.
GOAL 4: Extend interdisciplinary inquiry based science and engineering learning to high school.
GOAL 5: Improve student achievement in science, attitude toward science-technology-society, and interest in pursuing advanced science studies.
GOAL 6: Improve collaboration in student learning among university, school, and parents.

In order to achieve these goals, UB in collaboration with the Buffalo Public Schools, Buffalo State College, and Buffalo Museum of Science will engage in the following activities:

- Science and technology teacher professional development with a focus on science inquiry content and pedagogical content knowledge through interdisciplinary science and engineering research and workshops to be led by UB and BSC STEM faculty and students.
- School-based support for teacher implementation of interdisciplinary inquiry-based science instruction by UB STEM graduate students assigned to BPS classrooms and after-school and weekend science clubs designed to expand student inquiry learning opportunities. Additional support will come from service learning students from UB, BSC and area colleges. ISEP offerings will also include summer enrichment and university research internships for BPS students.
- Expanded professional learning communities (PLC's) with mentoring relationship between UB STEM faculty members, undergraduate and graduate students, and BPS students and parents.

Additionally, the project will conduct research on the processes and conditions in which teachers develop interdisciplinary science inquiry knowledge; how this information may be translated into pedagogical content knowledge that ultimately improves students' science learning; and how professional learning communities may support the development of this pedagogical content knowledge. The project also will study the impact of associated activities on participating graduate students.

Evaluation

Ohio's Evaluation & Assessment Center for Mathematics and Science Education was contracted to conduct summative, external evaluation activities for the UB/BPS ISEP project. Overarching evaluation efforts focus on assessing progress towards project goals and monitoring project implementation at the project, school, and classroom levels. The E & A Center provides external summative evaluation services for the ISEP project and works closely with the internal evaluation and research team, led by Dr. Xiufeng Liu, to provide formative feedback for project improvement. Primary tasks of the E & A Center include:

a) Design and modify the external evaluation plan and protocols over the life of the project.
b) Advise, as requested, design protocols and instruments to be used by the internal evaluation and research teams.
c) Recommend, develop, and modify evaluation instruments.
d) Test evaluation instrument validity and reliability.
e) Prepare and supply or administer instruments for participants. Instruments may be provided in hard copy or online as requested by project personnel.
f) Collect and analyze quantitative (i.e., questionnaire, content assessment, demographic, performance/achievement) data and qualitative (i.e., written reflections, observations, interview/focus group) data from and regarding project participants and other relevant data to be used for comparison analyses.
g) Conduct focus groups and/or interviews of a sample of project participants.
h) Collect and analyze project artifacts and documents provided by project personnel.
i) Conduct protocol-based observations of a sample of participant teacher classrooms.
j) Integrate and synthesize data from the internal evaluation and research in the creation of annual and final reports.
k) Provide informal interim reports to project personnel as requested to inform project continuous improvement efforts.
l) Prepare and submit to Project PI annual and final project reports for the NSF.

During Year 1 of the project, the E & A Center and ISEP Project Team have communicated via email, conference calls, and two face-to-face meetings to discuss the progress of the evaluation and project. External evaluation activities conducted this year include: (a) modifying and finalizing the external evaluation plan; (b) recommending and developing evaluation instruments; (c) preparing online instruments for teacher participants; (d) collecting school-level baseline demographic data; and (e) preparing and submitting the Year 1 annual evaluation report.

Participants

Participants in the evaluation of the ISEP project are Buffalo Public School middle and high school teachers, their students in Grades 5 through 12, parents of the teachers' students, University at Buffalo and Buffalo State College STEM faculty, undergraduate students, and graduate students. Other key informants may include BPS district and building administrators, ISEP project personnel, and non-participating BPS middle and high school teachers.

Data Collection

Quantitative evaluation measures include questionnaires, content knowledge assessments, collection of baseline and longitudinal data, and protocol-based observations of teacher classrooms. Qualitative measures include interviews or focus groups, written reflections, and artifact and document review.

Multiple instruments used in the evaluation of MSP projects (PENN-STI and MSPinNYC) are being used or modified for use in this project. Other valid and reliable instruments that measure content knowledge (e.g., ATLAST, MOSART, STASKS) also have been referenced in order to develop an instrument that meets project data collection needs. Instruments used in the evaluation will have documented evidence of validity and reliability, but further validation will be conducted through both conventional procedures (i.e. content validation through expert review, criterion-related validation through correlation analysis, construct validation through exploratory and confirmatory factor analysis, internal consistency reliability analysis) and Rasch modeling.

Data Analysis

Quantitative data analyses will include appropriate descriptive statistics (e.g., means, standard deviation, frequencies) to describe demographic data and participant responses not gathered in a pre/post fashion. All data collected pre/post/delayed-post will be analyzed using repeated measures ANOVA. When quasi-experimental designs are used, repeated-measures analysis of covariance (ANCOVA) will be used to analyze data. Multiple regressions will be conducted for causal comparison. Effect sizes will be reported when sample sizes and quality of data are sufficient. Student performance data also will be analyzed via ANOVA to track changes in performance over time. Qualitative data will be coded and analyzed using the constant-comparative method. Multiple data sources will contribute to the development, revision and description of themes across project years. Triangulation of findings will occur at several levels. For example, findings from the surveys of teacher instructional practice from students can be used to adjust for teacher self-report bias. Classroom observation data and student achievement data will be triangulated with instructional practices questionnaire data to further validate findings and support attribution of impact to project activities. Additionally, student performance on standardized measures of student achievement, such as state assessments, may be compared to the performance of students in comparable, non-participating schools or classrooms. Iterative synthesis of qualitative and quantitative data facilitated by the evaluation design will provide many opportunities to validate tentative findings and explore alternative explanations. Further, the application of modeling (e.g., HLM or SEM) and rigorous statistical analyses (IRT–Rasch Model) will permit comparisons across cohorts of teachers and students, as well as across project years and school sites.

Evaluation Plan and Activities

The E & A Center will employ a mixed methods approach with both formative and summative data collection and analysis. The evaluation design will utilize a combination of pre/post, quasi-experimental, as well as causal comparative quantitative measures; and will collect relevant qualitative and descriptive data on project participants, their students, and participating schools. The evaluator will utilize data and findings provided by the internal evaluation team to create annual and final reports that synthesize findings from all measures. The evaluation will collect and analyze qualitative and quantitative data from all project participants, and will assess impact on students of participating teachers. Additionally, quantitative data will be triangulated with observation, interview, and written reflection data to provide a more rigorous assessment of project implementation and impact. This design will permit cross-examination among levels (i.e., project, school, teacher, and student) and will describe and measure the quality of implementation and effects on teacher and student learning and performance. Statistical comparisons will be made with other NSF MSP projects, when possible.

The external summative evaluation plan submitted with the project's proposal to the NSF was updated in February 2012 to ensure coordination of ISEP project activities, internal research/evaluation, and the external evaluation, following a very informative site visit conducted in December 2011. This plan will continue to be modified in response to emerging needs or changes in project plans. The updated summative evaluation matrix can be found in Appendix A. During the site visit in December 2011, three immediate evaluation goals were identified:

1. Develop a timeline and administration plan for instruments
2. Collect baseline data (2010-2011) – school- and teacher-level
3. Develop content knowledge assessment for teachers (and UB STEM UG and Grad students)

Table 1 represents external evaluation activities for January through December 2012.

Table 1. *E & A Center Primary Evaluation Activities and Timeline, January – December 2012*

Evaluation Activity	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Develop Teacher Pre-questionnaire												
Collect Baseline Data – School/teacher-level												
Administer Teacher Pre-questionnaire online												
Develop/test Teacher/STEM student CK/PCK instrument												
Develop PLC reflection subscale												
Develop Faculty Questionnaire												
Administer Teacher CK/PCK instrument online												
Administer STEM Student Post-Questionnaire (Liu version)												
Develop and test BPS Student Questionnaire												
Develop STEM Student Questionnaire (new version)												
Develop Parent Questionnaire												
Administer Faculty Questionnaire online												
Administer BPS Student Questionnaire hardcopy												
Administer STEM Student CK/PCK instrument online												
Administer Parent Questionnaire hardcopy												

Collection of Baseline Data

The E & A Center's Senior Statistician determined that the list of variables shown in Table 2 (school level) and Table 3 (teacher level) should be included in the baseline data. Both school- and teacher-level data are collected in order to follow the project's progress toward its goals. For goals related to teacher and student outcomes, the unit of analysis is the classroom. The ability to link student data to teachers and to link participant's data across years is critical to this project. For this reason, the E & A Center will require the use of a unique identifier for each teacher. For project goals related to transforming science education in the district, the unit of analysis is the school. All school level data will be linked to a school identifier such as the school name or an assigned code. In no case will identifiable school or individual data be reported either to the ISEP project team or to the NSF; all data will be reported in aggregate.

Variables in Tables 2 and 3 primarily represent those reported in the proposal to NSF but include a few others that were not previously collected and reported. Those variables shaded in green should be available on each school's State Report Card. Those shaded in yellow will be collected by the E & A Center on the *UB/BPS Teacher Pre-Questionnaire* in May 2012. Those shaded in blue will need to be provided by each participating school or by the BPS district office.

Baseline data for each of the 12 ISEP partner schools have been collected for the 2010-2011 school year and are reported in Appendix B. Data that were not available from the State school report cards or through the publically accessible BPS website database will be requested from the BPS central office in June 2012.

Table 2. *UB/BPS ISEP School-level Baseline Data (2010-2011)*

School-level Data			
Aggregate Science Teacher Information	**Aggregate Student Demographics**	**Middle School Aggregate Student Performance Data**	**High School Aggregate Student Performance Data**
All data to be associated with School Name/ID			
		% of students admitted to highly selective HS	Graduation rate – disaggregated by gender/race
		% of students taking advanced courses in MS	% of students attending post-secondary school
			% of students intending to major in STEM fields
		% of Students Meeting or Exceeding NY State Standards (Scoring at Level 3 or 4)	
Number of Science Teachers	Total number of students	Grade 4 ELA %	Regents English %
% American Indian or Alaska Native	% American Indian or Alaska Native	Grade 4 Math %	Regents Math A %
% Black or African American	% Black or African American	Grade 4 Science %	Regents Living Environments %
% Hispanic or Latino	% Hispanic or Latino	Grade 8 ELA %	Regents Chemistry %
% Asian or Native Hawaiian/ Other Pacific Islander	% Asian or Native Hawaiian/ Other Pacific Islander	Grade 8 Math %	Regents Earth Science %
% White	% White	Grade 8 Science %	Regents Physics %
% Multiracial	% Multiracial		Regents Integrated Algebra %
% w/o Appropriate License/Certificate	% Limited English		Regents Biology %
% w/ Master's Plus 30 Hours or Doctorate	% Students with disabilities		
% of Core Courses Taught by teachers with HQT	% Poverty (% free/reduced lunch)		
Turnover Rate of Teachers with Fewer than 5 Years of Experience	% Male		
Turnover Rate of All Teachers	% Female		
# of Teachers who collaborated with UB/BSC faculty/students			

Table 3. *UB/BPS ISEP Teacher-level Baseline Data (2010-2011)*

Teacher-level Data		
Aggregate Student Demographics	**Aggregate Student Performance Data**	**Teacher Demographics**
All data to be associated with Teacher Name/Unique ID		
Grade level or Grade band	Grade level or Grade band	Grade level or Grade band
Total number of students	Subject	Gender
% American Indian or Alaska Native	% of Students Meeting or Exceeding NY State Standards in this Subject (Scoring at Level 3 or 4)	Race/ethnicity
% Black or African American		Licensed/certified in subject currently teaching
% Hispanic or Latino		HQT status
% Asian or Native Hawaiian/ Other Pacific Islander		Years Experience Teaching Science
% White		Years at the Current School
% Multiracial		Courses Currently Teaching
% Limited English		Total STEM PD Hours completed in 2010-2011
% Students with disabilities		STEM Content PD Hours completed in 2010-2011
% Poverty (% free/reduced lunch)		STEM Assessment PD Hours completed in 2010-2011
% Male		STEM Pedagogy PD Hours completed in 2010-2011
% Female		STEM Curriculum PD Hours completed in 2010-2011
		STEM Content Graduate courses completed
		STEM Pedagogy Graduate courses completed
		STEM PD Hours with UB/BSC in 2010-2011
		STEM PD Hours NOT with UB/BSC in 2010-2011

Instrument Development

The E & A Center has begun work on developing instruments to collect participant data for the project. The first instrument (*UB/BPS ISEP Teacher Questionnaire*) will be administered online to all recruited, participating teachers in May and June 2012. This instrument was developed with permission from existing instruments previously used in NSF and USDOE MSP projects and in DRK12 projects[1].

[1] Lederman, N. G. (2006). Syntax of nature of science within inquiry and science instruction. In L. B. Flick and N. G. Lederman (Eds.), *Scientific inquiry and nature of science* (pp. 301-317). Netherlands: Springer. National Research Council. (2000). *Inquiry and the National Science Education Standards: A guide for teaching and learning.* Washington, DC: The National Academies Press. Liang, L. L., Chen, S. Chen, X., Kaya, O. N., Adams, A. D., Macklin, M., & Ebenezer, J. (2008). Assessing preservice elementary teachers' views on the nature of scientific knowledge: A dual-response instrument. *Asia-Pacific Forum on Science Learning and Teaching, 9*(1), 1-19. National Science Teachers Association (2000). *The nature of science—A position statement of NSTA*. Washington, DC. McGinnis, J. R., Kramer, S., Shama, G., Graeber, A. O., Parker, C. A., & Watanabe, T. (2002). Undergraduates' attitudes and beliefs about subject matter and pedagogy measured periodically in a reform-based mathematics and science teacher preparation program. *Journal of Research in Science Teaching, 39*(3), 713-737. Yasar, S., Baker, D., Robinson-Kurpius, S., Krause, S., & Roberts, C. (2006). Development of a survey to assess K-12 teachers' perceptions of engineers and familiarity with teaching design, engineering, and technology. *Journal of Engineering Education*, 205-216. National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.*

Also in development is the instrument that will be used to assess teachers' (and UB STEM students') content and pedagogical content knowledge. This instrument will utilize with permission items from a number of validated instruments[2] and will be pilot tested before use in the project. Initially, the instrument will collect baseline data on teachers' understandings of a range of science content and pedagogical approaches. This instrument will focus broadly on fundamental science concepts and classroom applications that relate to various aspects of a constructivist approach to science teaching (e.g., attending to student misconceptions, conducting demonstrations, conducting reviews). Although these specific understandings are important, they do not adequately capture the focus of the ISEP project on developing science teachers' interdisciplinary science inquiry understanding and skills so that they translate them into their science classroom teaching.

During the next year, Dr. Woodruff and Dr. Liu will assemble and lead a team of scientists and engineers to develop an interdisciplinary science inquiry content knowledge and pedagogical content knowledge measurement instrument. This instrument will not only be well-aligned with the ISEP project focus but also will address the next generation of science education standards that explicitly address interdisciplinary science inquiry including engineering design. Utilizing the framework for interdisciplinary science inquiry (i.e., Science and Engineering practices, and Cross-cutting concepts in the NRC's Conceptual Framework; and Science literacy in the Common Core), the assessment development team will translate those conceptual frameworks into a test specification document and develop questions accordingly. We anticipate that this instrument would be ready for validation and pilot testing by early Spring 2013.

Finally, an instrument to measure changes in BPS students' perceptions of science and engineering and in the classroom environment, an instrument to assess STEM faculty perceptions of aspects of the project, and an instrument to measure parent involvement in student learning will be developed during Summer 2012. These instruments are described briefly here.

1. *UB/BPS ISEP Teacher Questionnaire* will collect data from teachers who will participate in project activities beginning in June 2012. The questionnaire will be administered online via a secure link in May and June. The *UB/BPS ISEP Teacher Questionnaire* can be found in Appendix C.

Subscales of the teacher questionnaire include:

(a) comprehensive demographics, including PD history, to collect teacher and classroom data (pre- each academic year). Items in this section were developed with permission from: RMC Research (2009).

(b) perceived preparedness for aspects of science teaching (and mathematics teaching for those who also teach mathematics), including STEM coursework (pre- each academic year). Items on this subscale were modified with permission from the following: RMC Research (2009); and National Research Council (2012).

(c) perceived importance of teaching cross-cutting content in science and inquiry (pre and post- each academic year). Items on this subscale were modified with permission from the following: RMC Research (2009); and National Research Council (2012).

Washington, DC: The National Academies Press. RMC Research. (2009). *Needs Assessment Survey for evaluation of the Nebraska Mathematics and Science Partnership projects.* Denver, CO: Author.

[2] Lawson, A. E. (2000). *Science attitudes, skills, and knowledge survey (SASKS): Forms 1, 2, and 3.* Arizona State University, Arizona Collaborative for Excellence in the Preparation of Teachers: Tempe, AZ. Lawson, A. E. (2001). *Science teacher attitudes, skills, and knowledge survey (S-TASKS).* Arizona State University, Arizona Collaborative for Excellence in the Preparation of Teachers: Tempe, AZ. Schuster, D. & Cobern, W. W. (2007). Assessing pedagogical content knowledge of inquiry science instruction. *Proceedings of the National STEM Assessment Conference on Assessment of Student Achievement,* Washington DC. Schuster, D. & Cobern, W. W. (2007). *The pedagogy of science teaching test (POSTT).* Western Michigan University, Mallison Institute for Science Education: Kalamazoo, MI.

(d) measures of understanding of nature of science (NOS) and classroom science inquiry (SI) (pre and post- each academic year). Items on this subscale were modified with permission from the following: Lederman, N. G. (2006); National Research Council (2000); Liang, L. L., Chen, S. Chen, X., Kaya, O. N., Adams, A. D., Macklin, M., & Ebenezer, J. (2008); and National Science Teachers Association (2000).

(e) perceived importance of and familiarity with design, engineering, and technology (DET) (pre and post- each academic year). Items on this subscale were modified with permission from the following: Yasar, S., Baker, D., Robinson-Kurpius, S., Krause, S., & Roberts, C. (2006).

(f) attitudes and beliefs about teaching science, mathematics, and engineering design (pre and post- each academic year). Items on this subscale were modified with permission from the following: McGinnis, J. R., Kramer, S., Shama, G., Graeber, A. O., Parker, C. A., & Watanabe, T. (2002).

Additional Teacher Subscale: *UB/BPS ISEP Teacher PLC Reflection* will be added to the post-Teacher Questionnaire in order to assess teachers' perceptions of their own and others involvement in the developing professional learning communities in their schools. This subscale will be administered post- each academic year to all teacher participants across project years. Parallel versions of this subscale will be administered to faculty, STEM students, and parents participating in the school-based PLCs.

2. *UB/BPS ISEP STEM Student Questionnaire* will collect data from UB STEM graduate and undergraduate students who have participated in project activities beginning in Fall 2011 and going forward. The questionnaire will be administered online via a secure link in June and September of each academic year beginning in September 2012. The draft questionnaire will be available for project team review and comment by August 15. The *UB/BPS ISEP Survey of UB STEM Students* has been developed and administered by Dr. Liu. The E & A Center has reviewed the survey and recommends that this survey be administered pre- and post- the 2011-2012 academic year to measure change in UB students' perceptions of experiences and skills in order to respond to relevant research and evaluation questions. The E & Center suggests merging the current STEM student survey (developed and administered by Dr. Liu) with other subscales to collect data at appropriate time points in order to reduce survey fatigue. The revised *UB/BPS ISEP STEM Student Questionnaire* would serve as a comprehensive data collection tool. The *UB/BPS ISEP Survey of UB STEM Students* instrument currently collects the following data:

(a) comprehensive demographics, including experiential history and career plan data (pre- each academic year),

(b) preparedness for aspects of project activities in schools (post- each academic year),

(c) report of experiences in schools (post- each academic year),

(d) perceived value of project experiences (post- each academic year),

(e) self-efficacy in communicating science (pre and post- each academic year).

Additional subscales that will be added to the UB STEM student instrument (beginning with the September 2012 administration) pre and/or post will include:

(f) perceived preparedness for aspects of science teaching, including STEM coursework (post- each academic year). Items on this subscale were modified with permission from the following: RMC Research (2009); and National Research Council (2012).

(g) perceived importance of teaching cross-cutting content in science and inquiry (pre and post- each academic year). Items on this subscale were modified with permission from the following: RMC Research (2009); and National Research Council (2012).

(h) measures of understanding of nature of science (NOS) and classroom science inquiry (SI) (pre and post- each academic year). Items on this subscale were modified with permission from the following: Lederman, N. G. (2006); National Research Council (2000); Liang, L. L., Chen, S. Chen, X., Kaya, O. N., Adams, A. D., Macklin, M., & Ebenezer, J. (2008); and National Science Teachers Association (2000).

(e) perceived importance of and familiarity with design, engineering, and technology (DET) (pre and post- each academic year). Items on this subscale were modified with permission from the following: Yasar, S., Baker, D., Robinson-Kurpius, S., Krause, S., & Roberts, C. (2006).

(k) reflection on PLC involvement (post- each academic year).

Further, the E & A Center will receive 2011-2012 pre- and post-survey (raw) data for secondary analysis and testing of instrument psychometric properties to the extent that current data permit.

3. *US/BPS ISEP Teacher Content and Pedagogical Content Knowledge Assessment* will collect data from teachers who will participate in project activities beginning in June 2012. The questionnaire will be administered online via a secure link during the months of May and June. Assessment items will focus on pedagogical understanding of fundamental cross-cutting science and science inquiry concepts and understanding of engineering design processes and principles. The *US/BPS ISEP Teacher Content and Pedagogical Content Knowledge Assessment* can be found in Appendix D. The following sources have been used with permission to develop this assessment:

Lawson, A. E. (2000) *Science attitudes, skills, and knowledge survey (SASKS): Forms 1, 2, and 3;* and (2001) *Science teacher attitudes, skills, and knowledge survey (S-TASKS).*

Schuster, D. & Cobern, W. W. (2007) Assessing pedagogical content knowledge of inquiry science instruction; and (2007) *The pedagogy of science teaching test (POSTT).*

As noted earlier, this instrument will collect baseline data on teachers' understandings of a range of science content and pedagogical approaches. During the next year, the Dr. Woodruff and Dr. Liu will assemble and lead a team of scientists and engineers to develop an interdisciplinary science inquiry content knowledge and pedagogical content knowledge measurement instrument that will be pilot tested in Spring 2013.

4. *US/BPS ISEP STEM Student Content and Pedagogical Content Knowledge Assessment* will be a shorter version of the teacher content and pedagogical content knowledge instrument. Assessment items will focus on pedagogical understanding of fundamental cross-cutting science and science inquiry concepts and understanding of engineering design processes and principles.

5. *UB/BPS ISEP Faculty Questionnaire* will collect data from UB and BSC faculty on their perceptions of involvement with project activities and other K-12 outreach efforts, assessment of changes in STEM student learning related to involvement in project activities, and reflections on engaging in school-based professional learning communities resulting from project efforts. This questionnaire will be administered at the end of each academic year. Self-report data regarding engagement in K-12 outreach will be supplemented/validated by institutional data, if available.

6. *UB/BPS ISEP Parent Questionnaire* will collect data from parents of students whose teachers have participated in project PD activities beginning in Summer 2012. Parents will be surveyed regarding their perceptions of involvement in their own student's learning related to project activities, and reflections on engaging in school-based professional learning communities resulting from project efforts. This questionnaire will be administered at the beginning and end of each academic year. The instrument will be administered in hard copy and data will be supplemented by conducting parent focus groups in Spring annually.

7. *UB/BPS ISEP BPS Student Questionnaire* will measure students' perceptions of their experiences with and interest in science and engineering, and changes in the classroom environment related to the PD experiences of their teachers. Comparison group data will be collected (if feasible) from a well-matched group of students whose teachers are not participating in project activities. The survey will be administered pre and post each academic year to a random sample of each teacher's students.

Summary and Next Steps

Dr. Woodruff met on site with the ISEP project team on May 23. During that meeting, project personnel shared reflections on the project's progress during Year 1 and planned for priority activities for early Year 2. The project team is to be commended for a number of significant accomplishments during Year 1:

- Recruitment of a full cohort of middle and high school teachers from 12 targeted partner schools;
- Successful outreach to and collaboration with a range of STEM faculty mentors to accommodate teacher research interests;
- Enhancement of an existing mutually beneficial authentic partnership with the Buffalo Public Schools, its teachers, administrators, parents, and the community;
- Refinement of a multifaceted professional development experience for teachers that addresses individual teacher needs and interests as well as school-based needs;
- Effective communication among project partners, including face-to-face meetings with teachers and administrators on site in schools; and
- Establishing clear responsibility for oversight of project tasks.

Work to be completed by the evaluation team during Summer 2012 includes:

1. Administer and analyze *UB/BPS ISEP Teacher Questionnaire* and *US/BPS ISEP Teacher Content and Pedagogical Content Knowledge Assessment.*
2. Develop other evaluation instruments, including *UB/BPS ISEP STEM Student Questionnaire, US/BPS ISEP STEM Student Content and Pedagogical Content Knowledge Assessment, UB/BPS ISEP Faculty Questionnaire, UB/BPS ISEP Parent Questionnaire, UB/BPS ISEP Student Questionnaire and the PLC Reflection* subscale.
3. Monitor and assess pilot PLC.
4. Complete collection of school- and teacher-level baseline data.

Appendix A

Updated Summative Evaluation Matrix

Summative Evaluation of Teachers

Project Goal 1: Improve middle school science teachers' knowledge and skills in science inquiry through conducting interdisciplinary science research and engineering design with university STEM faculty.

Anticipated Outcomes	*Evaluation Design and Data Collection/Analysis*	*Instruments and Protocols to be used in development*	*UB/BPS ISEP Instrument*
Summative Evaluation Question 1: Have middle school science teachers' knowledge and skills improved as the result of conducting interdisciplinary science research and engineering design with university STEM faculty?			
Science teachers will demonstrate advanced knowledge and skills in conducting interdisciplinary scientific research and engineering design	Pre- and post-assessments of teacher CK and PCK and engineering design (Years 1-5) ANOVA	POSTT (Schuster, et al, 2010) ATLAST (Horizon Research, 2008)	*US/BPS ISEP Teacher Content and Pedagogical Content Knowledge Assessment*
Summative Evaluation Question 2: Have middle school science teachers improved their understanding of the nature of science and inquiry science teaching?			
Science teachers will demonstrate improved understanding of nature of science and inquiry science teaching	Pre- and post-assessments of teacher understanding of NOS and SI (open-response items) (Years 1-5) Rubric scored ANOVA	Teacher Views of NOS and SI (Crawford, Capps, & Woodruff, 2008) based on VNOS-Form C (Lederman et al, 2002) Teacher Survey of Design, Engineering, and Technology – Importance of DET and Familiarity with DET subscales (Yasar, et al, 2006) Attitudes and Beliefs about the Nature and the Teaching of Mathematics and Science (McGinnis et al, 2002)	*UB/BPS ISEP Teacher Questionnaire*
Summative Evaluation Question 3: Have middle school science teachers improved their competence in conducting inquiry science teaching?			
Science teachers will demonstrate improved practice in conducting inquiry science teaching	Pre- and post-questionnaires administered to teachers and their students (Years 1-5) Protocol-based observations of teacher classrooms (Years 2-5) Rasch modeling HLM (growth models) when quality of data and sample size are sufficient.	OMSP CPE Teacher Needs Assessment (Woodruff & Zorn, 2010) OMSP CPE Teacher Instructional Practices Questionnaire (Woodruff, 2010) based on Local Systemic Change teacher interview (Horizon Research, Inc, 2005) Fossil Finders Teacher Views of NOS and SI (Crawford, Capps, & Woodruff, 2008) based on VNOS-Form C (Lederman et al, 2002) Local Systemic Change Classroom Observation Protocol (Horizon Research,	*UB/BPS ISEP Teacher Questionnaire* *UB/BPS ISEP BPS Student Questionnaire*

		Inc, 2005) What Is Happening in This Class (WIHIC) Questionnaire (Aldridge & Fraser, 2000) Science Lesson Plan Analysis Instrument (SLPAI) (Jacobs, Martin, & Otieno, 2008)	

Project Goal 2: Increase science teacher quantity, quality, diversity and retention in urban schools.

Anticipated Outcomes	***Evaluation Design and Data Collection/Analysis***	***Instruments and Protocols to be used in development***	***UB/BPS ISEP Instrument***
Summative Evaluation Question 4: Has the total number of highly-qualified science teachers increased? Has the science teacher population become more diverse? Are highly-qualified science teachers being retained in urban schools?			
Total number of highly-qualified science teachers teaching in the participating schools will increase Science teacher population diversity will increase Participating science teachers will be retained in their urban teaching positions	Collect longitudinal descriptive demographic, performance, and retention data on teachers from participating schools (from 2009-2014) and district trend data regarding HQT status of teacher candidate pool and new hires (from 2004-2014) Descriptive statistics disaggregated by race/ethnicity and gender Chi-square analysis and/or Qualitative categorization	District HR data OMSP CPE Teacher Needs Assessment (Woodruff & Zorn, 2010)	*UB/BPS ISEP Teacher Questionnaire* *UB/BPS ISEP School-level Data (2009-2014)* *UB/BPS ISEP Teacher-level Data (2010-2014)*

Project Goal 3: Develop and sustain professional learning communities in urban schools, based on mentoring models, with help from university STEM faculty and graduate students.

Anticipated Outcomes	***Evaluation Design and Data Collection/Analysis***	***Instruments and Protocols to be used in development***	***UB/BPS ISEP Instrument***
Summative Evaluation Question 5: Are professional learning communities formed and active in each school?			
Participating teachers will form learning communities with other teachers in their schools and the district	Repeated measures, post-questionnaire administered to all teachers in participating schools (Years 2-5) Descriptive statistics and ANOVA	School Culture Assessment Questionnaire (Sashkin, 1995) Science Teacher School Environment Questionnaire (STSEQ) (Huang, 2006)	*UB/BPS ISEP Teacher PLC Reflection –subscale on post- Teacher Questionnaire*

Appendix A

Updated Summative Evaluation Matrix

Project Goal 4: Extend interdisciplinary inquiry based science and engineering learning to high school.

Anticipated Outcomes	***Evaluation Design and Data Collection/Analysis***	***Instruments and Protocols to be used in development***	***UB/ BPS ISEP Instrument***
Summative Evaluation Question 6: Are high schools with participating students implementing interdisciplinary inquiry in classrooms?			
Students of participating middle school teachers will continue experiencing interdisciplinary science inquiry learning in high school and will achieve higher than other students	Pre- and post-questionnaire administered to sample of participating district high school science teachers (Years 1 and 5) Descriptive statistics and ANOVA	Teacher Communication and Collaboration Questionnaire (OPAPP, E & A Center) School Culture Assessment Questionnaire (Sashkin, 1995) Science Teacher School Environment Questionnaire (STSEQ) (Huang, 2006)	*UB/BPS ISEP Non-participant Teacher PLC Reflection*

Project Goal 5: Improve student achievement in science, attitude toward science-technology-society, and interest in pursuing advanced science studies.

Anticipated Outcomes	***Evaluation Design and Data Collection/Analysis***	***Instruments and Protocols to be used in development***	***UB/ BPS ISEP Instrument***
Summative Evaluation Question 7: Are students achieving higher learning standards in science?			
Students of participating teachers will achieve at a higher level standard than students of non-participating teachers	Comparing performance of students of participating teachers with that of other students (Years 1, 3, 5) ANCOVA	Classroom-level data regarding student district and/or state standardized test scores	*UB/BPS ISEP School-level Data (2009-2014)* *UB/BPS ISEP Teacher-level Data (2010-2014)*
Summative Evaluation Question 8: Are students more interested in learning science and pursing advanced studies in science?			
Students of participating teachers will become more interested in science	Pre- and post-questionnaire administered to a sample of students of participating and non-participating teachers (Years 1-5) Comparing course taking patterns of students of participating teachers with that of other students (Years 1, 3, 5) Rasch modeling and ANOVA	Classroom-level data regarding student course taking patterns Science, Technology, and Society Attitude Scale (Attitude Domain) (Enger & Yager, 2000) Student Questionnaire (OPAPP, E&A Center)	*UB/BPS ISEP BPS Student Questionnaire* *UB/BPS ISEP Teacher-level Data (2010-2014)*

Appendix A

Updated Summative Evaluation Matrix

Project Goal 6: Improve collaboration in student learning among university, school and parents.

Anticipated Outcomes	*Evaluation Design and Data Collection/Analysis*	*Instruments and Protocols to be used in development*	*UB/BPS ISEP Instrument*
Summative Evaluation Question 9: Are parents actively involved in project activities that support student learning?			
Parents will become more actively involved in school-based after-school programs	Tracking participation of parents in project-related activities (Years 1-5) Pre- and post-questionnaire administered to parents of participating teachers' students (Years 1-5) Descriptive statistics and ANOVA	Tracking sheet of parent participation at school or classroom level (TBD by project team) Parent/Adult Support of Science (PENN, E & A Center)	*UB/BPS ISEP Parent Questionnaire*
Summative Evaluation Question 10: Are science teachers actively participating in project activities?			
Science teachers in the participating schools will maintain their involvement in the partnership	Project record of teacher participation (Years 1-5) Repeated measures, post-questionnaire administered annually to teachers (Years 1-5) Descriptive statistics and ANOVA	Project database School Culture Assessment Questionnaire (Sashkin, 1995) Science Teacher School Environment Questionnaire (STSEQ) (Huang, 2006)	*UB/BPS ISEP Teacher PLC Reflection –subscale on post- Teacher Questionnaire*
Summative Evaluation Question 11: Are university STEM faculty and students actively participating in project activities that improve K-12 science education?			
University STEM faculty and students will be actively involved in activities improving K-12 science education	Repeated measures, post-questionnaire administered annually to STEM faculty (Years 1-5) Repeated measures, post-questionnaire administered annually to STEM students (Years 1-5) ANOVA or Rasch modeling HLM (growth models) when quality of data and sample size are sufficient	Faculty Questionnaire (E & A Center) School Culture Assessment Questionnaire (Sashkin, 1995) Science Teacher School Environment Questionnaire (STSEQ) (Huang, 2006)	*UB/BPS ISEP Faculty Questionnaire* *UB/BPS ISEP STEM Student Questionnaire*

Appendix A

Updated Summative Evaluation Matrix

Summative Evaluation of STEM Students

Objective 1: To develop STEM undergraduate students' and graduate students' understanding of the nature of interdisciplinary science inquiry including engineering research.

Anticipated Outcomes	*Evaluation Design and Data Collection/Analysis*	*Instruments and Protocols to be used in development*	*UB/BPS ISEP Instrument*
Summative Evaluation Question 1: Have STEM undergraduate students' and graduate students' improved their understanding of the nature of interdisciplinary science and engineering research?			
University STEM students will have increased abilities to develop interdisciplinary scientific and engineering research plans.	Repeated measures, post-questionnaire administered annually to STEM faculty (Years 1-5) ANOVA	Survey of Faculty Advisors (E & A Questionnaire) Analysis of dissertation/thesis proposals	*UB/BPS ISEP Faculty Questionnaire*
University STEM students will demonstrate increased understanding of the nature of interdisciplinary science inquiry.	Pre- and post-assessments of teacher understanding of NOS and SI (open-response items) (Years 1-5) Rubric scored ANOVA	Teacher Views of NOS and SI (Crawford, Capps, & Woodruff, 2008) based on VNOS-Form C (Lederman et al, 2002) Teacher Survey of Design, Engineering, and Technology – Importance of DET and Familiarity with DET subscales (Yasar, et al, 2006) Attitudes and Beliefs about the Nature and the Teaching of Mathematics and Science (McGinnis et al, 2002)	*UB/BPS ISEP STEM Student Questionnaire*

Objective 2: To develop STEM undergraduate students' and graduate students' communication skills to promote interdisciplinary science inquiry to middle and high school science teachers and students.

Anticipated Outcomes	*Evaluation Design and Data Collection/Analysis*	*Instruments and Protocols to be used in development*	*UB/BPS ISEP Instrument*
Summative Evaluation Question 2: Have STEM undergraduate students' and graduate students' developed communication skills to promote interdisciplinary science inquiry to middle and high school science teachers and students?			
University STEM students will develop increased pedagogical knowledge related to interdisciplinary inquiry	Pre- and post-assessments of STEM student CK and PCK and engineering design (Years 1-5) ANOVA	POSTT (Schuster, et al, 2010) ATLAST (Horizon Research, 2008)	*US/BPS ISEP STEM Student Content and Pedagogical Content Knowledge Assessment*
University STEM students will develop increased ability to develop collaboratively interdisciplinary science teaching and learning activities	Document analysis at the end of each academic year of interdisciplinary science teaching and learning activities	Protocol to be adapted from AAAS Curriculum Materials Evaluation Criteria Science Lesson Plan Analysis Instrument (SLPAI) (Jacobs, Martin, & Otieno, 2008)	

University STEM students will effectively tutor middle and high school students	Pre- and post-questionnaire administered to a sample of participating tutees (Years 1-5) ANOVA	What Is Happening in This Class (WIHIC) Questionnaire (Aldridge & Fraser, 2000)	*UB/BPS ISEP BPS Student Questionnaire*

Objective 3: To develop STEM undergraduate students' and graduate students' appreciation of professional learning communities and collaborative skills to actively contribute to the PLCs.

Anticipated Outcomes	***Evaluation Design and Data Collection/Analysis***	***Instruments and Protocols to be used in development***	***UB/BPS ISEP Instrument***
Summative Evaluation Question 3: Have To STEM undergraduate students' and graduate students' developed an appreciation of professional learning communities and collaborative skills to actively contribute to the PLCs?			
University STEM students will develop increased appreciation of professional learning communities	Repeated measures, post-questionnaire administered to all teachers in participating schools (Years 2-5) Descriptive statistics and ANOVA	School Culture Assessment Questionnaire (Sashkin, 1995) Science Teacher School Environment Questionnaire (STSEQ) (Huang, 2006)	*UB/BPS ISEP STEM Student Questionnaire*
University STEM students will actively contribute to professional learning communities	Analysis of school activity log Repeated measures, post-questionnaire administered to all teachers in participating schools (Years 2-5) Descriptive statistics and ANOVA	School Culture Assessment Questionnaire (Sashkin, 1995) Science Teacher School Environment Questionnaire (STSEQ) (Huang, 2006)	*UB/BPS ISEP STEM Student Questionnaire*

Table 1B. *Aggregate Science Teacher Information*

	Middle (K-8) Schools					High Schools				College Board / Gates School (6-12)	Vocational Schools			
	Harriet Ross Tubman Academy	**Charles Drew Science Magnet**	**Lorraine Academy**	**Southside Elem.**	**Native American Magnet (NAMS)**	**East HS**	**Bennett HS**	**South Park HS**	**Riverside Inst. of Tech. HS**	**MST Prep. School at Seneca**	**Burgard Voc. HS**	**Hutchinson Central Technical HS**	**BPS District Average**	**NY State Average**
# of Science Teachers	Data are not available on the New York State School Report Card. These data will be collected from the BPS central office.													
% American Indian or Alaska Native														
% Black or African American														
% Hispanic or Latino														
% Asian or Native Hawaiian/ Other Pacific Islander														
% White														
% Multiracial														
% w/o Appropriate License/ Certificate [a]	1%	12%	0%	0%	4%	7%	0%	4%	8%	0%	8%	5%	3%	3%
% w/ Master's+30 or PhD [a]	20%	27%	35%	34%	20%	12%	36%	32%	27%	24%	24%	27%	29%	36%
% of Core Courses **NOT** Taught By HQT [a]	2%	12%	0%	0%	0%	7%	0%	4%	5%	0%	9%	6%	3%	5% in high-poverty; 0% in low-poverty schools
Turnover Rate of	33%	0%	20%	50%	18%	10%	67%	40%	25%	50%	27%	67%	27%	21%

Teachers with Fewer than 5 yrs Exp [a]														
Turnover Rate of All Teachers [a]	22%	24%	16%	17%	14%	13%	17%	25%	19%	27%	15%	17%	21%	13%
# of Teachers who collaborate with UB/BSC faculty/ students	Data are not available on the New York State School Report Card. These data will be collected from the BPS central office.													

Note. The - symbol indicates that data for a group of students have been suppressed. If a group has fewer than 5 students, data for that group and the next smallest group(s) are suppressed to protect the privacy of individual students.
[a] Percentage for all teachers in the building, not just science teachers.

Table 2B. *Aggregate Student Demographics*

	Middle (K-8) Schools					High Schools				College Board / Gates Foundation School (6-12)	Vocational Schools			
	Harriet Ross Tubman Academy	**Charles Drew Science Magnet**	**Lorraine Academy**	**Southside Elementary**	**Native American Magnet (NAMS)**	**East HS**	**Bennett HS**	**South Park HS**	**Riverside Inst. of Tech. HS**	**MST Prep. School at Seneca**	**Burgard Voc. HS**	**Hutchinson Central Technical HS**	**BPS District Average**	**NY State Average**
Total number of students	455	470	556	957	405	610	848	817	762	387	602	1069	31,590	2,692,649
% American Indian or Alaska Native	1%	0%	2%	1%	22%	0%	0%	1%	4%	0%	1%	3%	1%	-
% Black or African American	89%	88%	22%	21%	39%	90%	86%	25%	48%	85%	81%	42%	55%	19%
% Hispanic or Latino	4%	3%	10%	10%	16%	5%	5%	16%	23%	6%	7%	10%	15%	22%
% Asian or Native Hawaiian/ Other Pacific Islander	0%	1%	1%	2%	15%	1%	2%	2%	9%	1%	4%	6%	5%	8%
% White	5%	7%	63%	64%	6%	3%	5%	55%	15%	7%	7%	40%	23%	50%
% Multiracial	1%	0%	1%	3%	2%	0%	1%	1%	0%	1%	0%	0%	2%	-
% Limited English	0%	1%	0%	1%	28%	1%	4%	6%	20%	2%	6%	1%	10%	8%
% Students with disabilities	Data are not available on the New York State School Report Card. These data will be collected from the BPS central office.													
% Poverty (% free/ reduced lunch)	93%	92%	77%	80%	98%	80%	73%	73%	77%	68%	72%	66%	79%	48%
% Male	Data are not available on the New York State School Report Card. These data will be collected from the BPS central office.													
% Female														

Note. The - symbol indicates that data for a group of students have been suppressed. If a group has fewer than 5 students, data for that group and the next smallest group(s) are suppressed to protect the privacy of individual students.

Table 3B. *Middle School Aggregate Student Performance Data*

	Middle (K-8) Schools						
	Harriet Ross Tubman Academy	**Charles Drew Science Magnet**	**Lorraine Academy**	**Southside Elementary**	**Native American Magnet (NAMS)**	**BPS District Average**	**NY State Average**
% of students admitted to highly selective HS	Data are not available on the New York State School Report Card. These data will be collected from the BPS central office.						
% of students taking advanced courses in MS							
% of Students Meeting or Exceeding NY State Standards (Scoring at Level 3 or 4):							
Grade 4 ELA %	6%	26%	43%	43%	18%	28%	57%
Grade 4 Math %	21%	27%	65%	65%	56%	35%	67%
Grade 4 Science %	32%	72%	96%	87%	74%	68%	88%
Grade 8 ELA %	8%	12%	18%	25%	19%	23%	47%
Grade 8 Math %	16%	9%	39%	39%	34%	28%	60%
Grade 8 Science %	50%	23%	50%	51%	47%	42%	72%

Table 4B. *High School Aggregate Student Performance Data*

	High Schools				College Board / Gates Foundation School (6-12)	Vocational Schools			
	East HS	Bennett HS	South Park HS	Riverside Institute of Technology HS	MST Preparatory School at Seneca	Burgard Vocational HS	Hutchinson Central Technical HS	BPS District Average	NY State Average
Graduation rate – All Students	46%	49%	48%	31%	71%	52%	88%	50%	76%
Graduation rate - American Indian or Alaska Native	-	-	-	-	-	-	-	47%	63%
Graduation rate - Black or African American	45%	48%	32%	30%	70%	51%	87%	47%	61%
Graduation rate - Hispanic or Latino	-	-	-	34%	-	-	-	41%	60%
Graduation rate - Asian or Native Hawaiian/ Other	-	-	-	-	-	-	-	52%	84%
Graduation rate - White	-	-	56%	33%	-	-	88%	61%	85%
Graduation rate - Multiracial	-	-	-	-	-	-	-	-	70%
Graduation rate - Female	54%	53%	53%	40%	80%	51%	93%	55%	80%
Graduation rate - Male	36%	45%	43%	23%	61%	53%	83%	44%	71%
% of students attending post-secondary school [b]	82%	83%	67%	89%	97%	88%	88%	83%	82%
% of students intending to major in STEM fields	Data are not available on the New York State School Report Card. These data will be collected from the BPS central office.								
% of Students Meeting or Exceeding NY State Standards (Scoring at or above 65):									
Regents Comprehensive English %	80%	65%	56%	74%	80%	42%	95%	75%	83% [c]
Regents Integrated Algebra %	25%	41%	27%	22%	55%	22%	75%	45%	72% [c]
Regents Geometry %	19%	14%	13%	11%	20%	12%	72%	32%	73% [c]
Regents Algebra 2/Trigonometry %	2%	12%	0%	13%	12%	38%	18%	18%	65% [c]
Regents Living Environments %	42%	61%	57%	32%	58%	53%	93%	61%	78% [c]
Regents Physical Setting/Earth Science	11%	25%	33%	15%	24%	8%	-	37%	74% [c]
Regents Physical Setting/Chemistry %	-	10%	11%	50%	64%	-	42%	53%	73% [c]
Regents Physics %	-	-	-	0%	-	-	58%	57%	82% [c]

Note. The - symbol indicates that data for a group of students have been suppressed. If a group has fewer than 5 students, data for that group and the next smallest group(s) are suppressed to protect the privacy of individual students.
[b] Percentage is based on the total number students completing high school.
[c] All State Regents data are from 2009-2010.

Ohio Evaluation & Assessment Center
MATHEMATICS • SCIENCE • EDUCATION

Targeted MSP: The University of Buffalo/Buffalo Public Schools (UB/BPS)
Interdisciplinary Science and Engineering Partnership
Teacher Questionnaire, Summer 2012

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DEMOGRAPHICS

Dear Teacher,

The following survey contains questions about professional development, instructional practice, meeting various student needs, and other topics related to mathematics and science. The information you provide is critical to the success of the UB/BPS ISEP project in which your are participating. We thank you for your assistance in collecting this information.

Instructions:

Please provide answers that best represent your situation. We request the following identification information so that we can match this questionnaire with one you may be asked to complete in the future. Your responses will be completely confidential. No identifying information will be provided to project personnel. All data will be reported in aggregate. **NOTE: Current page won't be saved until you click "Next" button.**

* = Required field.

***1. The first letter of your FIRST name is:** __________

***2. The first letter of your LAST name is:** __________

***3. Your date of birth is:** __________
(Format: MM/DD/YYYY)

What is your gender?

- Female
- Male

Are you Hispanic/Latino(a)?

- No, not Hispanic/Latino(a)
- Yes, Hispanic/Latino(a)

Please select race(s) from list below. (Choose all that apply)

- American Indian or Alaska Native
- Black or African American
- White
- Asian
- Native Hawaiian or other Pacific Islander

Please identify the school in which you teach:

Select:

Approximately how many students do you teach in an average year?

***Do you currently teach or will you teach in the next school year science and/or mathematics?**

	* Yes	No
a. Science	○	○
b. Mathematics	○	○

***Are you certified to teach science and / or mathematics?**

	Yes	No
a. Science	○	○
b. Mathematics	○	○

Including this year . . .

	Year(s)
a. How many years have you taught in a K-12 school?	
b. How many years have you taught mathematics in a K-12 school?	
c. How many years have you taught science in a K-12 school?	
d. How many years have you taught at your current school?	

In which grade do you currently teach: (Check all that apply)

	Science	Mathematics
Grade 3	☐	☐
Grade 4	☐	☐
Grade 5	☐	☐
Grade 6	☐	☐
Grade 7	☐	☐
Grade 8	☐	☐
Grade 9	☐	☐
Grade 10	☐	☐
Grade 11	☐	☐
Grade 12	☐	☐

	Yes	No
Are you a special education teacher?	○	○
Are you a career/technical education teacher?	○	○

What course(s) are you currently teaching?

(Please check all that apply.)

- ☐ 3rd Grade Science
- ☐ 4th Grade Science
- ☐ 5th Grade Science
- ☐ 6th Grade Science
- ☐ 7th Grade Physical Science
- ☐ 8th Grade Life Science
- ☐ Regents Biology
- ☐ Regents Earth Science
- ☐ Regents Chemistry
- ☐ Regents Physics
- ☐ High School Environmental Science
- ☐ High School AP Biology
- ☐ High School AP Chemistry
- ☐ High School AP Physics
- ☐ High School AP Environmental Science
- ☐ High School IB Biology Jr. & Sr.
- ☐ High School IB Physics Jr. & Sr.
- ☐ High School Advanced Biology
- ☐ High School Advanced General Chemistry
- ☐ High School Organic Chemistry
- ☐ Other (please specify): ________

At your school, besides you, how many other teachers are employed full time to teach at your grade level in…

	Number of Teachers
a. Science	
b. Mathematics	

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Teacher Questionnaire, Summer 2012

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DEMOGRAPHICS (Cont'd)

Instructions:
Please provide answers that best represent your situation. **NOTE: Current page won't be saved until you click "Next" button.**

Please identify all degrees you have earned.

Degree Earned	**Field(s)**
BA or BS	
MA, MS or MEd	
PhD or EdD	
Other (describe)	

In which of the following field(s) are you certified to teach mathematics? (Please check all that apply.)

	Yes, I am certified
ELEMENTARY	
PREK-6, 5-6	☐
MIDDLE GRADES	
5-9, 7-8, 7-9	☐
HIGH SCHOOL	
7-12	☐

If you are certified to teach other field(s) in mathematics not listed above, please specify:

In which of the following field(s) are you certified to teach science? (Please check all that apply.)

	Yes, I am certified
ELEMENTARY	
PREK-6, 5-6	☐
MIDDLE GRADES	
5-9, 7-8, 7-9	☐
HIGH SCHOOL	
7-12	☐
Certification Areas:	
Biology	☐
Chemistry	☐
Earth Science	☐
General Science	☐
Physics	☐

If you are certified to teach other field(s) in science not listed above, please specify:

Are you presently teaching in an area for which you hold a certificate/license?

- ○ Yes
- ○ No

Do you meet NCLB requirements for Highly Qualified Teacher status?

(A Highly Qualified Teacher is one who holds at least a bachelor's degree; holds a valid teaching certificate; and demonstrates subject matter competency for the core content area s/he teaches.)

- ○ Yes
- ○ No
- ○ Unsure

Are you now or have you previously participated in professional development activities with Univiersity of Buffalo and/or Buffalo State College?

- ☐ Yes, during the 2011-2012 school year.
- ☐ Yes, during the 2010-2011 school year.
- ☐ No.

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Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Questionnaire, Summer 2012

Ohio Evaluation & Assessment Center
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Teacher Questionnaire, Summer 2012

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DEMOGRAPHICS (Cont'd)

Instructions:
Please provide answers that best represent your situation. **NOTE: Current page won't be saved until you click "Next" button.**

Approximately how many hours of professional development with the University of Buffalo and/or Buffalo State College have you participated in for each of the following foci?

	Number of Hours in 2010-2011 School Year:	Number of Hours in 2011-2012 School Year:
Content-related		
Assessment-related		
Curriculum-related		
Pedagogy-related		

In 2010-2011 school year, the number of hours of professional development activities in which you participated NOT with the University of Buffalo or Buffalo State College is:

In 2011-2012 school year, the number of hours of professional development activities in which you participated NOT with the University of Buffalo or Buffalo State College is:

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MATHEMATICS PREPARATION

Instructions:
Please provide answers that best represent your situation. **NOTE: Current page won't be saved until you click "Next" button.**

How many of the following mathematics undergraduate and / or graduate courses have you taken?

	Number of Undergraduate Courses:	Number of Graduate Courses:
a. College Algebra		
b. Geometry		
c. Statistics		
d. Calculus		
e. Integrated Mathematics		
f. Other (please specify h		

Considering your undergraduate or graduate preparation to teach, please indicate how well your degree(s) prepared you for teaching in the following areas.

	Not Adequately Prepared	Somewhat Prepared	Well Prepared	Very Well Prepared	Not Sure
a. Algebra	○	○	○	○	○
b. Algebra II	○	○	○	○	○
c. Geometry	○	○	○	○	○
d. Statistics	○	○	○	○	○
e. Pre-calculus	○	○	○	○	○
f. Calculus	○	○	○	○	○
g. Integrated Mathematics	○	○	○	○	○
h. Middle School Mathematics	○	○	○	○	○
i. Elementary School Mathematics	○	○	○	○	○
Other (please specify)	○	○	○	○	○

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SCIENCE PREPARATION

Instructions:
Please provide answers that best represent your situation. **NOTE: Current page won't be saved until you click "Next" button.**

How many of the following science and engineering undergraduate and / or graduate courses have you taken?

	Number of Undergraduate Courses:	Number of Graduate Courses:
a. Chemistry		
b. Physics		
c. Life Sciences -- Biology, Zoology		
d. Earth and Space Sciences -- Geology, Astronomy		
e. Physical Sciences (other than Chemistry and Physics)		
f. Engineering		
g. Technology Education		
Other (please specify)		

Considering your undergraduate or graduate preparation to teach, please indicate how well your degree(s) prepared you for teaching in the following areas.

	Not Adequately Prepared	Somewhat Prepared	Well Prepared	Very Well Prepared	Not Sure
a. Chemistry	○	○	○	○	○
b. Physics	○	○	○	○	○
c. Life Science	○	○	○	○	○
d. Earth and Space Science	○	○	○	○	○
e. Physical Science	○	○	○	○	○
f. Middle School Science	○	○	○	○	○

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g. Elementary School Science	○	○	○	○	○
Other (please specify)	○	○	○	○	○

Please indicate how well prepared you feel to do each of the following.

	Not Adequately Prepared	Somewhat Prepared	Well Prepared	Very Well Prepared	Not Sure
a. Provide science instruction that meets appropriate standards (district, state, or national).	○	○	○	○	○
b. Teach scientific inquiry.	○	○	○	○	○
c. Manage a class of students who are using hands-on or laboratory activities.	○	○	○	○	○
d. Lead a class of students using investigative strategies.	○	○	○	○	○
e. Take into account students' prior conceptions about natural phenomena when planning instruction.	○	○	○	○	○
f. Align standards, curriculum, instruction, and assessment to enhance student science learning.	○	○	○	○	○
g. Sequence (articulation of) science instruction to meet instructional goals across grade levels and courses.	○	○	○	○	○
h. Select and/or adapt instructional materials to implement your written curriculum.	○	○	○	○	○
i. Know the major unifying concepts of all sciences and how these concepts relate to other disciplines.	○	○	○	○	○
j. Understand how students differ in their approaches to learning and create instructional opportunities that are adapted to diverse learners.	○	○	○	○	○
k. Teach science to students from a variety of cultural backgrounds.	○	○	○	○	○
l. Teach science to students who have limited English proficiency.	○	○	○	○	○
m. Teach students who have a learning disability which impacts science learning.	○	○	○	○	○
n. Encourage participation of females and minorities in science courses.	○	○	○	○	○
o. Provide a challenging curriculum for all students you teach.	○	○	○	○	○
p. Learning the processes involved in reading and how to teach reading in science.	○	○	○	○	○
q. Use a variety of assessment strategies (including objective and open-ended formats) to inform practice.	○	○	○	○	○
r. Use a variety of technological tools (student response systems, lab interfaces and probes, etc) to enhance student learning.	○	○	○	○	○
s. Teach interdisciplinary science inquiry.	○	○	○	○	○

Within science, many teachers feel better prepared to teach some topics than others, resulting in differing needs for professional development. Please indicate the degree to which these professional development needs are a priority for you at the grade levels you teach, whether or not they are currently included in your curriculum. Select the response that indicates your priority for each statement.

	Not a Priority	Low Priority	Moderate Priority	High Priority	Not Sure
1). Help students develop the ability to communicate with others an argument based on evidence.	○	○	○	○	○
2). Help students develop an understanding of scale, proportion,					

and quantity as these concepts are used to describe the natural world.	○	○	○	○	○
3). Help students develop an understanding of the behavior of organisms.	○	○	○	○	○
4). Help students develop the ability to use mathematics and computational thinking.	○	○	○	○	○
5). Help students develop the ability to construct explanations and design solutions.	○	○	○	○	○
6). Help students develop an understanding of chemical reactions.	○	○	○	○	○
7). Help students develop an understanding of patterns in natural events.	○	○	○	○	○
8). Help students develop an understanding of the interactions of energy and matter.	○	○	○	○	○
9). Help students develop an understanding of form and function.	○	○	○	○	○
10). Help students develop an understanding of the structure and properties of matter.	○	○	○	○	○
11). Help students develop an understanding of the conservation of energy and increase in disorder.	○	○	○	○	○
12). Help students develop the abilities needed to do scientific inquiry.	○	○	○	○	○
13). Help students develop an understanding of the structure of the atom.	○	○	○	○	○
14). Help students develop an understanding of the molecular basis of heredity.	○	○	○	○	○
15). Help students develop an understanding of energy in the earth system.	○	○	○	○	○
16). Help students develop an understanding of the theory of biological evolution.	○	○	○	○	○
17). Help students develop the ability to develop and use valid models.	○	○	○	○	○
18). Help students develop the ability to obtain, evaluate, and communicate information.	○	○	○	○	○
19). Help students develop the ability to ask questions and define problems.	○	○	○	○	○
20). Help students develop an understanding of matter, energy, and organization in living systems.	○	○	○	○	○
21). Help students develop the ability to analyze and interpret data.	○	○	○	○	○
22). Help students develop an understanding of systems, order, and organization.	○	○	○	○	○
23). Help students develop an understanding of evidence, models, and explanation.	○	○	○	○	○
24). Help students develop an understanding of the cell.	○	○	○	○	○
25). Help students develop a scientific understanding of the earth in the solar system.	○	○	○	○	○
26). Help students develop an understanding of the interdependence of organisms.	○	○	○	○	○
27). Help students develop the ability to plan and carry out investigations.	○	○	○	○	○
28). Help students develop an understanding of change, constancy, and measurement.	○	○	○	○	○
29). Help students develop an understanding of geochemical cycles.	○	○	○	○	○
30). Help students develop a scientific understanding of the origins of the earth and the universe.	○	○	○	○	○

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Appendix C

Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Questionnaire, Summer 2012

Ohio Evaluation & Assessment Center
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Targeted MSP: The University of Buffalo/Buffalo Public Schools (UB/BPS)
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Science as Inquiry & Understanding the Nature of Science

Instructions:

Please provide answers that best represent your situation. **NOTE: Current page won't be saved until you click "Next" button.**

Current reform documents in science education call for teaching "science as inquiry." The following statements represent views of inquiry-based teaching and learning. Please indicate your level of agreement with each of these statements regarding inquiry-based science teaching and learning.

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree
1. Inquiry-based learning requires that learners engage in answering a scientifically-oriented question.	○	○	○	○	○
2. Inquiry-based learning requires that learners gather (or are given) data to use as evidence for answering a scientifically-oriented question.	○	○	○	○	○
3. Inquiry-based learning requires that learners manipulate and analyze data to develop evidenced-based explanations, by looking for patterns and drawing conclusions.	○	○	○	○	○
4. Inquiry-based learning requires that learners connect their explanations with explanations and concepts developed by the scientific community.	○	○	○	○	○
5. Inquiry-based learning requires that learners communicate, justify, and defend their explanations.	○	○	○	○	○
6. Inquiry-based learning requires that learners first understand basic, key science concepts prior to engaging in inquiry activities.	○	○	○	○	○
7. Inquiry-based learning assumes that all					

science subject matter should be taught through inquiry.	○	○	○	○	○
8. Inquiry-based learning requires that learners generate and investigate their own questions.	○	○	○	○	○
9. Inquiry-based learning requires the use of hands-on or kit-based instructional materials.	○	○	○	○	○
10. Inquiry-based learning requires that learners are engaged in hands-on activities.	○	○	○	○	○
11. Inquiry, as a process of science, can be taught without attention to specific science content or subject matter.	○	○	○	○	○
12. Inquiry-based learning assumes that learners build new knowledge and understanding on what they already know.	○	○	○	○	○
13. Inquiry-based learning assumes that learners formulate new knowledge by modifying and refining their current concepts and by adding new concepts to what they already know.	○	○	○	○	○
14. Inquiry-based learning assumes that learning is mediated by the social environment in which learners interact with others.	○	○	○	○	○
15. Inquiry-based learning requires that learners take control of their own learning.	○	○	○	○	○
16. Inquiry-based learning assumes that learners develop the ability to apply knowledge to novel situations, and that the transfer of learning is affected by the degree to which learners develop understanding.	○	○	○	○	○
17. Inquiry-based learning requires more sophisticated materials and equipment than other types of classroom learning.	○	○	○	○	○
18. Inquiry-based teaching requires that the teacher act as a facilitator or guide of student learning rather than as a disseminator of knowledge.	○	○	○	○	○
19. Inquiry-based teaching focuses more on what the students do, rather than on what the teacher does.	○	○	○	○	○
20. Inquiry-based teaching requires that the teacher have a strong background in the science content related to the inquiry.	○	○	○	○	○

Current reform documents in science education suggest that understanding the nature of science is critical for developing scientific literacy. The following statements represent views of the nature of science. Please indicate your level of agreement with each of these statements regarding the nature of science.

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree
1. Science is a systematic way to gain an understanding of the natural world using naturalistic methods and explanations.	○	○	○	○	○
2. Scientific knowledge is reliable and durable so having confidence in scientific knowledge is reasonable.	○	○	○	○	○
3. A universal step-by-step scientific method is	○	○	○	○	○

used by all scientists.

4. Scientific experiments are the only means used to develop scientific knowledge.

5. Contributions to science are made by people from all cultures around the world.

6. Scientific observations and conclusions are influenced by the existing state of scientific knowledge.

7. With new evidence and/or interpretation, existing scientific ideas are replaced or supplemented by newer ones.

8. Basic scientific research is concerned primarily with practical outcomes related to developing technology.

9. The principal product of science is conceptual knowledge about and explanations of the natural world.

10. Scientific laws are generalizations or universal relationships about some aspect of the natural world and how it behaves under certain conditions.

11. Scientific theories are inferred explanations of some aspect of the natural world.

12. All scientific laws have accompanying explanatory theories.

13. Scientific conclusions are to some extent influenced by the social and cultural context of the researcher.

14. Scientific observations are to some extent influenced by the observer's experiences and expectations.

15. Scientists may make different interpretations based on the same observations.

16. Scientific theories are subject to on-going testing and revision.

17. Scientific laws are theories that have been proven.

18. Cultural values and expectations do not influence scientific research because scientists are trained to conduct unbiased studies.

19. Scientists do not use their imagination and creativity because these can interfere with objectivity.

20. Scientific knowledge is tentative and may be abandoned or modified in light of new evidence or reconceptualization of prior evidence and knowledge.

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Design Engineering and Technology (DET) Survey

Instructions:

The term "technology," as used in the national science standards, implies the design, engineering, and the technological issues related to conceiving, building, maintaining, and disposing of the useful objects and/or processes in the human-built world. Sometimes this term is referred to as "technological education," **but, please note that it is separate from the use of computers and educational technology in the classroom. It is also distinctly different from job training or vocational education**.

In this questionnaire, we use the term "Design/Engineering/Technology" or DET, synonymously with what the science standards call "technology." Examples of different Design/Engineering/Technology (DET) functions include:
- Building a paper bridge that will support a weight,
- Designing the layout of a new playground,
- Inventing a new device or process,
- Building working models of devices or processes.

NOTE: Current page won't be saved until you click "Next" button.

Do you use any science kits during science instruction?

☐ Yes
☐ No

If yes, please list the type of kits you use (such as SEPUP, FOSS, GEMS, STC, EiE, etc.):

Section I

Please answer the following questions by checking the most appropriate answer.

	Not At All	A Little	Neutral/Undecided	Somewhat	Very Much
1. How familiar are you with Design/Engineering/Technology as typically demonstrated in the examples given above?	○	○	○	○	○
2. Have you had any specific courses in Design/Engineering/Technology outside of your preservice curriculum?	○	○	○	○	○
3. Did your preservice curriculum include any aspects of Design/Engineering/Technology?	○	○	○	○	○
4. Was your pre-service curriculum effective in supporting your ability to teach Design/Engineering/Technology at the beginning of your career?	○	○	○	○	○
5. How confident do you feel about integrating more Design/Engineering/Technology into your curriculum?	○	○	○	○	○
6. How important should pre-service education be for teaching Design/Engineering/Technology?	○	○	○	○	○
7. Do you use Design/Engineering/Technology activities in the classroom?	○	○	○	○	○
8. Does your school support Design/Engineering/Technology activities?	○	○	○	○	○
9. Do you believe Design/Engineering/Technology should be integrated into the K-12 curriculum?	○	○	○	○	○

To what extent do you agree with the following statements?

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree
10. Most people feel that female students can do well in Design/Engineering/Technology.	○	○	○	○	○
11. Most people feel that minority students (African American, Hispanic / Latino, and American Indian) can do well in Design/Engineering/Technology.	○	○	○	○	○

As you teach a science curriculum, it is important to include...

	Not At All Important	A Little Important	Neutral/Undecided	Somewhat Important	Very Important
12. Planning a project.	○	○	○	○	○
13. Using engineering to develop new technologies.	○	○	○	○	○

I would like to be able to teach my students to understand the...

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree
14. Design process.					
15. Use and impact of Design/Engineering/Technology.					
16. Science underlying Design/Engineering/Technology.					
17. Types of problems to which Design/Engineering/Technology should be applied.					
18. Process of communicating technical information.					

My motivation for teaching science is...

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree
19. To prepare young people for the world of work.					
20. To promote an enjoyment of learning.					
21. To develop an understanding of the natural and technical world.					
22. To develop scientists, engineers, and technologists for industry.					
23. To promote an understanding of how Design/Engineering/Technology affects society.					

How strong is each of the following a BARRIER in integrating Design/Engineering/Technology in your classroom?

	Not Strong At All	A Little Strong	Neutral/Undecided	Somewhat Strong	Very Strong
24. Lack of time for teachers to learn about Design/Engineering/Technology.					
25. Lack of teacher knowledge.					
26. Lack of training.					
27. Lack of administration support.					
Other (please specify)					

How strongly do you agree that ...

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree
28. Design/Engineering/Technology has positive consequences for society.					

How much do you know about the ...

	Not At All	A Little	Neutral/Undecided	Somewhat	Very Much
29. National science standards related to Design/Engineering/Technology?	○	○	○	○	○

Section II

Please answer the following questions by checking the most appropriate answer.

	Not At All	A Little	Neutral/Undecided	Somewhat	Very Much
30. How enthusiastic do you feel about including Design/Engineering/Technology activities in your teaching?	○	○	○	○	○
31. How prepared do you feel to include Design/Engineering/Technology activities in your teaching?	○	○	○	○	○
32. How important is it for you that Design/Engineering/Technology activities are aligned to mathematics state and national standards?	○	○	○	○	○
33. How important is it for you that Design/Engineering/Technology activities are aligned to science state and national standards?	○	○	○	○	○

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Attitudes and Beliefs about Teaching Science and Mathematics

Instructions:

Please provide answers that best represent your situation. **NOTE: Current page won't be saved until you click "Next" button.**

Please indicate your level of agreement with each of the following statements.

	Strongly Disagree	Disagree	Neutral/Undecided	Agree	Strongly Agree
In Grades K–9, truly understanding mathematics in schools requires special abilities that only some people possess.	○	○	○	○	○
The use of technologies (e.g., calculators, computers) in mathematics is an aid primarily for slow learners.	○	○	○	○	○
Mathematics consists of unrelated topics (e.g., algebra, arithmetic, calculus, geometry).	○	○	○	○	○
To understand mathematics, students must solve many problems following examples provided.	○	○	○	○	○
Students should have opportunities to experience manipulating materials in the mathematics classroom before teachers introduce mathematics vocabulary.	○	○	○	○	○
Getting the correct answer to a problem in the mathematics classroom is more important than investigating the problem in a mathematical manner.	○	○	○	○	○
Students should be given regular opportunities to think about what they have learned in the mathematics classroom.	○	○	○	○	○
Using technologies (e.g., calculators, computers) in mathematics lessons will improve students' understanding of mathematics.	○	○	○	○	○
The primary reason for learning mathematics is to learn skills for doing science.	○	○	○	○	○

Small group activity should be a regular part of the mathematics classroom.	○	○	○	○	○
Using technologies (e.g., calculators, computers) in science lessons will improve students' understanding of science.	○	○	○	○	○
Getting the correct answer to a problem in the science classroom is more important than investigating the problem in a scientific manner.	○	○	○	○	○
In Grades K–9, truly understanding science in the science classroom requires special abilities that only some people posses.	○	○	○	○	○
Students should be given regular opportunities to think about what they have learned in the science classroom.	○	○	○	○	○
Science is a constantly expanding field.	○	○	○	○	○
Theories in science are rarely replaced by other theories.	○	○	○	○	○
To understand science, students must solve many problems following examples provided.	○	○	○	○	○
The use of technologies (e.g., calculators, computers) in science is an aid primarily for slow learners.	○	○	○	○	○
Students should have opportunities to experience manipulating materials in the science classroom before teachers introduce scientific vocabulary.	○	○	○	○	○
Science consists of unrelated topics such as biology, chemistry, geology, and physics.	○	○	○	○	○
Calculators should always be available for students in science classes.	○	○	○	○	○
The primary reason for learning science is to provide real-life examples for learning mathematics.	○	○	○	○	○
Small group activity should be a regular part of the science classroom.	○	○	○	○	○
The idea of teaching science scares me.	○	○	○	○	○
The idea of teaching engineering design concepts scares me.	○	○	○	○	○
I prefer to teach engineering design concepts and science emphasizing connections between the two disciplines.	○	○	○	○	○
I feel prepared to teach engineering design concepts and science emphasizing connections between the two disciplines.	○	○	○	○	○

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Teacher Questionnaire, Summer 2012

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Citations for UB ISEP Teacher Questionnaire

Some items and subscales in this instrument have been modified and used with permission. The E&A Center would like to acknowledge and thank the following:

FOR INQUIRY TEACHING AND LEARNING QUESTIONS:
Lederman, N. G. (2006). Syntax of nature of science within inquiry and science instruction. In L. B. Flick and N. G. Lederman (Eds.), *Scientific inquiry and nature of science* (pp. 301-317). Netherlands: Springer.

National Research Council. (2000). *Inquiry and the National Science Education Standards: A guide for teaching and learning*. Washington, DC: The National Academies Press.

FOR NATURE OF SCIENCE QUESTIONS :
Liang, L. L., Chen, S. Chen, X., Kaya, O. N., Adams, A. D., Macklin, M., & Ebenezer, J. (2008). Assessing preservice elementary teachers' views on the nature of scientific knowledge: A dual-response instrument. *Asia-Pacific Forum on Science Learning and Teaching*, 9(1), 1-19.

National Science Teachers Association (2000). *The nature of science—A position statement of NSTA*. Washington, DC.

FOR ATTITUDES AND BELIEFS ABOUT TEACHING SCIENCE AND MATHEMATICS QUESTIONS:
McGinnis, J. R., Kramer, S., Shama, G., Graeber, A. O., Parker, C. A., & Watanabe, T. (2002). Undergraduates' attitudes and beliefs about subject matter and pedagogy measured periodically in a reform-based mathematics and science teacher preparation program. *Journal of Research in Science Teaching*, 39(3), 713-737.

FOR DESIGN, ENGINEERING AND TECHNOLOGY SURVEY QUESTIONS:
Yasar, S., Baker, D., Robinson-Kurpius, S., Krause, S., & Roberts, C. (2006). Development of a survey to assess K-12 teachers' perceptions of engineers and familiarity with teaching design, engineering, and technology. *Journal of Engineering Education*, 205-216.

FOR SCIENCE AND MATHEMATICS PREPARATION QUESTIONS:
National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: The National Academies Press.

RMC Research. (2009). *Needs Assessment Survey for evaluation of the Nebraska Mathematics and Science Partnership projects*. Denver, CO: Author.

If you are satisfied with your responses, please click **"Finalize the Questionnaire"** button to submit your responses or click "**Back**" to modify your responses. **Note: after the responses are finalized, you cannot make any changes to your responses or access this questionnaire.**

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Appendix D
Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge Pre-Questionnaire, Summer 2012

Ohio Evaluation & Assessment Center
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Targeted MSP: The University of Buffalo/Buffalo Public Schools (UB/BPS)
Interdisciplinary Science and Engineering Partnership
Teacher Conent Knowledge and Pedagogical Content Knowledge, Summer 2012

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Dear Participant:

We want to thank you for your participation in the UB/BPS ISEP project. As part of the project evaluation, you are being asked to complete this online questionnaire, which includes the questions regarding your basic information, the content knowledge, and pedagogical content knowledge which will be covered in the ISEP workshop. **Please complete this questionnaire by June 15.**

Please spend no more than 1.5 hour on this questionnaire, do not use any outside resources, and allow sufficient time to complete the questionnaire in one sitting. Although we have asked for identification information in order to link your responses across the points of data collection, you will never be identified in any reports or summaries of the data. After individual responses are entered into the database, access to the data is strictly limited. Your participation is completely voluntary; you may refuse to answer certain questions or withdraw from the evaluation at any point. All the questionnaire data are confidential. Failure to participate will not affect you in any way, but it will weaken the overall study because your important ideas and opinions will not be represented. **By clicking to the next page, you indicate your consent to participate in this portion of the evaluation.**

If you have questions about the questionnaire or the evaluation, please contact me at 513-529-1686. If you have questions about participant rights, please contact the Office for the Advancement of Research and Scholarship at Miami University, 513-529-3600. If you have questions or concerns regarding the UB/BPS ISEP project, please contact Xiufeng Liu, xliu5@buffalo.edu. Thank you again for your participation.

Sincerely,

Sarah B. Woodruff
Sarah B. Woodruff, Director
Ohio's Evaluation and Assessment Center for Mathematics and Science Education

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Appendix D
Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge Pre-Questionnaire, Summer 2012

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Teacher Conent Knowledge and Pedagogical Content Knowledge, Summer 2012

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Demographics

Instructions:
Please provide answers that best represent your situation. We request the following information so that we can match this questionnaire with one you may be asked to complete in the future. Your responses will be completely confidential. No identifying information will be used in any report or paper. **NOTE: Current page won't be saved until you click "Next" button.**

***1. The first letter of your FIRST name is:**

***2. The first letter of your LAST name is:**

***3. Your date of birth is:**
(Format: MM/DD/YYYY)

Please identify the school in which you teach:

Select:

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Appendix D
Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge Pre-Questionnaire, Summer 2012

Ohio Evaluation & Assessment Center
MATHEMATICS • SCIENCE • EDUCATION

Targeted MSP: The University of Buffalo/Buffalo Public Schools (UB/BPS) Interdisciplinary Science and Engineering Partnership

Teacher Conent Knowledge and Pedagogical Content Knowledge, Summer 2012

Teacher Content Knowledge & Pedagogical Content Knowledge

Instructions:

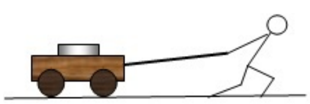
Items 1 through 14 of this assessment are composed of classroom science teaching vignettes similar to teaching practices one can find in classrooms today. Teachers contributed ideas for many of the vignettes; others are based on observations of teaching, or on science curriculum standards.

As you read each vignette, think about how you might teach science in a similar situation. Respond accordingly.

NOTE: Current page won't be saved until you click "Finalize the Questionnaire" button.

1 - Lesson on force and motion

Ms. Brandt is preparing a lesson to introduce her middle school students to the relationship between force and motion, namely that a net force will cause an object to speed up or slow down (Newton's 2nd Law). The classroom has available a loaded wagon to which a pulling force can be applied. Ms. Brandt is considering four different approaches to the lesson.



Thinking about how you would want to teach this lesson, of the following, which one is most similar to what you would do?

- A. I would raise the question of what kind of motion results from a constant force. I would then guide my students to explore the question themselves by pulling on a loaded wagon and observing what happens. From the evidence they would then propose a law, which I would then say is called Newton's 2nd law.
- B. I would write a clear statement of Newton's 2nd Law on the board and explain it carefully for my students. I would then have the students verify the law by pulling on a loaded wagon themselves and confirming what type of motion results.
- C. I would raise the question of whether there is any relationship between force and motion. Student groups would be free to explore this safely in any way they wish, using any available equipment in the lab. I would not prescribe but be available. Groups report back and discuss their findings at the end.
- D. I would write a clear statement of Newton's 2nd Law on the board and explain it carefully. Then I would demonstrate the law by pulling on a loaded wagon with a constant force in front of the class as they observe the motion.

Appendix D

Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge Pre-Questionnaire, Summer 2012

1A. Please briefly describe how you would introduce this same concept or topic to students in your classroom (at the specific grade level or in the course you teach).

2 - Organisms respond to environment

Ms. Pendleton's middle school students have conducted a series of experiments to collect data on how earthworms respond to their environment. Then in small groups they discuss their observations guided by a series of questions about the experiments. Ms. Pendleton now needs to wrap up the lesson.

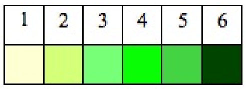
Of the following, which one is most similar to how you would wrap up this lesson?

- A. Have the students come up with a general conclusion based on the evidence they gathered from their earthworm experiments, while guiding them toward the concept or topic objective.
- B. Restate the concept or topic objective for the students, and ask students to provide supporting evidence from their earthworm experiments.
- C. Have students report their conclusions, based on the evidence gathered from their earthworm experiments.
- D. Restate the concept or topic objective for the students, relating it to the observations they gathered in their earthworm experiments.

2A. Please briefly describe how you would wrap up a lesson covering this same concept or topic to student in your classroom (at the specific grade level or in the course you teach).

3 - Photosynthesis

Ms. Hamid has been teaching her middle school students about photosynthesis, and in particular that chlorophyll production in plant leaves is light-induced. She sets up an experiment to illustrate this. She has placed fast-growing seedlings where they are exposed to different levels of light intensity. The students observe the growing plants over several days and estimate the amount of chlorophyll using a color chart to record leaf color each day. They record their data in their science notebooks and a classroom data table. On the last day, Ms. Hamid reviews the role of light in chlorophyll production as illustrated by this activity.



Thinking how you would teach this topic, of the following, which is closest to how you would evaluate Ms. Hamid's lesson?

- A. This is a good lesson design overall because Ms. Hamid begins with an explanation of the concept or topic she wants the students to learn followed by an activity for students to confirm that chlorophyll production is light-induced.
- B. Ms. Hamid begins appropriately with an explanation of the concept or topic she wants the students to learn. This being so, it is not clear that the activity is needed, especially since it requires so much class time.
- C. Ms. Hamid's approach is too pre-organized and prescriptive. It would be better for students themselves to decide how to set up plants and lights, see what happens, and figure out a way to compare chlorophyll production in the leaves.
- D. The instructional sequence would be better if the students did the plant observations first, thus showing that chlorophyll is light-induced, after which Ms. Hamid could explain more fully what is going on.

3A. Please briefly describe in what way your lesson covering this same concept or topic with students in your classroom (at the specific grade level or in the course you teach) would be different from the one described here.

4 - Air is matter

Ms. Harvey's middle school class has been learning about matter. She wants to address her students' misconception that gases (like air) are <u>NOT</u> matter. She introduces the topic by raising the question with her students about whether air is matter and how they could find out.

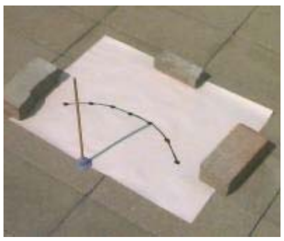
Ms. Harvey is still considering what to do next. Thinking about how you would teach this lesson, of the following, which is most similar to what you would do next?

- A. I would ask students to think up ways to test if air is matter using whatever materials or equipment we have in the classroom. I would then allow them to go ahead and try their various ideas, safely.
- B. I would help the students generate ideas about ways to test the question of whether air is matter. I'd then focus on the idea of feeling wind, have them investigate with fans, and to conclude that air is indeed matter.
- C. I would tell the students that air is indeed matter, and that although air is not very dense, there is something there that can be felt. I would then ask them to use fans at their desks to see if they could find evidence that air was matter.
- D. I would tell the students that air is indeed matter, and that although air is not very dense, there is something there that can be felt. I would then demonstrate this property to the class by having them feel the air from a fan.

4A. Please briefly describe another misconception / naïve conception that students may have about matter and how you would address it in your classroom (at the specific grade level or in the course you teach).

5 - Sundials

Ms. Navetta is planning a lesson for her middle school students on the changing position of the sun in the sky during the day and how this is the basis of a simple 'sundial' to tell time of day. The basic sundial is a simply a vertical stick on a piece of board, and in sunlight the angle of the stick's shadow can be marked on the board. Ms. Navetta also has a large demonstration model with lines marked at various angles and labeled with hours of the day.



Ms. Navetta considers various ways to conduct the lesson. Of those below, which is most similar to how you would teach?

- A. Explain how a sundial works related to sun position in the sky. Have each group assemble a basic sundial, using a prepared handout sheet with lines and hour markings. Then take the students outside to try out their sundials and see that they indicate the correct time of day.
- B. Do not first explain sundials but take the students outside and have each group set up a stick and board. Ask them to brainstorm what this might be useful for, and to expand on their ideas. Have them come back every hour, anticipating that they will mark a series of shadow lines to make what is effectively a sundial.
- C. Explain how a sundial works, in relation to sun position in the sky. Then gather the class outside around the large demonstration model, so they can see how the sundial indicates the time of day. Come back an hour later to see that the shadow has moved to the next marking.
- D. Instead of explaining sundials first, take the students outside and note the location of the sun in the sky. Have each group set up a stick and board and mark the position of the shadow. Ask them to suggest how this might be used as a 'shadow clock' to tell time of day. Have them come back every hour and mark a new shadow angle, labeling it with the hour, to make what is effectively a sundial.

5A. Please briefly describe what modifications you would make to your choice (A-D) to conduct a lesson covering this same concept or topic to students in your classroom (at the specific grade level or in the course you teach).

6 - General wrap-up of unit

Mr. Nelson's middle school students have just completed a unit in their earth science class. As a "wrap-up," Mr. Nelson would like students to re-examine the three main learning objectives that served as the focus for this unit.

Of the following, which is most similar to how you would like to conduct the wrap-up?

- A. I would ask the students what the main things were that they learned in the unit, according to their own ideas of what is important or interesting, and have them list these as the unit wrap-up.
- B. I would restate the three main learning objectives for the students, and then relate each of them to the specific concept or topic that arose in the unit.
- C. I would ask the students to reflect back on their work, and identify for themselves what the important main ideas of the unit were, then have them relate these to the original learning objectives.
- D. I would restate the three main learning objectives, then ask the students to say how the various concepts or topics that arose in the lesson related to each of these.

6A. Please briefly describe how you would conduct a “wrap-up” of a lesson with students in your classroo (at the specific grade level or in the course you teach) if many students had not demonstrated mastery of the main concept or topic of the lesson.

7 - Structure and function

Mr. Danzit will be teaching his middle school students a lesson on “structure and function” as applied to digestive systems. He has a set of pictures showing the mouths of different animals, including a finch beak, a dog jaw with teeth, and horse jaw with teeth. He also has a chart that he can distribute to the students, which will allow them to fill in information about what each of these animals can and cannot eat.

Thinking about how you would teach this lesson, of the following, which is the best statement on how Mr. Danzit should begin the lesson?

- A. Mr. Danzit should begin the lesson by carefully explaining the concept of structure and function as it relates to the digestive system, specifically mouth parts. He should then ask the students to fill out the chart using the pictures and his discussion as a guide.
- B. Mr. Danzit should allow the students to explore a set of photos showing animal mouths. He should then have the students write their own explanations about how these animals are similar and different, including what they eat.
- C. Mr. Danzit should begin the lesson by carefully explaining the concept of structure and function, while helping students fill in their charts, so they can clearly see examples of this concept as it relates to digestive systems.
- D. Mr. Danzit should begin the lesson by showing his students a picture of a shark mouth, asking student what this animal might eat. After a discussion, he should give each student a copy of the chart and the other pictures, asking students to complete the chart based on their early discussion.

7A. Please briefly describe how you would introduce this same concept or topic to students in your classroom (at the specific grade level or in the course you teach).

8 - Field trip

Appendix D
Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge Pre-Questionnaire, Summer 2012

Ms. Piper is taking her middle school class to the local nature center. Because they are currently studying food webs, she would like to use the field trip as a way to learn more about this topic.

Thinking about how you would teach, of the following, how would you most likely use a field trip to teach students about food webs?

- A. I would inform them that on our upcoming field trip they will be looking for examples of food webs. During the field trip, students could make their own list of interactions they observe relating to food webs, which we would discuss later as a group.
- B. I would inform students before the field trip that we are going to look for specific examples of food webs, providing them a checklist of interactions they should see. During the field trip, I would point out the various interactions, having them mark off each as we go.
- C. I would not tell students exactly what to look for during the field trip, but would ask them to make observations about any interactions they see between organisms. Afterwards we could discuss what they saw relating to food webs.
- D. I would inform students before the field trip that we are going to look for specific examples of food webs, providing them a checklist of interactions they should see. During the field trip, students could look for those examples and mark them off as we go.

8A. Please briefly describe how your choice (A-D) reflects your beliefs about the role of inquiry teaching a learning in your classroom (at the specific grade level or in the course you teach).

9 - Predator and prey

Mr. Peoples is conducting a unit on food chains and is about to introduce his middle school students to predator/prey relationships. He has a computer simulation 'game' for this subject that he can use with his class.

Thinking about how you would teach, of the following, which is the best advice for conducting this lesson?

- A. Mr. Peoples should explain that balance typically exists in nature such that the numbers of predators and their prey are related. For example, he can tell them that a rabbit population will increase if disease reduces the coyote population. He should then project the simulation game on the screen to demonstrate how the relationship between rabbit and coyote populations works.
- B. Mr. Peoples should explain that balance typically exists in nature such that the numbers of predators and their prey are related. For example, he can tell them that a rabbit population will increase if disease reduces the coyote population of the same region. He should have the students use the computer simulation to generate rabbit numbers over an extended period during which the population of coyotes falls, so that they can see the predator/prey relationships that he explained.
- C. Mr. Peoples should ask what would happen to rabbit numbers if many coyotes died of disease. After some discussion, Mr. Peoples should suggest that the students explore their ideas using the computer simulation to generate rabbit numbers over an extended period during which the population of coyotes falls. The students' finding would then be used in class discussion of predator/prey relationships.
- D. Mr. Peoples should begin by asking the students what they know about predators and prey. Without responding other than to encourage their ideas, Mr. Peoples should then introduce the computer simulation and invite them to use it on their computers in any way they wish to explore their ideas. The lesson would end with students reporting back what they found.

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9A. Please briefly describe how your choice (A-D) reflects your approach to using computer simulations to teach science in your classroom (at the specific grade level or in the course you teach).

10 - Sink or float

Ms. Hoo has her middle school students gather around a small pool of water. She has a set of objects of different sizes and different materials; chosen so that some will sink and some will float. Ms. Hoo's goals are to determine what students understand about objects that sink and float, and what naïve conceptions they may hold about density.

Thinking of how you would conduct this lesson, of the following, which is most similar to what you would do?

- A. Have students one by one drop an object into the water, with everyone observing whether it sank or floated. Then ask them to suggest what this depended on; if some suggest size and others suggest what the object is made of, have them test these ideas by dropping more objects. Then have them discuss and agree on a conclusion.
- B. Have students one by one drop an object into the water, with everyone calling out whether it sank or floated. Point out to them that all the stones sank, no matter how big or small, and all the wooden blocks floated. Conclude with the lesson objective, i.e. it is not size that matters but the material the object is made of.
- C. Drop objects one by one into the water, and have the students notice that some sink and some float. Point out that all the stones sank, no matter how big or small, and all the wooden blocks floated. Conclude with the lesson objective, that it is not size that matters but the material the object is made of.
- D. Have the students each take a selection of objects from the pile, drop them into the water, and note what happens. Then have them talk among themselves about it. Then ask volunteers to give their ideas about it, with others saying if they agreed or not.

10A. Please briefly describe how you would follow-up on this lesson with students in your classroom (at tl specific grade level or in the course you teach) to identify students' remaining misconceptions on this topi

11 - Light reflection

Ms. Baker will be teaching about reflection of light with her middle school class. Her aim is for students to come to understand that when a beam of light strikes a mirror it reflects at an angle equal to the angle at which it came in – the law of reflection. Ms. Baker has to decide on a lesson plan.

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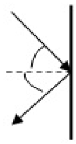
Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge Pre-Questionnaire, Summer 2012



Thinking about your own teaching, of the following, which is most similar to how you would structure and sequence the lesson?

- A. I would write the law of reflection on the board and illustrate with a diagram. Next I'd do a large-scale demonstration of the law for the class, using a light beam, mirror, and protractor, for several angles. We would discuss any questions the students had.
- B. I would ask students to find out what they can about light behavior and mirrors by exploring on their own using an assortment of available items, including light ray sources, mirrors, and protractors. I would not prescribe but be available. Toward the end, student groups would report back on what they did and found out.
- C. I would raise the question of might happen to a light beam when it strikes a mirror, for students to explore. Student groups would investigate at their benches using light ray sources, mirrors, and protractors, then propose a law to account for their observations. I would close the lesson with a discussion of the law of reflection.
- D. I would write the law of reflection on the board and illustrate with a diagram. Then I'd have the student groups verify the law experimentally using light ray sources, mirrors, and protractors, following an instruction sheet. We would then discuss how their results accorded with the law.

11A. Of the choices A-D, please rank these instructional approaches from the <u>most</u> teacher-directed lessor to the <u>least</u> teacher-directed lesson and explain your ranking.

12 - Moon in the daytime – a teachable moment

Ms. Luna had taught her middle school students how the appearance of the moon (different phases) is due to its illumination by the sun at different angles. As part of her lesson she used the picture shown, illustrating how the various phases look at night. Toward the end of the lesson one student Max looks out the window at the sky. He is surprised: he excitedly tells Ms. Luna he can see the moon but it is daytime! He is puzzled and asks how this can be. Ms. Luna wants to use this as a 'teachable moment' to enhance their understanding of how moon phases arise. She congratulates Max on his observation and has everyone go outside to look before coming back in.

Thinking about how you would teach, how would you suggest Ms. Luna *continue* when back in the classroom?

- A. Throw Max's question back to the students: ask them to explain the daytime observation by drawing sky diagrams for that day, showing moon and sun, and applying what they have learned about light and illumination.
- B. Tell the class there is no reason that the moon cannot be seen in the daytime. Then ask students to apply what she has taught them and draw diagrams showing how the moon is being illuminated by the sun on that day.
- C. Tell the class there is no reason that the moon cannot be seen in the daytime. Then draw a sky diagram on the board showing how the moon is being illuminated by the sun on that day.
- D. Throw Max's question back to the students: have them come up with ideas and possible explanations on their own, and report these to the class, followed by discussion.

12A. Please briefly describe what modifications, if any, you would make to this lesson in your classroom (a

the specific grade level or in the course you teach) if a large number of students in the class had been identified as having special learning needs.

13 - Thermometers and how they work

Mr. Dole is developing a science lesson for his middle grades students, in which he would like them to acquire an understanding of thermometers and how they work. He has real thermometers available, and also has materials that students could use to assemble their own basic thermometers (small bottle as bulb, cork with hole, straws and colored water). Mr. Dole considers four different ideas about how he might structure and teach the lesson.

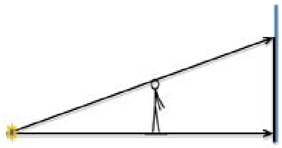
Thinking about how you would teach, of the following, which is most similar to the approach you would take?

- A. Start by telling the class that today they will discover something for themselves. Each group will have a bottle, cork, straw and colored water, plus containers of hot and cold water. Show them how to assemble the materials but give no further guidance. They can explore as they wish and come up with ideas, which they can then report to the class.
- B. Introduce the lesson by saying that students will be making a mystery device today, seeing how it behaves, and then thinking what it might be used for. Show the students how to assemble their materials, then have them explore what happens to the water column in the straw when they put the bulb in cold and hot water. Then ask them to suggest what they have 'invented' and what it can be used for. Finally wrap up with a discussion of thermometers and how they work.
- C. First ask the class what they know about thermometers. List student responses on the board, and then working from some of their ideas, draw a thermometer on the board and explain how it works. Then have students use thermometers at their tables, measuring the temperatures of cold and hot water.
- D. Write the lesson title 'Thermometers' on the board and draw a thermometer diagram. Explain how a thermometer works and answer student questions. Conclude by placing a large real thermometer in cold and hot water and showing students how the thermometer reading changes.

13A. Please briefly describe how you would modify this lesson in your classroom (at the specific grade lev or in the course you teach) in order to include a focus on engineering design or the relationship of science and technology.

14 - Light & shadows – a prediction task

Ms. Adams's middle grades students have learned that light travels in a straight path and that shadows arise when an object blocks light. Ms. Adams wants her students to be able to *apply* these ideas to make predictions about shadow behavior. She turns out the room lights, and has one student, Sam, stand in the light from a lamp on the floor, thus casting a shadow on the wall. Students draw ray diagrams in their notebooks showing how Sam's shadow is being formed. Ms. Adams then says that once we understand how shadows form we can *predict* what will happen to the shadow if Sam now moves further from the lamp.



Thinking about how you would teach, of the following, which is most like how you would suggest Ms. Adams handle the prediction aspect of the lesson?

- A. Have students follow her directions to make a second diagram in their notebooks to represent Sam further away, and point out to them how this diagram shows the shadow becomes smaller. Then have Sam actually move, to confirm the prediction.
- B. Draw a ray diagram on the board to show that the shadow will be smaller when Sam is further from the lamp. Then have Sam actually move to confirm your prediction.
- C. Ask the students to predict what will happen to the shadow if Sam moves further from the lamp. They can do this in any way they wish. Then have them report and explain their predictions. Finally have Sam move to check their predictions. If there are discrepancies let the students discuss and resolve.
- D. Ask the students to make their own predictions of what will happen to the shadow, based on what they have learned about shadow formation, and drawing suitable ray diagrams. Take a few predictions, then have Sam move to check what actually happens. If there are discrepancies, lead a discussion to resolve.

14A. Please briefly describe what modifications, if any, you would make to this lesson in your classroom (a the specific grade level or in the course you teach) if a large number of students in the class had been identified as gifted learners.

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Targeted MSP: The University of Buffalo/Buffalo Public Schools (UB/BPS) Interdisciplinary Science and Engineering Partnership

Teacher Conent Knowledge and Pedagogical Content Knowledge, Summer 2012

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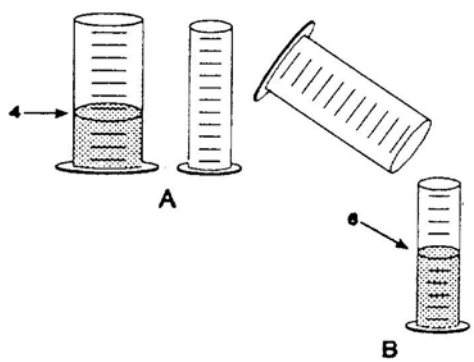
Teacher Content Knowledge & Pedagogical Content Knowledge (Cont'd)

Instructions:

Items 15 through 40 cover a variety of science content. Some of the items have two parts. Each item has only one correct response.

NOTE: Current page won't be saved until you click "Finalize the Questionnaire" button.

15. To the right are drawings of a wide and a narrow cylinder. The cylinders have equally spaced marks on them. Water is poured into the wide cylinder up to the 4th mark (see A). This water rises to the 6th mark when poured into the narrow cylinder (see B).



Both cylinders are emptied, and water is poured into the narrow cylinder up to the 11th mark. How high would this water rise if it were poured into the empty wide cylinder?

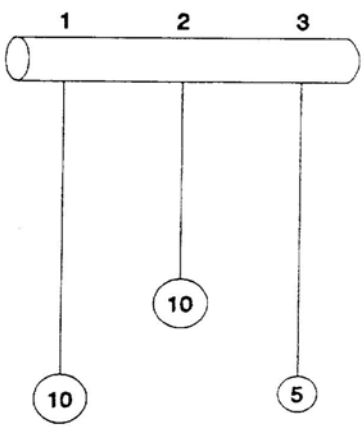
- A. to about 7 1/2
- B. to about 9
- C. to about 8

- D. to about 7 1/3
- E. none of these answers is correct

15A. Because

- A. the ratios must stay the same.
- B. one must actually pour the water and observe to find out.
- C. the answer can not be determined with the information given.
- D. it was 2 less before so it will be 2 less again.
- E. you subtract 2 from the wide for every 3 from the narrow.

16. At the right are drawings of three strings hanging from a bar. The three strings have metal weights attached to their ends. String 1 and String 3 are the same length. String 2 is shorter. A 10 unit weight is attached to the end of String 1. A 10 unit weight is also attached to the end of String 2. A 5 unit weight is attached to the end of String 3. The strings (and attached weights) can be swung back and forth and the time it takes to make a swing can be timed.



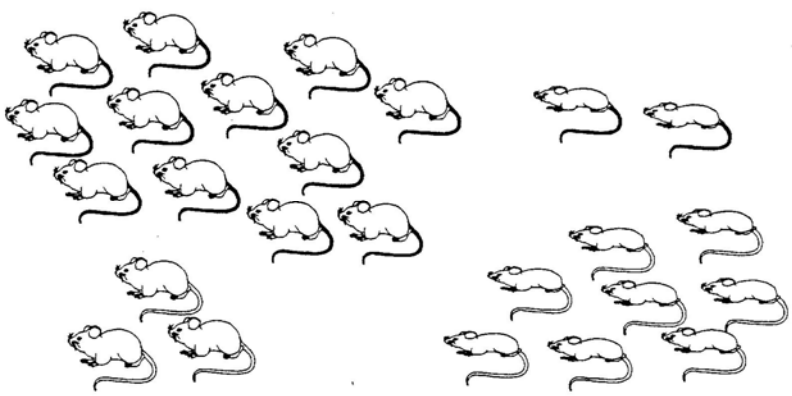
Suppose you want to find out whether the length of the string has an effect on the time it takes to swing back and forth. Which strings would you use to find out?

- A. only one string
- B. all three strings
- C. 2 and 3
- D. 1 and 3
- E. 1 and 2

16A. Because

- A. you must use the longest strings.
- B. you must compare strings with both light and heavy weights.
- C. only the lengths differ.
- D. to make all possible comparisons.
- E. the weights differ.

17. Farmer Brown was observing the mice that live in his field. He discovered that all of them were either fat or thin. Also, all of them had either black tails or white tails. This made him wonder if there might be a link between the size of the mice and the color of their tails. So he captured all of the mice in one part of his field and observed them. Below are the mice that he captured.



Do you think there is a link between the size of the mice and the color of their tails?

- A. appears to be a link
- B. appears not to be a link
- C. can not make a reasonable guess

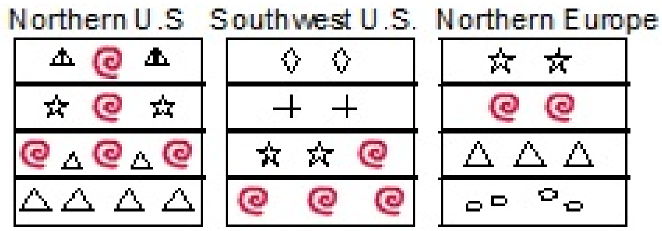
17A. Because

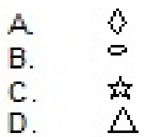
- A. there are some of each kind of mouse.
- B. there may be a genetic link between mouse size and tail color.
- C. there were not enough mice captured.
- D. most of the fat mice have black tails while most of the thin mice have white tails.
- E. as the mice grew fatter, their tails became darker.

18. Which of the following properties of the Earth is the result of the processes of living things?

- A. The Earth's oceans are salty
- B. The Earth has magnetic poles
- C. The Earth's atmosphere contains a lot of oxygen
- D. The Earth's crust contains a lot of volcanic rock

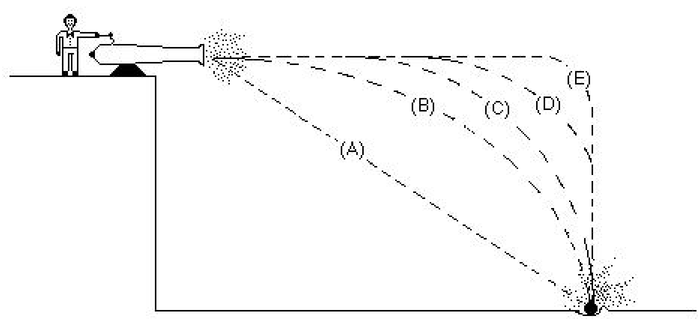
19. If the diagrams below represent rock layers at three different places on Earth and the shapes in the diagrams represent the type of fossils found in each rock layer, which of the following is most likely to be found immediately below the lowest rock layer in the Southwest U.S.?





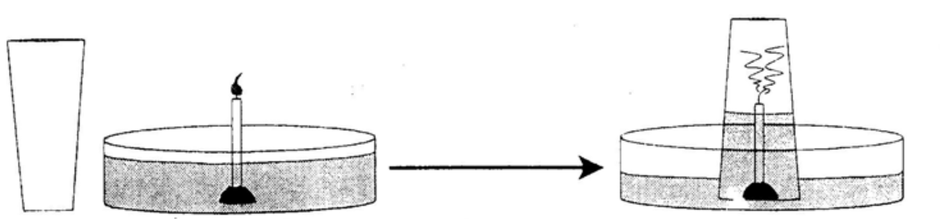
- A
- B
- C
- D

20. A ball is fired by a cannon from the top of a cliff as shown in the figure below. Which of the paths would the cannon ball most closely follow?



- A. A
- B. B
- C. C
- D. D
- E. E

21. The figure below at the left shows a drinking glass and a burning birthday candle stuck in a small piece of clay standing in a pan of water. When the glass is turned upside down, put over the candle, and placed in the water, the candle quickly goes out and water rushes up into the glass (as shown at the right).



This observation raises an interesting question: Why does the water rush up into the glass?

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Here is a possible explanation. The flame converts oxygen into carbon dioxide. Because oxygen does not dissolve rapidly into water but carbon dioxide does, the newly- formed carbon dioxide dissolves rapidly into the water, lowering the air pressure inside the glass.

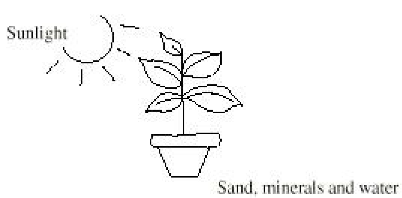
Suppose you have the materials mentioned above plus some matches and some dry ice (dry ice is frozen carbon dioxide). Using some or all of the materials, how could you test this possible explanation?

- A. Saturate the water with carbon dioxide and redo the experiment noting the amount of water rise.
- B. The water rises because oxygen is consumed, so redo the experiment in exactly the same way to show water rise due to oxygen loss.
- C. Conduct a controlled experiment varying only the number of candles to see if that makes a difference.
- D. Suction is responsible for the water rise, so put a balloon over the top of an open- ended cylinder and place the cylinder over the burning candle.
- E. Redo the experiment, but make sure it is controlled by holding all independent variables constant; then measure the amount of water rise.

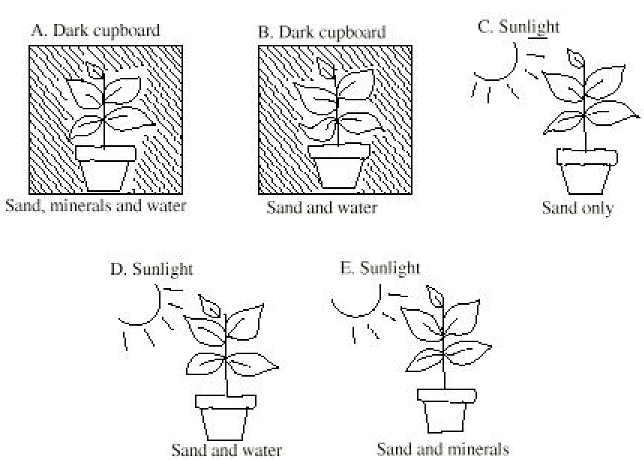
21A. What result of your test (mentioned in #21 above) would show that your explanation is probably wrong?

- A. The water rises the same as it did before.
- B. The water rises less than it did before.
- C. The balloon expands out.
- D. The balloon is sucked in.

22. A girl had an idea that plants needed minerals from the soil for healthy growth. She placed a plant in the Sun, as shown in the diagram below.



In order to check her idea she also needed to use another plant. Which of the following should she use?



- A
- B
- C
- D
- E

23. Whenever scientists carefully measure any quantity many times, they expect that:

- A. all of the measurements will be exactly the same.
- B. only two of the measurements will be exactly the same.
- C. all but one of the measurements will be exactly the same.
- D. most of the measurements will be close but not exactly the same.

24. How would you explain the phases of the moon?

- A. The apparent size of the moon changes.
- B. The part of the lighted side of the moon that we see changes.
- C. The shadow of the earth falls on the moon.
- D. The amount of light falling on the moon changes.

24A. What's the reason for your answer in question #24:

- A. The distance from the earth to the moon changes.
- B. The earth comes between the sun and the moon.
- C. The position of the moon, earth and sun changes.
- D. The distance from the sun to the moon changes.

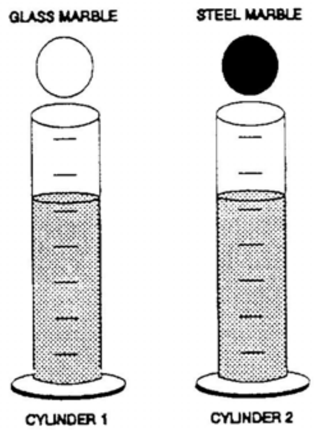
25. Maria collected the gas given off by a glowing piece of charcoal. The gas was then bubbled through a small amount of colorless limewater. Part of Maria's report stated, "After the gas was put into the jar, the limewater gradually changed to a milky white color." This statement is:

- A. an observation.
- B. a conclusion.
- C. an assumption of the investigation.
- D. a hypothesis.

26. To the right are drawings of two cylinders filled to the same level with water. The cylinders are identical in size and shape.

Also shown at the right are two marbles, one glass and one steel. The marbles are the same size but the steel one is much heavier than the glass one.

When the glass marble is put into Cylinder 1 it sinks to the bottom and the water level rises to the 6th mark. If we put the steel marble into Cylinder 2, the water will rise.

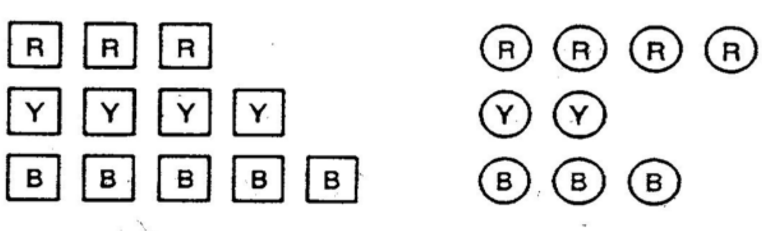


- A. to the same level as it did in Cylinder 1
- B. to a higher level than it did in Cylinder 1
- C. to a lower level than it did in Cylinder 1

26A. Because

- A. the steel marble will sink faster.
- B. the marbles are made of different materials.
- C. the steel marble is heavier than the glass marble.
- D. the glass marble creates less pressure.
- E. the marbles are the same size.

27. Three red square pieces of wood, four yellow square pieces, and five blue square pieces are put into a cloth bag. Four red round pieces, two yellow round pieces, and three blue round pieces are also put into the bag. All the pieces are then mixed about. Suppose someone reaches into the bag (without looking and without feeling for a particular shape piece) and pulls out one piece.



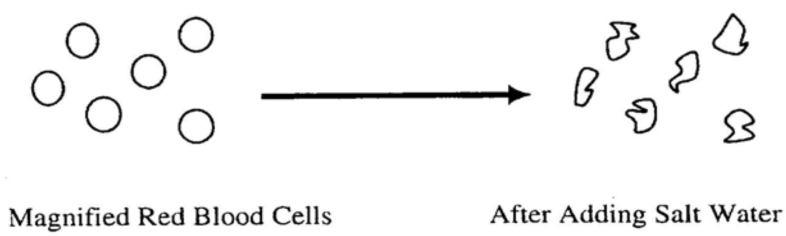
What are the chances that the piece is a red round or blue round piece?

- A. can not be determined
- B. 1 chance out of 3
- C. 1 chance out of 21
- D. 15 chances out of 21
- E. 1 chance out of 2

27A. Because

- A. 1 of the 2 shapes is round.
- B. 15 of the 21 pieces are red or blue.
- C. there is no way to tell which piece will be picked.
- D. only 1 of the 21 pieces is picked out of the bag.
- E. 1 of every 3 pieces is a red or blue round piece.

28. A student put a drop of blood on a microscope slide and then looked at the blood under a microscope. As you can see in the diagram below, the magnified red blood cells look like little round balls. After adding a few drops of salt water to the drop of blood, the student noticed that the cells appeared to become smaller.



This observation raises an interesting question: Why do the red blood cells appear smaller?

Here are two possible explanations: I. Salt ions (Na+ and Cl-) push on the cell membranes and make the cells appear smaller. II. Water molecules are attracted to the salt ions so the water molecules move out of the cells and leave the cells smaller.

To test these explanations, the student used some salt water, a very accurate weighing device, and some water-filled plastic bags, and assumed the plastic behaves just like red- blood-cell membranes. The experiment involved carefully weighing a water-filled bag in a salt solution for ten minutes and then reweighing the bag.

What result of the experiment would best show that explanation I is probably wrong?

- A. the bag loses weight
- B. the bag weighs the same
- C. the bag appears smaller

28A. What result of the experiment would best show that explanation II is probably wrong?

- A. the bag loses weight
- B. the bag weighs the same
- C. the bag appears smaller

29. An insulated bottle keeps a cold liquid in the bottle cold by

- A. destroying any heat that enters the bottle
- B. keeping cold energy within the bottle
- C. trapping dissolved air in the liquid
- D. slowing the transfer of heat into the bottle

Appendix D
Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge
Pre-Questionnaire, Summer 2012

30. Three students added equal volumes of pond water to each of four beakers (I-IV) and placed each in a different constant temperature bath, maintained at 5°C, 15°C, 25°C, and 35°C, respectively. The students then added 6 water fleas to each of four beakers and recorded the time in each case. After 1 hour, the students removed 3 water fleas from each beaker and each student immediately observed the water fleas under a microscope. Heart rates were recorded as beats per minute. The results of the experiment are summarized below.

	Beaker Temp	Time Water Fleas Added	Time Water Fleas Removed	Beats/minute (average of 3 Water Fleas)
I	5°C	2:00 pm	3:00 pm	41
II	15°C	2:10 pm	3:10 pm	119
III	25°C	2:20 pm	3:20 pm	202
IV	35°C	2:30 pm	3:30 pm	281

The data obtained in this experiment lend support to which of the following statements?

- A. At 45°C the heart rate of water fleas would be 320 beats/minute.
- B. Water fleas swim more slowly at high temperature.
- C. Metabolic rate in water fleas is directly proportional to water temperature.
- D. Heart rate in water fleas is inversely proportional to water temperature.
- E. Between 0°C and 5°C

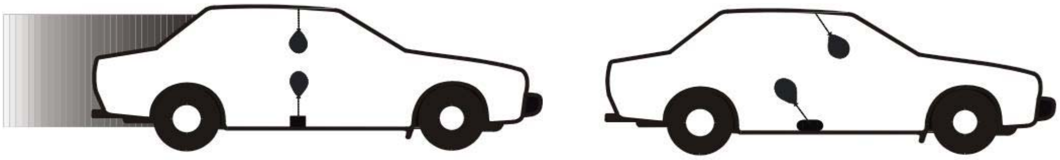
31. Despite a very strong wind, a tennis player manages to hit a tennis ball with her racquet so that the ball passes over the net and lands in her opponent's court. Consider the following forces:

i. a downward force of gravity
ii. a force by the "hit"
iii. a force exerted by the air

Which of the above forces is (are) acting on the tennis ball after it has left contact with the racquet and before it touches the ground?

- A. i only
- B. i and ii
- C. i and iii
- D. ii and iii
- E. i, ii, and iii

32. A vehicle with its windows rolled up is traveling down the road at 50 miles an hour. Two balloons are inside. One balloon is hanging straight down from the ceiling by a string. The other balloon is also attached to a string but is floating straight up (see figure). When the driver slams on the brakes, the hanging balloon swings forward and the floating balloon swings backward.



This observation raises an interesting question: Why did the hanging balloon go forward while the floating balloon went backward? Here is a possible explanation: The hanging balloon is relatively heavy; so its momentum carried it forward when the vehicle stopped. The floating balloon, being lighter than air and having less momentum, went backward because as the vehicle stopped, the

heavier air molecules inside the vehicle rushed forward and piled up at the front. Thus, the piled-up air molecules at the front pushed harder on the front side of the balloon than the relatively fewer air molecules on the balloon's backside. Thus, the balloon was pushed backward.

Suppose you have two balloons just like those in the vehicle, a large airtight chamber on wheels, and a vacuum pump (a pump that can extract air from airtight chambers). What experiment using these materials would test the possible explanation?

- A. Suck the air out of the chamber. Because air does not weigh anything, nothing will happen to either balloon.
- B. Attach the two balloons inside the chamber. Extract the air. Push the chamber and then stop it.
- C. Replicate the experiment using the vehicle just as before so that you have a controlled experiment.
- D. Place the balloons in the chamber and set it in motion. Then stop it and use the pump to extract the air.
- E. The hanging balloon is heavier so it will swing with the momentum. The floating

32A. What result of your experiment would show that the explanation is probably wrong?

- A. The momentum will carry the heavier balloon forward.
- B. The two balloons each do something different.
- C. If both balloons moved in the direction of the vacuum at the same pace and stopped at the same time, then it does not matter if there are molecules pushing on the balloons.
- D. The balloons would go backward.
- E. The floating balloon goes backward.

33. A biologist found two forms of mice living in a valley - those with slight toe webbing and those without toe webbing. The later damming of a river made much of the valley marshy. Years later most of the mice living in the valley were found to have webbed toes. Very few, if any, of the non-webbed form could be found. Which statement best explains the observed change in the mouse population?

- A. Webbed toes in mice are controlled by more than one gene.
- B. Mice with toe webbing survived at a higher rate and reproduced more often than did the non-webbed form.
- C. The mice ran in the marshy valley so most developed webbing
- D. Dampness in the valley increased the mutation rate in the mouse population.
- E. Mice with non-webbed toes grew webbing because it helped them run and move about in the marshy valley.

34. A weather balloon filled with hydrogen gas greatly increases in volume as it ascends to high altitudes. The expansion of the balloon is primarily due to:

- A. a decrease in the average kinetic energy of the hydrogen molecules inside the balloon.
- B. an increase in the average kinetic energy of the hydrogen molecules inside the balloon.
- C. a decrease in the average kinetic energy of the surrounding atmosphere molecules.
- D. an increase in the rate of collision of the hydrogen molecules against the inside walls of the balloon.
- E. a decrease in the rate of collisions of the atmosphere molecules on the outside walls of the balloon.

35. Below is a list of properties of a sample of solid sulfur:

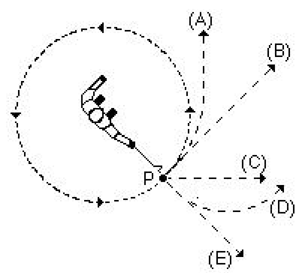
i. Brittle, crystalline solid
ii. Melting point of 113°C
iii. Yellow color
iv. Combines with oxygen to form sulfur dioxide

Which, if any, of these properties would be the same for one single atom of sulfur obtained from

the sample?

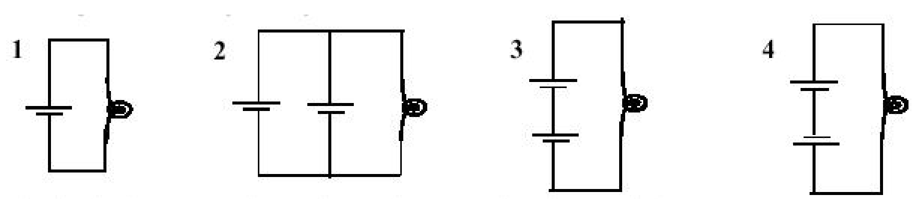
- A. i and ii only
- B. iii and iv only
- C. iv only
- D. All of these properties would be the same
- E. None of these properties would be the same

36. A steel ball is attached to a string and is swung in a circular path in a horizontal plane as illustrated in the figure to the right. At the point P indicated in the figure, the string suddenly breaks near the ball. If these events are observed from directly above as in the figure, which path would the ball most closely follow after the string breaks?



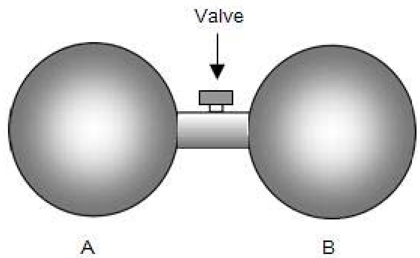
- A. A
- B. B
- C. C
- D. D
- E. E

37. The bulbs and batteries illustrated below are identical, and the battery orientations are indicated in the circuit diagrams shown. Which circuit produces the brightest light bulb?



- A. Circuit 1 because one battery does not have to work against another battery
- B. Circuit 2 because two batteries connected in parallel produce more voltage than either one or two batteries connected in series
- C. Circuit 3 because two batteries connected in series with the same orientation produce about twice the voltage of a single battery, and more than any other combination shown
- D. Circuit 4 because two batteries connected in series and oriented in opposite directions produce about twice the voltage of a single battery, and more voltage
- E. Circuits 2 and 3 produce bulbs with the same brightness.

Use the following illustration when answering item 38.



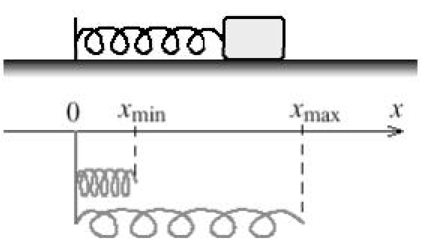
38. Two bulbs of equal volumes contain a gas. The gas pressure is equal in both bulbs. Bulb 'B' is heated to a temperature of 100°C while Bulb 'A' remains at room temperature. During the heating the valve is open. After heating, the valve is closed and the system is allowed to cool. What happens?

- A. Bulb 'B' will have more molecules than Bulb 'A'.
- B. Bulb 'A' will have more molecules than Bulb 'B'.
- C. Bulb 'B' will have greater pressure than Bulb 'A'.
- D. Bulb 'A' and Bulb 'B' will possess equal pressures.

39. A stone dropped from the roof of a single story building to the surface of the Earth:

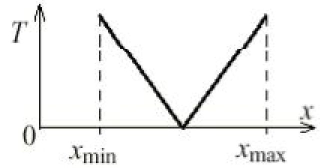
- A. reaches a maximum speed soon after release and then falls at a constant speed thereafter.
- B. speeds up as it falls because the gravitational attraction gets considerably stronger as the stone gets closer to the Earth.
- C. speeds up because of an almost constant force of gravity acting upon it.
- D. falls because of the natural tendency of all objects to rest on the surface of the Earth.
- E. falls because of the combined effects of the force of gravity pushing it downward and the force of the air pushing it downward.

40. A block oscillates with negligible friction on the end of a spring as shown in the figure below. The minimum and maximum lengths of spring as it oscillates are, respectively, x(min) and x(max).

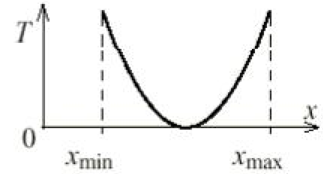


Which one of the following graphs represents the total energy (T) of the block and spring system as a function of x?

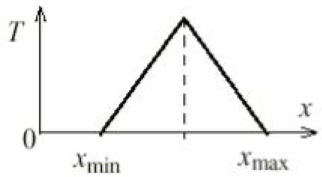
A.



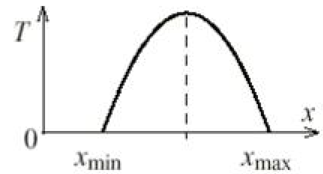
B.



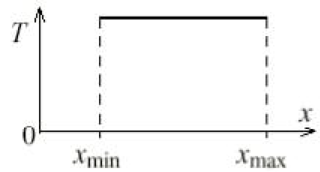
C.



D.



E



- A
- B
- C
- D
- E

<< Back **Finalize the Questionnaire**

Appendix D
Targeted MSP: The University of Buffalo/Buffalo Public Schools ISEP Teacher Content Knowledge and Pedagogical Content Knowledge Pre-Questionnaire, Summer 2012

Ohio Evaluation & Assessment Center
MATHEMATICS • SCIENCE • EDUCATION

Targeted MSP: The University of Buffalo/Buffalo Public Schools (UB/BPS)
Interdisciplinary Science and Engineering Partnership
Teacher Conent Knowledge and Pedagogical Content Knowledge, Summer 2012

Thank you for completing the questionnaire

The E & A Center acknowledges and thanks contributors to this assessment. Items on this instrument were adapted and used with permission from the following sources:

Item 1 - 14:

Schuster, D. & Cobern, W. W. (2007). *The pedagogy of science teaching test (POSTT)*. Western Michigan University, Mallison Institute for Science Education: Kalamazoo, MI.

Item 15 - 40:

Lawson, A. E. (2000). *Science attitudes, skills, and knowledge survey (SASKS): Forms 1, 2, and 3*. Arizona State University, Arizona Collaborative for Excellence in the Preparation of Teachers: Tempe, AZ.

Lawson, A. E. (2001). *Science teacher attitudes, skills, and knowledge survey (S-TASKS)*. Arizona State University, Arizona Collaborative for Excellence in the Preparation of Teachers: Tempe, AZ.

Miami University, Oxford, OH 45056. www.muohio.edu. 513.529.1686

Section 4b: Response to Evaluator's Report

Interdisciplinary Science and Engineering Partnership (ISEP) with Buffalo Public Schools

Year 1: 2011 – 2012

As noted Dr. Woodruff last met on site with the ISEP project team on May 23. During that meeting, project personnel shared reflections on the project's progress during Year 1 and planned for priority activities for early Year 2. The project team will continue our work to:

- Successful outreach to and collaboration with a range of STEM faculty mentors to accommodate teacher research interests;
- Complete placement of 58 teachers in summer PD options, BSC course, individual and team research projects;
- Review results of MOUs between teachers and researchers with implementation plans;
- Refinement of a multifaceted professional development experience for teachers that addresses individual teacher needs and interests as well as school-based needs;
- Recruit a full cohort of middle and high school teachers from 12 targeted partner schools;
- Enhancement of an existing mutually beneficial authentic partnership with the Buffalo Public Schools, its teachers, administrators, parents, and the community;
- Effective communication among project partners, including face-to-face meetings with teachers and administrators on site in schools; and
- Establishing clear responsibility for oversight of project tasks.

Work to be completed by the evaluation team during Summer 2012 includes:

1. Administer and analyze UB/BPS ISEP Teacher Questionnaire and US/BPS ISEP Teacher Content and Pedagogical Content Knowledge Assessment.
2. Develop other evaluation instruments, including UB/BPS ISEP STEM Student Questionnaire, US/BPS ISEP STEM Student Content and Pedagogical Content Knowledge Assessment, UB/BPS ISEP Faculty Questionnaire, UB/BPS ISEP Parent Questionnaire, UB/BPS ISEP Student Questionnaire and the PLC Reflection subscale.
3. Monitor and assess pilot PLC.
4. Complete collection of school- and teacher-level baseline data.

Specific Responses to Evaluator Report.

1. The ISEP project team and evaluation team will continue the effective and regular consultation between ISEP leadership and the Evaluation team on the nature of interdisciplinary science and engineering and the effective measure of teachers' understanding of this concept.
2. The ISEP project team will design a more specific follow-up training on support for implementation. During the Fall and Spring, each ISEP supported teacher will attend monthly meetings (3-hours). The meeting will provide an opportunity for teachers to share their experiences in implementing interdisciplinary inquiry teaching in their classrooms and for us to provide any needed necessary pedagogy supports. Meetings will rotate between UB, BSC, the Museum and various schools. Also, for those teachers who would like to receive graduate credits for attending these meetings, a 1-credit seminar course entitled "Interdisciplinary Science and Engineering Partnership", to be co-taught Professors Liu and Gardella, has been

created for both the fall and the spring semesters. Attending the monthly meetings is mandatory, but registering for course credit will be optional.

3. In Fall, 2012, in preparation for the first planned meeting of the External Advisory Board and our Steering Committee, we will prepare a report on the summer placements, implementation plans and baseline data from evaluation, and a research review. ISEP leadership will include Sarah Woodruff in this meeting so as to maximize feedback to the full ISEP team.

Section 5: Implementation Plan

University at Buffalo/ Buffalo Public Schools ISEP

Year 2: 2012 - 2013

ISEP Year 2 Plan: July 2012 – July 2013

For Year 2 we anticipate full implementation of core activities detailed in grant application and in 5-year plan including the following categories which are detailed in the following chart:

- Teacher professional development
- School-based wrap-around supports
- PLC's
- Research & evaluation

	July & August	Fall	Spring	June 2013
Teacher professional development	Teachers engaging in research experiences and share projects through PLC's; planning for implementation in upcoming school-year 12 BPS teachers participating in 3-week Summer STEM Institute at Buffalo State College Identify continuing and new graduate and undergraduate students to work with teachers during the upcoming school-year through consultation with district and school leadership Orientation for grad & undergrad students	Part-time fall institute to establish reporting and assessment plans; construct in-class and afterschool teams and workshops Teacher implementation of inquiry science teaching; after school projects; classroom visits by STEM graduate students and retired master teachers; and visits to UB	Graduate seminar facilitated by UB Graduate School of Education on Inquiry science teaching (with graduate credit option) Teachers nominated/ self-nominated for summer 2013 research experiences and Summer STEM Institute (proposed summer programs finalized by May) Faculty/research teams and mentors identified Ongoing communication with school and district leadership to align and maximize resources, placements, and opportunities	Placements finalized for research projects and plans; Proposed implementation including short and long term inquiry projects and afterschool programs

School-based wrap-Around supports	Reflect on summer research activities and curriculum plans; explore related school needs and collaboratively plan for in-school activities for upcoming year	School meetings to review building plans and activities; identify ongoing needs and changes; assess viability of plans and assign GA/RA and undergraduate support. Meet with parent group to plan activities. Review building supplies and equipment requests. GA's and RA's support in-class and afterschool activities and service learning students; in-school and afterschool activities School-based parent participation Ongoing purchasing of STEM related equipment as determined through collaborative discussions and planning with school and district leadership	Ongoing activities (begun in fall) with extensive communication between all parties to ensure benefit and alignment with grant and school/district planning Ongoing partner events including family nights at BMS Announcement of summer camps for middle school students and summer research internship opportunities for high school students	Complete school year with regard to graduate and undergraduate students placed in schools and prepare for summer research programs Summer research internships made available with application process Summer camp enrichment opportunities for participating middle school students

PLC's	Preliminary communication regarding PLC pilot and initial meeting with participants Technology interfaces developed and tested Teachers engaged in summer research prepare products to share through PLC's	Web interface established and contributions made by participating teachers, graduate students, partners, and parents Scheduled meetings and communication to support PLC's Develop new interfaces and PLC's as needed/ warranted	Ongoing monitoring of PLC activity; communication and meetings to encourage participation and alignment with ongoing STEM related activities associated with ISEP Ongoing interactions with DPCC to encourage parent involvement Ongoing interactions with core partners to encourage their participation in support of ISEP goals	Plan to incorporate new research activities and new teachers, graduate students, researchers, parents, and teachers in PLC's (existing and evolving)

Evaluation	Develop and pilot instruments to measure changes in BPS students' perceptions of science and engineering (UB/ BPS ISEP STEM Student Questionnaire) Develop and pilot instrument to assess STEM faculty perceptions (UB/BPS ISEP Faculty Questionnaire) Develop and pilot instrument to assess parent perceptions (UB/ BPS ISEP Parent Questionnaire) Administer and analyze UB/BPS Teacher Questionnaire and Teacher Content and Pedagogical Content Knowledge Assessment Monitor and assess pilot PLC's Complete collection of school and teacher level baseline data	Ongoing collection of data and preparation of instruments	Fully developed instruments measuring content knowledge and pedagogical content knowledge (UB/ BPS ISEP STEM Teacher Content Knowledge & Pedagogical Content Knowledge Assessments) - for teachers, students, and graduate students	Ongoing collection of data and monitoring of ISEP components Preparing for evaluation of summer research components and final activities in schools

Research	Participant observation of teachers conducting research at university research laboratories and industrial partner sites during the summer 2012 Interview of teachers and hosting scientists and engineers on their conceptions of interdisciplinary science inquiry and engineering designs during the summer 2012 Working with the external evaluator to develop standardized measurement instruments on science teachers' interdisciplinary science inquiry content knowledge and pedagogical content knowledge Completing gathering school information as baseline data for graduate students Participant observation of STEM graduate students conducting research with teachers, summer 2012	Observation of teachers implementing interdisciplinary science inquiry in their classrooms during the academic year of 2012-2013 Supporting teachers in implementation interdisciplinary science inquiry through a monthly seminar during both the fall and spring semesters Periodic interviews of teachers on their changing conceptions of interdisciplinary science inquiry teaching Working with the external evaluator to develop standardized measurement instruments on science teachers' interdisciplinary science inquiry content knowledge and pedagogical content knowledge	Observation of teachers implementing interdisciplinary science inquiry in their classrooms during the academic year of 2012-2013 Supporting teachers in implementation interdisciplinary science inquiry through a monthly seminar during both the fall and spring semesters Working with the external evaluator to develop standardized measurement instruments on science teachers' interdisciplinary science inquiry content knowledge and pedagogical content knowledge	The post-doc research associate will write (i.e., lead author) at least two articles and each doctoral student research assistant will write (i.e., lead author) at least one article suitable for research conference presentation and/or scholarly journal publication. A collection of cases in interdisciplinary science teaching and engineering design will also be assembled. The Research Team will prepare for studying the next round of teachers conducting research at UB and partnering facilities

	Interview of STEM graduate students on their conceptions of interdisciplinary science inquiry and engineering designs during the summer 2012	Observation of the undergraduate academy seminar during the fall and spring semesters on preparation of STEM students to work in schools Organizing graduate student orientation sessions to prepare them to work in schools; Interview of STEM graduate and undergraduate students on their experiences and perceptions of communicating science to students and teachers Continuing validation of the measurement instrument on STEM student science communication, and developing a draft instrument related beliefs and valuing in professional learning communities (PLC).	Ongoing activities related to studying graduate student impacts (continuation of fall activities)	The doctoral student research assistant will write (i.e., lead author) at least one article (focusing on graduate students) suitable for research conference presentation and/or scholarly journal publication. A collection of useful resources on communicating science in schools will also be assembled Preparing for next round of summer research experiences with regard to research of graduate students