2009 GK-12 Project Posters

Alabama

Auburn University (with Tuskegee University)
GK-12 Fellows in Science and Mathematics for East Alabama Schools
Florence Holland / hollafm@auburn.edu
Theme: Integrating Research into K-12 Classrooms

Show Me The Research!: GK-12 Fellows in Sciences and Mathematics for East Alabama Schools

Our project partners two doctoral granting institutions (Auburn University and Tuskegee University), and two school districts (Lee County School System and Macon County School System). Auburn University and Tuskegee University send 15 graduate students (GK-12 Fellows) into classrooms in six schools in the two school districts to assist science and mathematics teachers (GK-12 Teachers). One primary objective of the program is for fellows to bring their research into the classroom environment on a regular basis. At the beginning of each term the fellows introduce themselves and their research by presenting a poster or a PowerPoint presentation. Fellows are encouraged to make this presentation hands-on and to incorporate related worksheets and activities. In addition to the formal presentation, fellows are then asked to integrate topics concerning their research into lesson plans to reinforce the concepts the students are learning throughout the course. Fellows attempt to make the connections between lab-based research and everyday science on a consistent basis. This type of integrative curricula allows for students and teachers to understand that science and math are not just courses you can “put on the shelf” and forget about but rather tools you use in one’s daily life.

Students also bring their research into the GK-12 community by delivering hands-on exhibits of their research at our local GK-12 community Saturday Academies. Over the course of an hour, GK-12 students and parents participate in a GK-12 Expo that allows student from all schools to visit with each GK-12 Fellow and have them explain briefly about their research and its relevance.

University of Alabama Tuscaloosa
Graduate Teaching Fellows in Middle and High School Education
Beth Todd / btodd@eng.ua.edu
Theme: International Collaborations
Sustainable Energy for Rural Alabama and Peru: An International Collaboration with Engineers Without Borders™

The international collaboration on sustainable energy has been an integral component of our GK-12 project since its inception. To that end, an international experiential learning course has been developed with a focus on GK-12 Fellows as some of the initial participants. The goals of the course are to develop an understanding through experience of engineering as a rapidly globalizing profession, the challenges facing engineers in a developing country, the development of professional learning outcomes not easily taught in traditional classrooms, and creation of things that make people’s lives better. In the summer of 2008, a group of Fellows installed 18 solar panels in three remote Peruvian Amazon villages. The course included conception, planning and installation of the project. In Peru, the Fellows lived and worked with villagers on installations following the Engineers Without Borders™ model. As part of the trip, the Fellows also experienced a deconstruction study of the ancient engineering marvel Macchu Picchu. Internal and external evaluations of this portion of the GK-12 project were performed using Likert Scale and open answer questionnaires. The Fellows rated the development of teaming, communications, and experiential learning skills as particular strengths of the program. This course will continue development throughout our GK-12 project with the goal of ultimate institutionalization. For our partner schools, the Fellows have taken their knowledge of solar energy into middle and high school science and engineering classrooms. The Fellows have been able to compare what they see in rural Alabama with what they saw in Peru.

Arizona

Arizona State University
Down-to-Earth-Science
Jan Snyder / jan.snyder@asu.edu
Theme: Integrating Research into K-12 Classrooms

What is the “Big Idea”?

Emphasizing unifying themes in science is proposed as a strategy to minimize the curricular incoherence that exists in many current science curricula (AAAS, 1989; National Research Council, 1996; National Science Teachers Association, 1993). A science curriculum that uses
“common themes” or “unifying concepts” or “big ideas” to create coherence and connections across subjects and grade levels is more likely to lead to a more robust understanding by students. However, in spite of the recognized importance of unifying concepts, for a variety of reasons, teachers often do not teach the necessary content in the context of “big ideas.” In addition, the lessons are difficult to design and even more so to evaluate. The Arizona State University GK-12 Project Fellows have focused their efforts on mapping the important concepts of their research to unifying concepts, or big ideas, in the lessons they are developing for their respective classrooms. The poster will also illustrate inquiry-based methods that have been developed to facilitate the links between the Fellow’s research area and the unifying concepts outlined in the Arizona State Standards. Thinking about the way in which experts (i.e. GK-12 fellows) in science and engineering conceive of the “big ideas” and the integration of research and education has led to an improved understanding of how to communicate these concepts to K-12 students. An important outcome has been that students’ conceptualizations and understanding of the research-related concepts, promote their personalized ownership of the unifying concepts.

Northern Arizona University
Biotechnology Integration Opportunities for Teacher Education and Content (BIOTEC)
Laura Hagenauer / Laura.Hagenauer@nau.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms

GK-12 Biotechnology Integration Opportunities for Teacher Education and Content (BIOTEC)
The BIOTEC program was created to enhance inquiry-based science teaching while expanding the interdisciplinary preparation of graduate students in biotechnology. One main innovative concept of this project is the use of biotechnology as a means to add relevancy and interest in STEM concepts in K-12 classrooms. BIOTEC was initiated in June 2008 at Northern Arizona University, Flagstaff, AZ. Five graduate student fellows were paired with seventh and ninth grade science teachers in five schools in the Flagstaff Unified School District. Teacher and fellow teams have developed curricula and research opportunities for students in these classrooms, focusing on biotechnology, current research and inquiry. Fellows have created occasions for students to learn more about and use biotechnology, research techniques, and the scientific method. At the same time, the fellows have improved their communication and presentation skills and their teaching and curriculum development abilities. We present several examples of specific projects that fellows have developed.

University of Arizona
BioME: Biology from Molecules to Ecosystems
Stacey Forsyth / forsyth@bio5.org
Theme: Summer Workshops

BioME Summer Institute: Building the Foundation for Successful Teacher-Fellow Partnerships
Our GK-12 program hosts an annual Summer Institute for teachers and fellows who will be beginning their partnerships in the fall. The week-long Institute orientes fellows and teachers to NSF GK-12 and BioME program goals, establishes a foundation for upcoming teacher-fellow partnerships, familiarizes participants with resources they can use in their classrooms, and provides a conceptual framework for teaching biology in the context of evolution. BioME fellows, teachers, and staff participate in a variety of experiences that support these goals. Because BioME spans grades K-12, a subset of these activities are structured as grade-level breakout sessions. We assign partnerships prior to the
Institute and dedicate substantial time throughout the week for collaborative planning.

Highlights of the Summer Institute include:
• A panel discussion with current BioME teachers and fellows;
• A science resource fair that showcases UA resources available for teaching biology;
• A lecture on evolution that provides a conceptual context for the program;
• A field trip in which we explore biodiversity at different elevations in a local mountain range and learn about some of the fellows’ field research;
• Laboratory visits in which teachers visit their fellows’ labs and learn more about their research.

Teachers and fellows leave the Summer Institute with well-articulated goals, specific strategies for planning and communicating, and some activities ready to bring into the classroom. The effectiveness of the Summer Institute has been evident: when the school year starts, fellows transition smoothly into their work with K-12 teachers and students.

University of Arizona
CATTS - Collaboration to Advance Teaching Technology and Science
Megan Alexander / mjoy@email.arizona.edu
Theme: Integrating Research into K-12 Classrooms

CATTS Science and Engineering Project at Sycamore Elementary & Corona Foothills Middle School, Vail, Arizona
The CATTS program serves the University of Arizona and the greater Tucson community by providing innovative teaching methods and experiential learning projects in conjunction with the National Science Foundation GK-12 Science Teaching initiative. One of these partnerships is geared towards introducing 5th grade ELP (Extended Learning Program) students to the principles of engineering, experimentation and team work through inquiry-based learning and hands-on teaching methods. Not only do we strive to teach and instill a curiosity for knowledge, but we also act as role models for female students as successful women in the field of engineering. We bring our research into the classroom setting by designing experiments for the classroom that uses the same underlying principles we use as graduate and undergraduate students in the laboratory. One of these experiments includes studying the stress-strain behavior of “human tissue.” The students use soft rope candy to represent a human tendon and performed a uniaxial tensile test by applying various weights to the “tendon” and measuring the amount it stretched. They vary the cross-sectional area of the tendon and for each increment of weight they calculated the amount off stress. Given the strain, they are able to plot stress-strain curves for their data and compare the slopes of each curve as a function of the cross-sectional area. In addition to working with 5th grade ELP, we have also started a Girl’s Club at the neighboring middle school. The purpose of this club is to encourage girls to explore science and engineering, instill confidence, and act as role models during a critical time of the student’s life. All of the lessons provide hands-on experience, one-on-one student-teacher interaction, and exposure to fundamental engineering principles.

Arkansas

University of Arkansas
GK-12: Inquiry and Innovative Thinking by Design
Morgan Ware / meware@uark.edu
Theme: Summer Workshops

“KIDS” K-12, I Do Science: GK-12 Summer Camp that Works
We present our approach to the summer training which our GK-12 Fellows and Teachers receive together as teams. This training spans the first month of the summer leaving the rest completely open for the Fellow’s research, and is logically broken into four weeks: 1) pedagogy of inquiry and standards, 2) team development and technology integration, 3) lesson development, and 4) mock classroom and science camp for kids. This model has been modified each year of our program.
based on participant feedback and perceived utility. We will present the logistics of training Fellow-Teacher teams and some of the measurable outcomes in our program that are a direct result of each part of the training.

**California**

**California State University, Los Angeles**  
IMPACT LA: Improving Minority Partnerships and Access through CISE-related Teaching  
Nancy Warter-Perez / nwarter@calstatela.edu  
Theme: Summer Workshops

**IMPACT LA: Engineering Workshops that Work**  
During the first year of IMPACT, we have held four workshops for teachers and fellows (two in the summer and one per quarter) to help foster strong teacher-fellow teams, prepare fellows for the classroom, and expose teachers and fellows to engineering careers and hands-on activities. In order to build a strong team, a wide array of workshop activities were conducted to allow teachers and fellows opportunities to get to know more about one another. Fellows received training on the different styles of learning, creating a lesson plan, and standards, and teachers and fellows brainstormed about different how to handle different classroom scenarios. Workshops also afforded opportunities for teacher-fellow partners to plan their lessons and for fellows to practice lessons with valuable feedback from experienced teachers. Some workshop engineering highlights include a field trip to the Jet Propulsion Laboratory led by a manager of the Mars Rover Project, engineering hands-on activities including building a BristleBot, the NAE presentation on changing the conversation about engineering, and the training for publishing TeachEngineering lesson plans. Through our poster we hope to share our activities and workshop experiences with the GK12 community. In addition, we’ll bring handouts that describe our workshop structure and featured activities including workshop agendas, ice breaking activities, and workshop evaluation rubrics.

**University of California Berkeley**  
GK-12: Exploring California Biodiversity  
Rosemary Gillespie / gillespie@berkeley.edu  
Theme: Integrating Research into K-12 Classrooms

**Communicating Science Using Current Research**  
To combat the incipient apathy toward science in urban adolescents, our fellows are bringing them into the excitement of cutting-edge research by involving them in current graduate studies. We present the students with the opportunity to design their own experiments to answer contemporary scientific inquiries. Using authentic specimens and live organisms to engage the students in the process of science, we create a fun and empowering atmosphere to encourage questions and curiosity. We introduce science as a dynamic and creative process that is about exploring, observing, asking questions, and testing ideas. This has been highly successful both in engaging students and in enabling fellows to incorporate themes and techniques from their own work.

**University of California, Los Angeles**  
UCLA SEE-LA: Science and Engineering of the Environment of Los Angeles  
Janice Daniel / janice@ucla.edu  
Theme: Integrating Research into K-12 Classrooms

**Integrating UCLA SEE-LA GK-12 Fellow Research Activities into Los Angeles School Curriculum**  
This new GK-12 program places graduate fellows in two pairs of urban middle and high schools within Los Angeles Unified School District and Culver City School District to act as scientists-in-residence. Fellows
partner with master science teachers and spend two days per week interacting with students and the school community at large. Over the course of their fellowship year, Fellows are charged with developing three inquiry-based lesson plans, including one that explicitly integrates their respective research topics into the developed lesson. We will present several examples of research-based lessons that focus on the SEE-LA theme – the environment of Los Angeles. One fellow’s plan integrates water quality investigations for regional urban and natural watershed systems into the 6th-grade earth science curriculum and standards. Samples are drawn from a variety of stream systems, which vary in relative constituents and chemical makeup. Students are provided qualitative chemical kits and must undertake “forensic” investigations to determine the correct source of the stream water (given a selection of choices). We also present a novel energy-based lesson for 8th-grade physical science curriculum that focuses on fuel cell technology and current environmental policy in California. Having fellows develop and communicate research-based lesson plans to a pre-college audience provides critical communication training and also provides middle and high school students exposure to state-of-the-art research being conducted at UCLA.

Authors: Mark Moldwin, Terri Hogue, Peter Nonacs, Janice Daniel, Helen Jung and Ben Davis

University of California San Diego
Graduate Teaching Opportunities
Shelley Glenn Lee / sglenn@ucsd.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms

Socrates Fellows: Effectively Integrating Research into the High School classroom and Fostering Student Leadership in Science
The Socrates Fellows project is bridging the gap between the research community and the community at large by integrating current research into existing high school curriculum. Beginning with a 5-week summer institute and continuing through the academic year, graduate fellows work closely with teacher fellows and project staff to develop and implement authentic science experiences related to topics such as Biodiversity, Climate Change, and Cell/Molecular Biology. Investigations and experimentation protocols have been developed to engage high school students with relevant local issues such as the ecological role of bees, ocean acidification, the effectiveness of ecotourism, as well as to introduce new techniques to understand cellular and molecular processes as they relate to enzyme production, DNA damage, and genetic mutations. Many activities have been implemented in the classroom, while others have been effective at enhancing extracurricular activities such as after school science clubs, science fair projects, and community events. Through reflection, discussion, and collaboration throughout the year, teachers and graduate fellows have had the opportunity to improve their communication skills and to positively influence high school students’ experiences with science.

University of California Santa Barbara
Let's Explore Applied Physical Science
Wendy Ibsen / ibsen@cnsi.ucsb.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms

LEAPS: Connecting UCSB researchers with junior high students, teachers, and families
The LEAPS (Let’s Explore Applied Physical Science) program brings graduate students into two 8th-grade physical science classes at Santa Barbara Jr. High. Four graduate fellows join the classes of two 8th-grade science teachers twice each week. Fellows take part in a week long, teacher-led training in early August, during which fellows practice presenting both classroom lessons and the 10-minute presentations they give to students describing their graduate studies. Later in the school year, fellows train other graduate students in methods of effectively communicating science. For example, family science nights organized by the LEAPS program rely heavily on graduate student volunteers outside the program to run science-related stations through which families rotate. LEAPS fellows train their peers to present these stations to a wide audience. Further, as part of a guest scientist speaker series at the junior high, fellows train scientists outside of the LEAPS program to communicate their research to the students. The LEAPS program encourages fellows to incorporate their research into the 8th grade classroom. Their research is integrated into lessons (in many forms) whenever it overlaps the topic covered in class. LEAPS fellows also organized a field trip to UCSB so that the 8th graders were able to see their research tools and labs. Further, science fair mentoring allowed students to choose topics associated with fellows’ graduate research. These represent just a few of the ways fellows’ research has been brought into the classroom.

Colorado

Colorado School of Mines
GK-12 Learning Partnerships
Jennifer Picucci / jpicucci@mines.edu
Theme: Summer Workshops
Tech Camp for Students
Our summer program, Tech Camp for Students, is available to all students in the school system with which we partner. The students spend five days learning many exciting uses of technology in math and science at no cost to them. They are able to work with programs like ALICE and do all kinds of hands-on activities.

Colorado State University
GK-12: Human Impacts Along the Front Range of Colorado
Yeni Garcia / garc7544@bears.unco.edu
Theme: Integrating Research into K-12 Classrooms
The Poudre Learning Center: A natural site for students in local schools to explore human impact in Colorado
The Poudre Learning Center (PLC) is a focal point where fellows and teachers work together to enrich students’ experience with inquiry-based, research concepts and applications of the Colorado State Science Content Standards. GK-12 Fellows have worked closely with particular schools to design lessons that incorporate their own research and the district’s content standards. Recent projects include human impact on landforms, macroinvertebrate studies, soil investigations, and water quality. Using an inquiry approach, students develop techniques for individual learning and are enabled to build a better conceptual understanding of science. The PLC has become an important place for inquiry-based education through the sustainable study of the Poudre River and surrounding ecosystems. Learning occurs through laboratory activities, field activities, and field research carried out at the center with the help of many interns and GK-12 Fellows working with classroom teachers and/or at the center.

University of Colorado
GK-12: Inspiring and Building Tomorrow’s Workforce: A Grades 3-12 Engineering Continuum
Malinda Zarske / malinda.zarske@colorado.edu
Theme: Integrating Research into K-12 Classrooms
Creating Tomorrow’s Engineers: Because Dreams Need Doing
The TEAMS (Tomorrow’s Engineers…creAte…iMagine…Succeed) program has brought hands-on engineering into K-12 classrooms for years. Since 1999, 68 GK-12 TEAMS Fellows have influenced the lives of thousands of Colorado public school youth. Weekly, Fellows bring their engineering expertise and areas of engineering interest and research into partner classrooms to ignite the curiosity of youngsters and demonstrate how engineering is essential to the health, happiness and safety of everyone. Virtually all of our GK-12 Fellows use — and develop — K-12 engineering curricula for classroom instruction that is published and freely disseminated though the standards-based, online TeachEngineering digital library (http://www.teachengineering.org), part of the National Science Digital Library created through a collaboration of four engineering GK-12 grantees. GK-12 Fellows create original K-12 curricula — based largely on their research and intellectual pursuits — and classroom-test and refine it for ultimate publication in the TeachEngineering collection. For example, Fellows have published lessons related to their work in Engineering for Developing Communities, renewable energy and biomedical research. Already, 30 curricular units, 198 lesson plans and 330 hands-on engineering activities have been published in TeachEngineering by our TEAMS GK-12 Fellows, with more in the works.

University of Colorado at Boulder
Graduate Teaching Fellows in Ethnically Diverse Classrooms: A Collaborative Model
Susan Whitehead / susan.whitehead@colorado.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms
Enhancing STEM disciplines through a focus on ecology of extreme environments
Project EXTREMES (EXcellence in Teaching and Research for Elementary and Middle School Engagement in Science) is a collaboration between Boulder Valley School District (BVSD) and University of Colorado (including partners from Ecology and Evolutionary Biology, Computer Science, and the Cooperative Institute for Research in Environmental Science). The goal is to enhance science, technology, engineering, and math skills of ethnically diverse students through a focus on the ecology of extreme environments. Graduate teaching fellows work with the project for two years. One year is spent in 4th or 5th grade classrooms extending F.O.S.S. curriculum to include the ecology of two extreme environments: the salt marsh and the alpine/tundra. Activities include field trips to BVSD's Sombrero Marsh and CU's Mountain Research Station. These locations are also monitored using sensor networks, making field conditions accessible from the classroom and demonstrating the value of technology in ecological research. Fellows spend a second year working with middle school teachers to develop an after-school science program, which focuses on independent research projects and provides BVSD students with opportunities to work with graduate fellows in their science laboratories. The program provides diverse teaching experiences for graduate fellows, extensive training in inquiry-based, hands-on approaches for teachers and fellows, and increased knowledge and understanding of STEM disciplines for BVSD students.

Delaware

University of Delaware
GK-12: Improvement of Science Education in Vocational Technical High
Jeffrey Spraggins / jms@udel.edu
Theme: Integrating Research into K-12 Classrooms

Understanding Hydrothermal Vents: Ions, Energy Transfer, and Graduate Research.
Presented here is a project developed for 9th-grade physical science students aimed at introducing them to a collaborative research effort between the Department of Chemistry & Biochemistry and the College of Marine Studies at the University of Delaware. The goal is to relate the material covered in the New Castle County Vocational Technical School District’s physical science curriculum to the science surrounding hydrothermal vents. Students learn specific Delaware state standards for physical science while being introduced to these unique ecosystems found on our ocean floors. In an activity called “What is the Smoke?” students work to understand the chemical reactions taking place inside hydrothermal vents and how the chemical properties of these systems drive biological behavior. A unique aspect of this project is that it has been developed for two separate class settings. In the first case, the project was designed to bridge the entire semester in which students used wiki pages to post their work. The newest adaptation is an abbreviated version which can be completed in two class periods, but still incorporates web-quest activities and a qualitative analysis laboratory experiment. For both versions, the final aspect of the project is a research presentation where I discuss my graduate studies aimed at understanding the chemical reactions taking place inside hydrothermal vents using mass spectrometry.

District of Columbia

Howard University
GK-12 Interdisciplinary Science Research Experiences for Middle Schools
Marcus Alfred / maralfred@howard.edu
Theme: Integrating Research into the Classroom

Research in the Classroom and The Howard University GK12 Project: Interdisciplinary Science Research for Middle Schools (ISMS)
The Howard University ISMS project seeks to expose GK-12 fellows, teachers, and students to new perspectives and skills in STEM fields, and to create new opportunities in STEM fields for all participants. Howard University and its school partners, Cesar Chavez Charter Middle School for Public Policy, Howard University Charter Middle School for Math and Science, Bladensburg High School, and Bishop
Carroll High School are located in the Washington DC Metropolitan area. All of the middle schools and high schools face common challenges as other schools in many urban areas. The fellows and teachers have worked together to find successful ways to include fellows’ research into activities and modules.

Florida

Florida Atlantic University
Project ChemBOND: The Next Generation
Vanessa Seamon / vseamon@fau.edu
Themes: Integrating Research into K-12 Classrooms, Summer Workshops

Project ChemBOND: Unique Ideas for Development of Activities and Implementation of Graduate Student Research in High Schools

Our GK-12 program, now in its second year of implementation, primarily focuses on chemistry classes, but has now extended to biotechnology and environmental classes at four high schools. Nine graduate fellows and eight high school teachers collaborated with the program directors to develop and present activities all of which adhere to specific guidelines. Program goals include: 1) introducing new approaches to learning chemistry, biotechnology and environmental sciences which, in turn, improve high school students' critical thinking and problem solving skills 2) further enhancing the communication skills of the graduate fellows by presenting aspects of their STEM research that relate to the high school curriculum and 3) adding to the scientific knowledge and scientific inquiry of the high school teachers through their interactions with the graduate fellows. Several methods were applied in order to successfully meet these goals. A one-week summer workshop was organized to familiarize the graduate fellows and high school teachers with a unique set of guidelines by which to develop activities. These guidelines focus on encouraging critical thinking and in-depth understanding of key concepts. The workshop also focused on discussions of several ideas and activities which lead to the outcomes experienced this year, such as creative ways in which the graduate fellows were able to bring their research into the high school setting. The methods concerning the summer workshop guidelines for activity development and graduate fellow incorporation of STEM research into the high school curriculum will be presented.

Florida Institute of Technology
Integrated Science Teaching Enhancement Partnership (InSTEP)
Richard Tankersley / rtankers@fit.edu
Theme: Communicating STEM

Talking the Talk: Protocol for Assessing Presentation Skills of GK-12 Fellows

In an effort to improve the ability of GK-12 Fellows to communicate scientific and technical information to non-scientific audiences, InSTEP has developed a procedure for assessing oral presentation skills. The Presentation Skills Protocol (PSP) is designed to evaluate both traditional lecture-style presentations as well as interactive ones with the presenter and audience asking and answering questions. PSP was developed in collaboration with InSTEP’s external evaluators (The Study Group, Inc.) and is based on a review of the literature on effective presentations, especially those of a technical nature. The protocol focuses on eleven presentation skills and criteria, including organization, accuracy, relevance, logic, language, equity, delivery, audiovisual aids, use of time, questions, and presence. An associated rubric operationally defines each of the criteria at three categorical levels of skill: (1) proficient, (2) developing, and (3) needing attention. PSP provides a mechanism for partner teachers and program administrators to provide Graduate Fellows with regular and consistent feedback on the quality and effectiveness of their classroom presentations. Results to date indicate the protocol is extremely effective as both an instructional tool and as an evaluative instrument for assessing changes in presentation skills over time. Thus, in addition to helping Graduate Fellows sharpen their communication skills, PSP may be used to document improvements in these skills as a result of the GK-12 experience and to develop instructional activities and strategies that tie to skill improvement and target specific criteria.

University of Florida
SPICE
Suzan Smith / Suzan@cpet.ufl.edu
Theme: Summer Workshops

S.P.I.C.E. - Creating Learning Communities

SPICE (Science Partners for Inquiry-based Collaborative education) places priority on creating a learning community in which the program participants can flourish through sharing ideas, support, collaboration, and expanding knowledge. The program begins every year with a two-week Summer Institute, followed by a one-week Short Course for the incoming fellows. During the Summer Institute participants spend time
learning about the program's goals and about the inquiry-based instructional philosophy, but also spend time getting acquainted as a group. SPICE encourages collaboration and sharing through several interactive activities and field trips. Alumni SPICE Teachers take leadership roles and present components of the institute, fellows share their research and in some cases the group visits their labs and/or field sites. Three-fourths through the Summer Institute, the teachers and fellows fill out cards requesting their co-teaching partners. In most cases, everyone is matched with a compatible partner they had a hand in selecting, which in our experience significantly aids in creating positive, motivated teams. The one-week Short Course is for the incoming fellows only and introduces basic teaching pedagogy and hands-on, inquiry-based activities first hand. The fellows participate in the activities as if they were the middle school students they will soon be working with. The Short Course is taught by a College of Education professor, who is also a member of the SPICE Advisory Board. SPICE has found, through many years of trial and error, that experienced middle-school teachers do not appreciate trainings in basic pedagogy, as they are already trained and experienced in such skills; however, the pedagogy significantly helps the fellows understand how to communicate at a middle-school level and in an effective, interesting manner. Additionally SPICE conducts four workshops throughout the school year to bring the entire group together to share and collaborate. These workshops give participants an opportunity to regroup.

University of South Florida
Students, Teachers, And Resources in the Sciences (STARS)
Diana Prieto / dprieto@mail.usf.edu
Theme: Communicating STEM

Train the Trainers: STARS Mentor Teacher Workshops
STARS gives elementary teachers and students a clearer understanding of science and engineering concepts. Our fellows, all of whom are graduate engineering students, have the challenging task of translating science and engineering concepts into lessons of great instructional and pedagogical value. Our train-the-trainer program was conceived to impact hundreds of science teachers and thousands of students across the Hillsborough County in Tampa. The program operates in collaboration with the School District Hillsborough County to create Mentor Teacher Workshops (MTW) that aim at training elementary school teachers across the county. The lessons and activities for the MTW are prepared and presented by our graduate fellows and a set of selected mentor teachers. This experience also serves to develop higher level communicational skills in the graduate fellows. In this poster we present the general coordination process, as well as the details of the lesson planning, preparation and presentation. We also include a set of insights stressing the personal and professional gains of the fellows and a pictorial demonstration of the assessment received from the MTW attending teachers.

Georgia

Emory University
PRISM
Jordan Rose / jrose14@emory.edu
Theme: Summer Workshops

Emory’s PRISM Summer Institute: An Immersion Experience
The PRISM program fosters teams of teachers and graduate students to collaboratively develop and implement Problem-Based Learning (PBL) lessons in science and math classes. In order to prepare our participants for success, we begin with a two-week Summer Institute. Our main goals are to introduce PBL pedagogy, allow participants to practice writing and implementing PBL lessons with feedback, and begin building the partnerships between teachers and graduate students. Our Summer Institute is an immersive PBL experience. Teachers and graduate students begin as student learners faced with a PBL scenario that motivates them to discover what PBL is and how it can be implemented. Participants teach each other about PBL while experiencing what it is like to be a PBL student. Meanwhile, the workshop leaders model the facilitation techniques that are central to PBL. The scenario also introduces ideas about the differing professional cultures among teachers and graduate students in order to begin conversations about roles, expectations, and communication within teams. After the PBL is complete, we deconstruct the process of implementing PBL and discuss the challenges they might face when implementing this in their own classrooms. We write learning objectives, practice group facilitation, explore existing PBL lessons to adopt or adapt, strategize how to incorporate labs or simulations, and discuss assessing student learning. Structured work time allows student-teacher teams to complete their original and adapted lessons. Case clinics provide feedback from peers and PBL experts. Participant evaluations at the end of the Institute and several months afterward provide leaders with the feedback to continually improve the experience.
Georgia Institute of Technology
STEP Up
Marion Usselma / marion.usselman@ceismc.gatech.edu
Theme: Summer Workshops

Tech to Teaching: Institutionalizing the Georgia Tech STEP Program Graduate Student Training
The Student and Teacher Enhancement Partnership (STEP) program began in 2001 and has now provided professional development for more than 100 graduate students. In January 2009 we launched an NSF “Innovation through Institutional Integration” program entitled “Tech to Teaching” (T3) to pull together many disparate Georgia Tech educational initiatives into one coherent whole. The major goal of the T3 program is to bring together resources from around Georgia Tech to enable graduate and undergraduate students to effectively pursue careers in teaching, either at the college or K-12 level.

The T3 program includes multiple strands to promote effective teaching, ranging from active advising and mentoring, to workshops and courses, to immersion experiences. The STEP summer training (a 10 week, 7 hours per week, 3-credit course developed for our GK-12 program), provides instruction in learning theory, pedagogical strategies, classroom management, and effective K-12 partnering, and requires that all students conduct three videotaped microteaching exercises. This training will be institutionalized as an 8000-level course, and will eventually be offered to all interested Georgia Tech graduate students. This poster will provide the details of this training as used in the GK-12 program, and the changes that will take place as it morphs into the T3 graduate training program.

Hawaii

University of Hawaii at Hilo
Partnerships for Reform through Investigative Science and Mathematics (PRISM)
Elizabeth Stacy / estacy@hawaii.edu
Theme: Communicating STEM

PRISM Fellows: Communicating Science through Culture, Connections & Conservation

PRISM Fellows are broadening science literacy in Hawai‘i by developing culture-infused, place-based science curricula, forging connections between K-8 students and local scientists, and promoting environmental awareness and action. Over three years, 28 PRISM Fellows have partnered with over 50 elementary and middle school teachers to develop 19 standards-based curricula in marine and terrestrial environments. PRISM curricula incorporate math, art, language arts, and technology and have been implemented in over 60 classrooms, reaching over 1,400 students. PRISM Fellows bridge modern scientific and local cultural knowledge by infusing science lessons with native values, beliefs, and practices, including the important Hawaiian value, “Malama ka ‘Aina,” or “Caring for the Land.” Fellows further enrich these lessons by recruiting scientists from Hawaii’s federal, state, and nongovernmental agencies into the PRISM ‘ohana (family). These scientists, many of whom are affiliate faculty of UH Hilo’s TCBES M.S. Program, are broadening hands-on opportunities for students in the conservation and restoration of native species and habitats. Through such collaborations, PRISM is developing a community of practice in science education and empowering students to make a difference in their communities. Fellows further develop their communication skills and promote scientific literacy through outreach to non-partner teachers, integration of PRISM curricula into teacher workshops, coordination of Science Nights at PRISM schools, and participation in community events. Fellows also communicate science to a broad audience through the development of PRISM website, newspaper and newsletter articles, a PRISM brochure, individual project posters, and local TV and radio segments.
Our GK-12 program has enjoyed a decade of innovative teaching methodologies and interdisciplinary partnerships. Thirty-five fellows have partnered with over 200 educators, nearly 5000 students, and countless members of the public to create enduring lessons and more scientifically informed citizens. By integrating their research with education, fellows have enjoyed academic success and published 16 journal articles with data from GK-12 projects. Fellows have transcended the boundaries of university campuses to enrich STEM content in Hawaii and increase their own communication capacity as well as that of fellow scientists. The program marketed itself and its products to a wide audience of teachers, academia, K-12 and college students, educational and community organizations, and the general public through printed materials (brochures; posters; CDs; newspaper, magazine, and journal articles), audiovisual resources (PowerPoint; radio; videos), internet-based activities (networking and project websites; YouTube), and in-person forums (public, K-12, and university instruction; community events; Teacher-At-Sea program). The effectiveness of media products were measured through student and audience self-report evaluations; teacher and student thank-you letters; requests for information; feedback from grant renewals; and documentation of the number and type of participants. The success of these multi-media products was enhanced by encouraging fellows to independently design their own education and outreach experiences catered to their strengths, by taking advantage of existing educational opportunities, by producing quality products, by working with a diversity of audiences, and by making media products available beyond the tenure of their fellowship.

Idaho

Idaho State University
GK-12: Enhancing Science Literacy in Southeast Idaho with Community-based Projects and University/K-12 Partnerships
Rosemary Smith / smitrose@isu.edu
Theme: Integrating Research into K-12 Classrooms

Idaho State University GK-12: Bringing locally relevant science and engineering projects into the classroom
Our project emphasizes engaging students, Fellows, and Teachers in locally-relevant science and engineering projects. We get our GK-12 teams out there building robots, monitoring their environment, modeling molecules, conducting energy audits, restoring wetlands, designing pop-up books, extracting and analyzing DNA sequences, and mapping lava
flows. The project model is one Fellow: one Teacher, and we place students in three local high schools and several middle schools. Fellows come from the diverse disciplines of Biology, Chemistry, Geosciences, Mathematics, and Engineering. Our poster will provide eleven “vignettes” of our GK-12 Fellows, showing how they bring their science and engineering knowledge, skills, and passion into the classroom. We will also provide additional how-to-do-it and lesson ideas as separate sheets. Many of the described projects are directly related to the Fellow’s own research—either through the research question itself, the laboratory or field techniques, or the application of science or engineering process skills. Each vignette will also provide insight into the pitfalls and hurdles and the solutions and adaptations that are necessary for the successful integration of the Fellow’s research into the classroom. Fellows learned how to extract the essence of their research efforts to produce a relevant activity for younger students. Student responses to the activities suggest increased engagement in STEM subjects, and a greater understanding of how scientists and engineers build the body of knowledge necessary to tackle projects and provide solutions. Our goal is for every participant to increase their scientific literacy!

University of Idaho
NSF GK-12: STEPS (Scientists and Teachers Educating and Preparing Students)
Pallan / pallan@uidaho.edu
Theme: Summer Workshops

Providing Professional Development (PD) for Fellows & Teachers
The overall goal of all of our professional development is to make everyone into better science teachers and learners. We have found the PD we provide allows the graduate students to work successfully in their classrooms. Translating science knowledge for anyone is a hard task, but having to do it so upper elementary students can understand is very challenging. Fellows also need lots of support in learning how to engage all students and how to manage an elementary classroom. Teachers gain valuable insight into teaching science through inquiry as well as acquiring new content knowledge through working with their teaching partner.

Illinois
University of Illinois at Urbana-Champaign
GK-12 Graduate Teaching Fellowships
Christopher Whalen / cwhalen@illinois.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms, and Marketing Your Project

GK-12 Impacting Our Community in Real Ways: The Nature of Bonds that Don’t Break
This GK-12 program has a long history of excellence. In our eight years of involvement, we have witnessed tremendous personal development in our fellows and an ever-increasing impact in our community. Most notably, the relationships we have built have been strong and sustainable. These have resulted in several fellow-teacher scientific publications, presentations at national meetings, and class field trips to highlight but a few. Here, we present the work of our four current fellows: how they have (1) brought their research into the classrooms (2) inspired students (3) received notoriety in the community and (4) developed an action research plan to foster their own personal growth. Specifically, we identify and discuss the action research plan of the fellows as a core component to aiding the central mission of the NSF’s GK-12 program: to develop graduate students who can effectively “communicate science and research”, “inspire transformation”, and “stimulate interest in science” (www.gk12.org). Evaluation data and experience convincingly show that not only can GK-12 accomplish these goals, but it exceeds them. For instance, we find that the lives of our K-12 students are permanently changed in such a way that their very perceptions of what a scientist is and what a scientist does are altered.
As a result of our program, students see science and scientists as “cool.” We know that such views provide a substantial impetus toward the pursuit of scientific careers and thus conclude that GK-12 both wisely invests in future generations of scientists and forges strong bonds between K-12 schools and institutes of higher education.

Indiana

Indiana University Purdue University (IUPUI)
The GK-12 Urban Educators Program at IUPUI: Teaching and Learning Science through Research
Kathleen Marrs / kmarrs@iupui.edu; Alexis Green / abehm@iupui.edu
Theme: Integrating Research into K-12 Classrooms

The IUPUI Urban Educators GK-12 Program
Our 11 GK-12 fellows represent graduate programs that span a range of disciplines, including Biology, Chemistry, Physics, Earth Sciences, Psychology, Pharmacology, Medical Neuroscience, Microbiology, and Biotechnology. The Fellows have spent over 4,400 hours in Indianapolis schools and outdoor classrooms with teacher partners, bringing authentic, inquiry-based research activities to over 1,000 high school and middle school students throughout the year. This poster showcases some of the best examples of research-based projects developed over the year. The translational aspect of our project emphasizes the interface between basic research, clinical medicine, and public understanding of science. In doing so, our GK-12 fellows translate the research they do in the lab or in the field to a form that students can understand and experience as an issue of relevance in their lives.

One example is Alexis Green’s project: “Integrating Alcoholism Research into a 7th-Grade Life Science unit on Traits and Inheritance.” She says her research in behavior genetics has been helpful in teaching lessons on genetics, inheritance, and traits to middle school science students. Her specific focus is to explore linked traits associated with alcoholism in mice that have been selectively bred to possess high or low alcohol drinking traits. She worked with her Teacher Partner to design a series of lessons that enabled the students to explore inherited and acquired traits and the effect of environment on the selection of these traits. They wanted the students to understand that organisms have many traits, that some of these traits are linked, and that some of these traits can be beneficial while others may not be beneficial in certain environments. They focused on how traits can be specifically selected for over time, either artificially or naturally. Alexis took care to address Indiana Standards. Specific lessons included recognizing and analyzing traits related to alcoholism, and recognizing selective breeding for specific traits in a mouse model as well as in domestic dogs as compared to wild wolves. Students learned to differentiate between acquired and inherited traits using a variety of examples including the altering of traits through use of metabolic steroids in athletes. The final lesson in this series called for students to create their own populations of birds with different beak types and different sized seeds. This activity was designed to assess the student’s understanding of the effect of environment on traits over time.

Purdue University
Indiana Interdisciplinary GK-12
Amy Childress / childsres@purdue.edu
Theme: International Collaborations

Purdue GK-12 in China: Combining International Research with International Education
Our program sent three former fellows, one former teacher, and three faculty to China in November 2007. This trip combined the GK-12 program’s mission to advance graduate student STEM research and contribute to K-12 education. The participants spent one week working with science faculty at the Jiangsu Institute of Education (JIE) and taught GK-12-developed middle-school math and science inquiry lessons to Chinese middle school students with ~200 Chinese teachers observing! The GK-12 fellows then traveled to other Chinese universities where they conducted research related directly to their doctoral studies. This trip was developed in part from a prior collaboration between JIE and Purdue: the Sino American Center for Science Education Research and Engagement. Fellows worked with
their research advisors and the GK-12 staff to identify research collaborators. Longer term outcomes included one fellow receiving a post-doctoral research position offer at his Chinese host institution. Another fellow has been asked to return to give a seminar at her host institution, take part in a conference, and is also continuing collaborative research and has new graduate applicants from China for her research group now that she has a US faculty position. A second international trip is planned for 2009.

Kansas

Wichita State University
Pass Me the Salt: Extending the Research Training Tower to Pre-College Students
Mark Schneegurt / mark.schneegurt@wichita.edu
Theme: Integrating Research into K-12 Classrooms

Primary Biology Research in the High School Classroom
Primary research is central to careers in biology, however, research is not typically brought into the high school classroom. Learning outcomes and career choices may depend on the nature of exposures to research. We hypothesized that open-ended primary research activities would improve student and teacher attitudes towards scientific research and increase interest in science careers. Long-term projects should excite teachers and impact students that don't directly participate in research programs. One focus of our program is the introduction of primary research into three high schools in the Wichita Public Schools through the “Pass Me the Salt” program. Cadres of high school students and teachers work with graduate fellows on a broad program of research. Specific projects include antimicrobial properties of prairie plants, lifting and Valsalva effects, development of molecular biology techniques using household materials, ecotoxicology of the herbicide isoxaben, survey of mussels in the Arkansas River, and the characterization of halotolerant bacteria from oligohaline environments. Research scientists are traditionally trained through a system of peer mentorship inherent in every laboratory, where more experienced trainees pass on their knowledge, “the salt,” to the next generation. The goal was to extend the research training tower to pre-college students. Attitudinal surveys and personal interviews have been used to assess the value of open-ended research projects in connecting students to research and careers in science. Initial results show a positive effect, and high school students have generated research presentations and publishable data.

Kentucky

University of Kentucky
Algebra Cubed
Chris Mattingly / cmatting@ms.uky.edu
Theme: Integrating Research into K-12 Classrooms

Algebra Cubed: Math Research in Action!
We will present various lessons that our fellows have constructed for their classrooms that focus on at least part of their research. As mathematical research is not as tangible as other fields, it is often difficult to present in a manner that is understandable to those without an undergraduate knowledge level. We hope to bridge some of these gaps and thereby make mathematical research more approachable and interesting to middle and high school students, in hopes of engaging their interest at an early stage. This can help the students understand the process that goes into mathematical research. Lessons will include some topics in topology, geometry and measure theory.

University of Louisville
Groundwork Education in Mathematics & Science (GEMS)
Christine Rich /
Theme: Communicating STEM

Fellows Communicating STEM: It’s More than the Facts
GK-12 Fellows in K-12 classrooms can do so much more than merely convey STEM concepts. In GEMS, Fellows are charged not only with communicating STEM facts and figures, but also with modeling the nature and practice of science. Infusing lessons with multiple opportunities for students to hone their science process skills begins during summer workshop training. Leaders model lessons from Chemical Interactions, Force & Motion and Connected Math Program II for the new Fellow-Teacher Teams. Embedded in the workshop’s deeper content is an emphasis on integrating formative assessments that develop students’ abilities to analyze data, draw inferences, and clearly communicate understanding. Formative assessment strategies, such as Exit Slips, Markerboarding, Lines of Learning, and Commit and Toss, encourage student discourse while at the same time providing feedback on student understanding (or misconception) to the Fellow-Teacher Teams. Is it working? GEMS had the opportunity to “blanket” 7th-grade science by placing Fellows with all 3 physical science teachers at Farnsley, a Title I middle school in our urban district. These same teachers taught the previous year using the same FOSS curricular materials. Fellow-teacher teams were deliberate in the implementation
of formative assessment strategies that would develop process skills. Farnsley far outpaced the district and state in the percentage gain in composite scores from the previous year. More importantly, there was a significant rise in the percentage of students that earned the state’s highest rating of “distinguished” in science. A closer analysis of the data showed that gains in the open response portion of the KCCT were closely aligned with the physical science content taught by GEMS Fellow-Teacher Teams.

**Louisiana**

**Louisiana Tech University**

GK-12 Teaching Fellows Program

David K. Mills / dkmills@latech.edu

**Theme: Integrating Research into K-12 Classrooms**

**Creating Connections: a Model for Incorporating Scientific Investigation and Research into Louisiana’s K-12 Curriculum**

This project involves over 27 GK12 Teaching Fellows working in north Louisiana middle and high schools over a three-year period. The program is centered on the theme of molecular science and nanotechnology (MSNT), a combination of biology and engineering at the nanoscale. MSNT laboratories developed in our Partner Schools are staffed by Fellows and serve as foci for fellow and teacher generated lab modules, fellow, teacher, student, research mentor interaction, and hands-on student engagement in science and engineering. A K-12 outreach laboratory at Louisiana Tech is used to teach teachers and students MSNT concepts and scientific investigation principles. Through collaboration with university research faculty and K-12 teachers, Louisiana Tech’s “Creating Connections” program is integrating bio- and nanotechnology research into the K-12 curriculum. The program integrates these efforts with two other K-12 outreach programs, an NSF RET program and the Shell Oil/LRC nanoSCIENCE project. In bridging these programs, teachers were partnered with a Teaching Fellow and the Fellow’s Research Mentor to provide teachers with authentic experiences in cutting-edge interdisciplinary research. Fellows participated in workshops designed to provide experiences with hands-on, inquiry-based teaching strategies and training in being an effective mentor. Fellows also participated in the professional development component of the RET program and directed mini-workshops on technology for nanoscale research, data interpretation and analysis, nanoassembly, image analysis, and materials characterization. Fellows worked with teachers to give a formal research presentation at our RET Research Symposia and aided teachers in integrating their research experience into an inquiry-based lesson plan.
Maine

University of Southern Maine
Sustaining the Maine ScienceCorps: Collaborative Integration of Research Experiences and Active Learning into Bioscience Education
Monroe Duboise / duboise@usm.maine.edu
Themes: Integrating Research into K-12 Classrooms, International Collaborations

University of Southern Maine GK-12 Fellows Integrate Microbial Biodiversity Research and Education in Rural Maine and Kenya
Graduate Teaching Fellows are revealing the ecological importance and diversity of microbes and viruses to high school students in rural Maine and now in Kenya through collaboration in research and education with colleagues at the University of Nairobi. In three high schools, Fellows are facilitating studies of massive sulfide deposits in rural Maine including a former iron mining site where acid mine drainage at pH 2.5 and below is observed. Microbes and viruses including those in extreme environments are important in the graduate studies of several Fellows. The rural high school students and their teachers participate in the collection of field samples, extraction of total DNA, amplification of conserved DNA sequences with the polymerase chain reaction (PCR), molecular cloning of the amplified DNA fragments, and comparison of DNA sequences obtained with available genetic databases to begin a profile of the microbial biodiversity present at the study sites. Some rural students will travel to USM on a university-wide poster day in April to present their research to each other and to the USM community. Thus the Fellows facilitate learning of fundamental concepts of microbiology and molecular biology within an active research context that concludes with a summative process of data analysis and presentation. Research and learning has been given a global scientific context through parallel investigations of microbial and viral diversity of soda lakes of the Great Rift Valley where extreme alkaline, saline, and thermal conditions are typical. In October 2008 a team of Fellows did initial virus isolations from the alkaline lakes and visited rural and urban secondary schools with Kenyan colleagues.

Maryland

Johns Hopkins University
Broader Impact from Graduate Students Transferring Engineering Principles (BIGSTEP) to K-12 Education
Michael Karweit / mjk@jhu.edu
Theme: Communicating STEM

Light, Sound, and Waves and Inventors of the Future
Through BIGSTEP, graduate fellows have been working on increasing interest in math and science among minority middle school students by developing and delivering educational materials that stress the everyday relevance of engineering and technology. These Learn Units include hands-on design projects, discovery activities, “tinkering,” and the underlying math and science that make our world work. The delivery strategy is to provide not only teacher training, materials, and lesson plans, but also to put in place an infrastructure that will provide continuing substantive support to the classroom. Some example modules from the Sound, Light, and Waves unit include Jello Lenses (application of refraction to correct near- and far-sightedness), Target Practice (use the property of reflection to maneuver a laser obstacle course), Make a Paper Plate Speaker, and Disappearing Beads (matching refractive indices of beads and a liquid to make the beads visually disappear). The graduate fellows are currently introducing these modules in classrooms at the Patterson Park Public Charter School and the Friendship Academy of Engineering and Technology, both in Baltimore, MD.

Inventors of the Future (IF), based on invention and problem solving for high school and middle school students, gives students the chance to explore their ability to identify, express, and create possible problems within their given theme. IF’s goal is to reach out to students, get them excited about science, technology, engineering, and mathematics, and
encourage them toward careers in those fields. IF is designed to be sponsored locally by companies, universities or other science-rich organizations. Students are grouped based on areas of interest, and the groups are given funds to create their inventions. Mentors are recruited from the area to provide knowledge, experience, and support to the student groups throughout the duration of the program. The students work with local university students, graduate students, and professors as well as local engineers. On the last day of the program (duration of one to two months), students give a PowerPoint presentation describing their inventions. Everybody wins: Students discover the thrill of creating; Companies and institutions cultivate a winning community image; Local schools tap the power of mentoring to enrich their educational offerings. And, together, we encourage the quest for knowledge that previous generations have encouraged in.

Massachusetts

University of Massachusetts Boston
Watershed-Integrated Sciences Partnership (WISP)
Barbara Plonski bplonski@miltonps.org
Theme: Integrating Research into K-12 Classrooms

“Smoosh Cup” Madness: “Smooching” Styrofoam Cups Expands Fifth Graders’ Scientific Curiosity
Fifth grade students participating in the WISP Project (Watershed-Integrated Sciences Partnership) that partners University of Massachusetts Boston, Boston Public Schools, and Milton Public Schools learned that water pressure exerts a force and followed a research expedition of the RV Atlantis and DSV Alvin on-line. Students decorated styrofoam cups that were later attached to the submersible DSV Alvin and brought to a depth of 4400 m. The students followed the adventure of their cups by visiting WISP Fellow Emilia DeForce’s website (www.emeliadeforce.com) which provided a log of her cruise aboard the RV Atlantis. A classroom-based lesson on pressure was reinforced when the students’ pressure-shrunken cups were returned to them. Students gained an understanding of an important topic (pressure) as well as insights into oceanographic research. The local newspaper, The Milton Times wrote an article on the colorful shrunken cups returned from the deep sea.
Authors: Mary Bodkin, Denise Ellis, Jonna Grimsby, Emilia DeForce, Bob Chen, Barbara Plonski

Worcester Polytechnic Institute
Partnership in Math and Science Education (PIMSE): Assisting Middle School Use of Tutoring Technology in the Classroom
Cristina Heffernan / ch@wpi.edu
Theme: Integrating Research into K-12 Classrooms

Computer Science Fellows Share their research
Our GK-12 Fellows are Computer Scientists who work on intelligent tutoring systems called ASSISTment. Middle-school students and teachers are using this system with the help of the fellows in the classroom. In this poster we will describe how they share the work they do on ASSISTments with the students. Fellow Mike Sao Pedro designs web-based virtual science worlds to help tutor kids through the scientific inquiry process. He works with students while they use the ASSISTment program in math class. As part of his research, he also worked with the school's science teachers to run a study using his science system. After running the experiment, Mike returned to the classroom and presented his findings on the data he collected from the students in a way the students could understand. Having been directly involved in the research, the students were able to make the connection between their role in it and what Mike does. Finally, Mike also explained how he got to where he was, and how WPI was able to give him financial aid to go to college. Zach Pardos and his cooperating teacher collaborated on a research project. They used the ASSISTments to develop the questions in the study. These questions were part of the normal instruction in the class. When Zach presented the results of their study the students were exposed to the process he used to conduct his research. They were interested in hearing about it because they were the subjects. Leena Rezag does learning studies using the ASSISTments and then studies the data to determine which tutoring technique worked better when. Like Zach, she ran a study with the students she is working with as a GK-fellow.

Michigan

Michigan State University
Ecological Literacy in the K-12 Classrooms of Rural Michigan
Robin M. Tinghitella / hibbsr@msu.edu
Themes: Integrating Research into K-12 Classrooms, Summer Workshops

Bringing Fellows’ Research to K-12 Classrooms through the Summer Institute and School-year Workshops
Communicating fellows’ research in K-12 classrooms is critical to GK-12
programs which strive to improve student understanding of science and mathematics and fellows’ ability to explain science to broad audiences. At Kellogg Biological Station (KBS) we accomplish these goals by developing lessons that incorporate fellows’ research during quarterly school-year workshops and a yearly Summer Institute. School-year workshop topics are chosen to highlight the expertise of graduate student fellows. Summer Institutes provide intensive exposure to science content, training in inquiry-based teaching methods, and partnership-building activities. Both activities are led by KBS scientists, Michigan State College of Education faculty, and lead teachers from participating districts. We begin building effective teacher-fellow teams at the yearly Summer Science Institute. Fellows and their mentor teachers are tasked with developing a 90-minute K-12 module incorporating the fellow’s field of research (e.g. plant genetics, biogeochemistry, avian behavior) and science content that addresses state grade-level content expectations. Modules typically model field-based observations and data collection techniques, and data analysis and interpretation. Teachers and researchers spend two days working collaboratively with science education and STEM faculty to develop the modules, and then lead other workshop participants (typically 50-60 other teachers) through them. Teachers leave workshops with the tools to present modules with or without the aid of a fellow – making them scientists in their own right. Sample modules and lesson plans highlighting fellow research and a handout with advice “To Fellows From Fellows” will be available at our poster.

Minnesota

University of Minnesota
Graduate Fellows and Environmental Biology in K-12 Schools
Rebecca Batalden / smit2007@umn.edu
Theme: Integrating Research into K-12 Classrooms

Experiential Learning, Experimental Methods: Doing “real science” with elementary students

Science experiments are an excellent way to motivate elementary-school students and get them excited about science. They can be designed to accommodate students’ skill levels and teachers' time and resources. We describe research projects in four GK-12 schools that used the scientific process in a variety of settings and ranged from teacher-directed to student-driven inquiry.

University of Minnesota Duluth
Graduate Fellows in Science and Mathematics Education
Heidi Ojibway / heidiojibway@fdirez.com
Themes: Communicating STEM, Integrating Research into K-12 Classrooms

Ask a Scientist: Exploring student’s questions about the natural world, Fond du Lac Ojibwe School, Cloquet, Minnesota

Science is reaching new heights in Mrs. Heidi’s class thanks to graduate fellow Andrea Johnson. Students were given a survey to see what they thought of science and scientists prior to this partnership. As one might imagine, the images portrayed by the students were of a grey-haired man with glasses in a lab coat working behind a table with test tubes. Now, that image has changed thanks to the student-centered approach to learning that the classroom has implemented. Andrea began by presenting her studies in geology. This highlighted the exciting and adventurous work that she does studying rivers, and it amazed the students that she was a scientist. They were astonished to see that scientists do more than look through microscopes. The students’ enthusiasm for having a scientist in the class sparked the idea to let their questions guide the topics of study, thus “Ask a Scientist” was developed. Questioning is the most important aspect of scientific investigations. Students had the chance to ask a lingering question about the natural world. These questions guided weekly lessons. One was, “how do rivers get to places?” This directly related to Andrea’s research on the historical physical changes of a river. Students were asked to make a hypothesis, formulate a plan to test their hypothesis and carry out the plan. Small boxes with sand
were brought into the classroom for hands-on investigation centers. The students then shared the new knowledge they had discovered with their peers. Ask a Scientist Day with Andrea is looked forward to each week as a time to explore endless possibilities. Today, if you ask one of the students what a scientist is or does, or if they enjoy science, you better have a long time to listen.

Missouri

Washington University
Engineering Education for a Global Technological Society
Jose Lopez / joselopez@ese.wustl.edu
Theme: Marketing Your Project

Engineering, Science, and Math Education for a Global, Technological Society
This poster presents our First Lego League® (FLL) module and discusses the other modules developed by Washington University's GK-12 program. The FLL module introduces middle-school students to engineering and engineering methodology by participating in the FLL's robotics competition.

Montana

Montana State University
GK-12 Science and Society Fellows: Partnering with Rural Schools in the Greater Yellowstone Ecosystem
James Meadow / jfmeadow@gmail.com
Theme: Integrating Research into K-12 Classrooms

Seeing beyond the visible: Bringing hidden science into rural classrooms in SW Montana
Bringing advanced research topics into rural K-12 settings provides significant opportunities to both students and fellows. Specialized research topics that explore the inconspicuous aspects of our environment rarely grasp the unguided attention of middle school students, and are ideal topics for rural GK-12 programs. Fellows of Montana State University's "Science and Society" program use the scientific method to engage students and help them understand different "invisible" aspects of our surrounding environment such as, microbiology and paleoecology. For example, to learn about the microscopic airborne life forms that are commonly present in their environment, Three Forks Middle School students exposed agar-filled Petri dishes to the air for 10 minutes and then compared growth of the different types of microbial colonies. This experiment is being conducted throughout the school year to elucidate some of the seasonal effects on airborne microbes. At Shields Valley Middle School, global systems that influence climate change were introduced through inquiry-based lessons and experiments, and past changes in climate have been observed by studying ice core records, lake cores, tree rings, and other proxy records of paleoclimate. The 7th- and 8th-grade students are currently creating their own research questions that can be answered by coring local evergreen trees, and will use these tree ring records to answer their research questions in the spring. Montana State University GK-12 Fellows also explore research topics on ecology and restoration, geology, snow science, and soil science.

Nebraska

University of Nebraska
Project Fulcrum
Marisol Baquerizo-Birth / fulcrum2@unl.edu
Theme: Integrating Research into K-12 Classrooms

Project Fulcrum: Current Scientific Research into K-12 Classrooms
A source of conversation in the classroom between RSEMs (Resident Scientists Engineeers and Mathematicians) and students is research conducted by the RSEM. This dialogue shares innovative research ideas with students fostering thought-provoking questions and encouraging students to pursue the sciences. Incorporating research into a K-12 classroom requires the RSEM to think of unique ways to make the material relevant for students. To achieve this, one Project Fulcrum (PF) RSEM uses online journals and video chats to detail her life and research in South Africa. This allows for students to experience field work, new places, and to ask questions about South Africa, enriching 7th-grade biology classes. Another PF scientist uses a mobile radar truck to show how simple machines such as gears, axles, and wheels work together. This real life example of simple machines excites students as they identify simple machines performing research. A RSEM shows raw footage of parrots in a social setting to 5th-grade students and asks the students to observe specific behaviors. By documenting and analyzing this data, students use the scientific method in a current research setting. A PF mathematician uses fractal geometry to illustrate patterns to kindergarten students. Once students understand fractals, they come up with more complicated patterns on
their own. These activities provide students with an accurate portrayal of science, scientists and their research.

New Jersey

Montclair State University
GK-12 Fellows in the Middle: Partnerships for Inquiry and Interdisciplinary Middle School Science and Mathematics
Mary West / westm@mail.montclair.edu
Theme: Communicating STEM

Math and Science – Perfect Together!
Our GK-12 program matches eight graduate students, four in science and four in mathematics, with middle school teachers in the surrounding urban/suburban districts in northern NJ. Cooperating with their district teachers, each pair of math and science fellows designed interdisciplinary science and math lessons around their research interests and planetary science, this year’s theme. An important outcome has been improved communication between math and science teachers in participating schools. Field trips also play an integral role in the program. Fellows and teachers led a field trip to the Dreyfuss Planetarium at the Newark Museum, and to the rainforest in Panama (by webcam), and will soon take the middle-school students on a trip to the Buehler Challenger and Science Center to simulate a space mission, and to “Mars” (webcam to Cornell University’s Mars Lab). Our GK-12 program (csam.montclair.edu/gk12) has also developed international collaborations with middle schools in Beijing and Shandong, China thanks in part to NSF’s Division of Graduate Education and Office of International Science & Engineering. Interdisciplinary lessons include: enzyme kinetics with Legos (ratios), chemical calibration curve (graphing), evolution camouflage (statistics), stairsteps up the mountain (graphing, slope, Pythagoras), proportions in the human body (golden ratio, slope and y-intercept), relative and absolute dating (graphing and interpreting graphs), orbital and rotational periods of planets (ratios, graphing, line of best fit, linear equation), craters in flour (graphing), planets to scale (proportions), cube planets (powers), planet picking (percentages), solar system in a can (proportions), and planet densities (ratios).

New Jersey Institute of Technology
Computation and Communication: Promoting Research Integration in Science and Mathematics (C2PRISM)
Robert Fellman / rtf2@NJIT.edu
Theme: Integrating Research into K-12 Classrooms

C2PRISM: Computation and Communication: Promoting Research in Science and Mathematics
C2PRISM pairs doctoral students in the sciences, technology, engineering and mathematics with high school teachers working in Newark to bring cutting edge research and computational knowhow into the everyday learning experience of their students. Currently the eight

C2PRISM Fellows teach Chemistry, Environmental Science, Anatomy and Physiology, Physics, Algebra and Geometry to high schoolers in grades 9 through 11. A key focus of the work is to find ways to add computational elements of fellows’ research into the content of the curricula presented in their classrooms in a way that both stimulates
imagination, inquiry and interest of the students and is consistent with the goals of the state Core Curriculum Content standards. Emphasizing the improvement of student computational skills, Fellows have developed exercises that illustrate elements of their research. For example, one Fellow, an Electrical Engineer whose doctoral research is in optimizing the functionality of the internet by creating robust encryption algorithms, showed his algebra class how matrix multiplication could be used to encode and decode simple messages. He developed a Power Point Game and a set of exercises for the students called “GuessWord” that illustrated both an essential element of his engineering research and a property of matrices. This exercise is posted on our Website: http://web.njit.edu/c2prism/engineering.html. This poster stresses the importance we place on using our Fellows’ computational research as vehicles for enriching the teaching and learning experience of our high school partners.

Rutgers University
Graduate Teaching Fellows in the Newark Public Schools: A Collaborative Model for Developing Inquiry-Driven Science Classrooms
Andrew Parsekian / parsekia@pegasus.rutgers.edu
Theme: Integrating Research into K-12 Classrooms
Incorporating Environmental research into classroom explorations in Newark, New Jersey
The Rutgers University-Newark program uses graduate fellows research on environmental sciences to interest their 6th-grade classes in science. There are serious environmental issues that students witness in the area, see in the media and study in school that the fellows are studying. The introduction of activities that address these issues increase student interest and raise awareness, help them see science as a potential career and view the fellow as doing important and exciting work. Examples of fellows’ research related to the environment include:
• Induced Polarization (IP) images zones of ice content in permafrost soils in Alaska can help characterize ice content distribution for carbon balance and global warming modeling. The concept of Induced Polarization as a method of exploration geophysics is investigated by searching for mineral bodies in a sand-tank experiment.
• Recent seismicity in the area has been well publicized in the media. A plot of earthquakes on satellite images shows that they line up along faults that could be active. This work is integrated into a classroom activity through an investigation that involves both the effects of an earthquake as well as earthquake mitigation strategies.
• Geochemistry is being used to analyze chromium in soil samples from the nearby Hackensack Meadowlands. The goal of the project is to determine where the reduction of chromium (VI) occurs in the subsurface and its relationship to the water table. Students use different foods to create a mixture which will be analogous of soil. This introduces the concept of soil as a mixture and how any change in the composition will change the properties of the soil.

Rutgers University
Building a Learning Community in Science and Mathematics through Educational Partnerships: Track II
Kathleen M. Scott / scott@biology.rutgers.edu
Theme: Integrating Research into K-12 Classrooms
Building a Learning Community in Science and Mathematics through Educational Partnerships: Track II
This project began with a Track I grant in 2000. Since then, it has successfully developed STEM learning communities by bringing together local school districts and Rutgers University in educational partnerships. In the current project, seven Fellows in graduate programs in Ecology and Evolution; Biomedical Engineering; Molecular Biosciences; and Endocrinology and Animal Bioscience are working with seventeen middle school science, mathematics and technology teachers from four school districts within commuting distance of the Rutgers New Brunswick Campus. Educational partnerships began with a summer Institute when Fellows prepared Power Point presentations about their research; these were used to introduce Fellows to middle school students during the academic year. In another summer activity designed to be used during the school year, Fellows and teachers developed activities that combined aspects of the Fellows’ research with relevant middle school topics. Some of these activities have been adapted for the Rutgers Science Explorer, a 40' mobile science laboratory that extends the Rutgers community beyond the New Brunswick campus and brings the excitement of the Fellows’ research to middle school students around the state of New Jersey.

Stevens Institute of Technology
New Jersey Alliance for Engineering Education (NJAEE)
Alfred Zeisler / Alfred.Zeisler@stevens.edu
Theme: Integrating Research into K-12 Classrooms
GK12: New Jersey Alliance for Engineering Education (NJAEE)
NJAEE promotes the integration of problem-solving, innovation and inventiveness within mainstream high school STEM curricula. A cohort of graduate Fellows collaborate with Stevens faculty, education professionals in the Center for Innovation in Science & Engineering
NJ Alliance for Engineering Education

New Mexico

University of New Mexico
E-MRGE: Ecohydrogeology in the Middle Rio Grande Environment
Brittany Barker / barkerbr@unm.edu
Theme: Communicating STEM

Increasing Educational Experience in Rural Regions: Bringing STEM into the Classroom in New Mexico
E-MRGE places fellows in three rural schools, providing 6th- to-8th graders with an opportunity to interact with graduate students from STEM disciplines. E-MRGE concentrates on using a student-centered inquiry-based approach while teaching science. In the classroom, this approach allows students to build their own scientific knowledge with guidance from experienced scientists. Fellows use their research and experiences to engage students and encourage them to explore scientific problems in a manner different than that which they may be accustomed. Additionally, fellows supplement their lessons with scientific method based projects and field trips to provide students with similar investigations a scientist would pursue. Based at natural preserves in New Mexico, the field trips expand student’s learning through hands-on experiences with geology, biology and ecohydrology. Specific topics during these trips include the impacts of urban development on the environment, abiotic and biotic factors affecting plant and animal communities, and the tectonic and ecological evolution of New Mexico. E-MRGE has also partnered with an outdoor experiential learning program that promotes positive youth development and place-based field science during rigorous outdoor activities. Our program’s benefits are twofold: it provides teachers with an opportunity to learn new hands-on, inquiry based approaches to teaching; and it allows students the opportunity to obtain a better grasp of the scientific process and what it means to be a scientist. Lastly, participating fellows benefit through evaluating and modifying their communication skills to relay their STEM knowledge to less experienced audiences.

challenging societal problems. NJAEE is also developing a 9-credit graduate certificate program Teaching and Learning in STEM Disciplines. Requirements for the graduate certificate include three courses: (1) Innovations in Teaching and (2) Pedagogy: The Art and Science of Teaching and Learning (each offered through Montclair State University); and (3) a Communicating Engineering course to be offered at Stevens, which is based on the successful Communicating Science course framework developed by the Lawrence Hall of Science. A one-semester practicum in a K-12 classroom and the development and dissemination of a K-12 module based on graduate research are also requirements for the certificate program. Additional partners include Bergen Community College, Montclair State University, Partnerships for Creative Action, and various school districts throughout NJ.
New York

Brooklyn College of the City University of New York
City as Lab
Michelle O'Dea / modea@brooklyn.cuny.edu
Theme: Communicating STEM

Communicating STEM in Brooklyn
Brooklyn College Fellows are working in five small environment/science-themed high schools in Brooklyn. Each school’s unique project emphasizes the communication of science, technology and math skills to high school students in the urban environment. The projects utilize a “city-as-lab” focus, whereby projects are designed to help students study features of their own communities. The Fellows’ purpose within these schools is to help science teachers and their students improve their scientific reasoning. Each group of Fellows and teachers aid their school teams in identifying empirical questions and designing experimental approaches to address these issues. Students then work towards the collection and analysis of data. The communication of student work is also of great importance, and Fellows have assisted school teams in developing oral and poster presentations for their classmates and community. Each Fellow-led team assists in developing community-based research chosen by their respective school. Our groups in Brownsville and East Flatbush study air quality by examining asthma rates and estimating the levels of NO2, CO, CO2, SO2, and particulate matter, and communicate their results to promote air quality awareness in the school communities. Students in Flatbush track nutrient loading into an urban fresh-water lake using a relational database and GIS technology. Students collect and test water samples, and then analyze and interpret the data. A living environment class in East Flatbush is investigating food sources in relation to possible causes of the high rates of diabetes in the neighborhood. In Bushwick, the students are becoming tree stewards by adopting neighborhood trees. They study the health of the trees and present their findings.

Columbia University
Learning through Earth and Environmental Field Studies (LEEFS)
Jeffrey Lancaster / jrl2132@columbia.edu; Nadine Els bnh2103@columbia.edu; Andrew Mugler / ajm2121@columbia.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms, International Collaborations, and Summer Workshops

Strategies for Connecting Contemporary Research and Technology to Inquiry-Based Learning in an Urban Middle School with Extension to an International Collaboration
We have used a combination of visuals and technology along with in-class experimentation to extend and augment the standard New York City science core curriculum. In doing so, we have also sought methods that will effectively translate to a planned international collaboration with a middle school in the Dominican Republic. More effective presentations tailored to varied student ability levels are the result of standard-based planning and conversations between the graduate student and teacher focused on content expertise and pedagogical knowledge. We report here on the processes and products of an urban middle school science collaboration including several techniques we use in the classroom (inquiry-based learning, concept-driven planning, fieldwork), example lessons, and how we have planned for future international collaboration.

Experiential Learning: Sparking Engagement and Creativity through Fieldwork
A central goal of high school science education is to actively engage students so that they can experience first hand the challenges and rewards of carrying out basic and applied research. This can be difficult because of limited resources and research training of high school educators. A challenge for university scientists is to make research accessible to the general public. We show how these limitations can be overcome through collaborations between high school science teachers...
and their students, graduate students and university faculty. Susan Vincent of The Young Women’s Leadership School and Columbia University scientists are studying biological sustainability of Piermont Marsh on the Hudson River. The project provides opportunities for inner city, minority students to participate in scientific research while developing a deeper understanding of an estuarine system that contributes vitally to the economy and quality of life in the Hudson River Basin. Fellow Nadine Els has enabled LEEFS to expand the field research program to include an investigation of the effects of increased atmospheric CO2 on the ocean; the hydrological dynamics between the interior pools of Piermont Marsh and the Hudson River; the effects of the ingestion of plastics on marine animals; and trout populations in the Hudson River. In the summer, students do fieldwork, and throughout the year, continued research is integrated into the science classroom. They learn rigorous field sampling techniques and basic laboratory skills that allow them to become more competitive for college placements.

**Exploring microbiology with seventh grade math**

A 7th-grade math teacher in Brooklyn and a graduate student in mathematical biology have applied the 7th-grade math curriculum to topics in quantitative microbiology. Once a week students participate in a 45-minute lesson in which a scientific topic is explored using mathematical concepts that are being taught concurrently. The curriculum provides rich opportunities for scientific application: both exponential notation and area formulas were used to obtain two independent estimates of the size of a bacterial colony undergoing exponential growth (shown in a video); probability trees were used to predict the outcomes for a population of cells infected by a virus which must decide between lysis and lysogenesis; and students were tested for staphylococcus (with lab results obtained at the Columbia Medical Center), and a general discussion was held (with the students doing corresponding calculations) about the risk of false positives and the comparison of a sample statistic with the population mean. We seek to excite students and broaden their knowledge while strengthening their grasp of fundamental mathematical concepts.

**CUNY, The Graduate Center**

The CUNY Science Now GK-12 Program
Victor S. Strozak vstrozek@gc.cuny.edu
**Theme:** Integrating Research into K-12 Classrooms

**Using the living urban environment to engage high school students in authentic research experiences.**

Science Now is integrating authentic research experiences into the high school science curriculum. These experiences engage students in “real-world” science related to the Fellows’ research and the theme of understanding the living urban environment. In the project’s first semester, Fellows and high school teachers have developed and taught a number of innovative activities that focus on science process skills and content knowledge along with basic literacy and numeracy skills that form the basis of an ARM. This poster will present highlights of the research experiences that the CUNY Fellows have developed. It will also present an overview of the project’s interdisciplinary focus on the living urban environment as a research theme for high school students. By investigating their own backyard, students become engaged in research, learn science process skills and science content, and develop research projects on some aspect of their urban environment.

**Polytechnic University**

Revitalizing Achievement by using Instrumentation in Science Education (RAISE)
Vikram Kapila / vkapila@poly.edu
**Themes:** Communicating STEM, Integrating Research into K-12 Classrooms

**Revitalizing Achievement by using Instrumentation in Science Education (RAISE): Communicating STEM**

RAISE partners NYU-Poly and 4 high schools to integrate modern sensing, instrumentation, and monitoring technologies in the lab curriculum of science courses. Our poster will describe several communication strategies used throughout the project. Summer pedagogy workshops help Fellows to develop techniques for better
communicating advanced STEM topics to students. They are given technology related articles and receive training to communicate key ideas contained in the article to non-specialized groups. They use visual aids (e.g., power-point and instructional videos) and hands-on lab activities to demonstrate real-world physical phenomena and to reach out to auditory, visual, and tactile/kinesthetic learners. Fellows use their engineering backgrounds to introduce students to real-world applications of science concepts. For example, labs demonstrating tipping and sliding of a rectangular block receive students’ utmost attention when the relevance of underlying phenomenon is shown to be critical for including safety factors in building design. Fellows use scientific/technological tools (e.g., computerized sensor and measurement technology, robots, Google SketchUP to learn CAD basics, and Microsoft Excel for design data entry and graphical plotting) to convey to students modern approaches for doing STEM work. They have created classroom forums for students to conduct group discussions related to STEM. Students take leadership positions and learn communication strategies which they can then extend to other classes and outside the classroom.

**Applying Mechatronics to Promote Science (AMPS): Bringing Fellow’s Research into the K-12 Setting**

AMPS aims to (1) broaden the educational experience of GK-12 Fellows; (2) enhance technological proficiency of teachers; and (3) afford opportunities to K-12 students to develop, apply, and enhance their science, technology, engineering, and math (STEM) skills. AMPS takes advantage of students’ fascination with modern technologies, e.g., robots, by using this as a hook, to stimulate them to learn about STEM disciplines. Fellow Nicole Abaid integrates her marine systems research at an all girls’ middle school by using in-class mechatronics and robotics demonstrations. Moreover, she is developing a marine biology and underwater robotics based fun-science exhibit for the New York Aquarium. Pavel Khazron exploits the interactive MATLAB software to present fundamental concepts of his image processing research to middle-school students. Jennifer Haghpanah uses the tools from robotics to explain to students the behavior of elastin based protein block copolymers that she generates in the lab for research. She teaches her students how proteins can be made to function as “bio-bots.” Alternatively, she creates novel robotic illustrations to mimic the functions of protein and DNA. This cross-fertilization of robotics and protein engineering allows her students to learn about biologically-inspired engineering designs.

**Rensselaer Polytechnic Institute (RPI)**

Building Bridges from High School to Grad School: Inspiring Students Through Discovery-based Activities in Energy and the Environment

Kristen Sikora / sikork2@rpi.edu

**Theme**: Integrating Research into K-12 Classrooms

**Bringing Emerging Research Projects into the Classroom**

The use of cutting-edge research to encourage high school students to pursue careers in STEM disciplines presents new and exciting opportunities. Topics of current interest, such as energy and the environment, are especially appealing since students can relate to the media. However, bringing complex problems to the high school setting can be challenging, mainly because of the need to simplify advanced scientific concepts to a level that relates to their academic curriculum. Aware of this, fellows and teachers have managed to show students how research is conducted through the development of interactive, hands-on activities. For instance, research on wind turbines, specifically placement optimization, is a forefront topic of intensive research. This research has been introduced to teams of high school students who are working on the development of a scaled-down model of the city of Albany, NY to study how cities affect the performance of wind turbine arrays. The model will be tested in a wind tunnel at RPI. Furthermore, with the topic of sustainability in mind, fellows have designed activities for students to explore the biodiversity of the pond ecosystem, while honing their microscope skills. In addition, students recognized the effects that various pollutants can have on a healthy ecosystem. Students also learned the proper use of a spectrophotometer. The
success of bringing fellows' research into the K-12 setting depends on the level of communication between teachers, fellows and professors. Consequently, our program places emphasis on these skills by means of workshops and brown-bag seminars. Assessment from teachers and professors about the level of difficulty of the in-class activities and projects has been conducted and proper feedback is given to GK-12 fellows.

SUNY College of Environmental Science and Forestry
Environmental Science to Promote Sustainable Urban, Rural, and Indigenous Communities
Yazmin Rivera / yarivera@syr.edu
Theme: Integrating Research into K-12 Classrooms

Steps to success: From students to scientists
The project seeks to enhance high school student science learning and engagement, and teacher and graduate student professional development. It builds upon a well-established school-college partnership program, ESF in the High School. Through this dual enrollment program, high school students across New York receive college credit for The Global Environment, an ESF course that engages students in the scientific process while addressing a range of environmental and social issues. Our project enriches this program by partnering nine graduate Fellows, who form the ESF Science Corps, with high school teachers at “home” schools in urban, rural and indigenous communities throughout central New York. At “home” schools Fellows serve as scientists in residence, facilitating learning experiences and, in return, learn to better communicate their own research. Fellows use their graduate research experience to mentor students as they develop independent research projects. High school students present their projects at the Environmental Summit, a science symposium held on the ESF campus and attended by high school students, teachers, graduate students and faculty. In addition, Fellows visit other participating high schools and lead inquiry- and research-based activities called “road shows.” In school year 2008-2009, Fellows mentored 146 high school student researchers, and engaged over 420 students through 38 “road show” presentations. Ultimately, SUNY-ESF’s GK-12 project enables students to be scientifically literate, well-informed young adults who possess the skills required to meet society’s immediate and future challenges.

North Carolina
Duke University
MUSIC-Math Understanding through Science Integrated with Curriculum
Paul Klenk / pak@duke.edu
Themes: Integrating Research into K-12 Classrooms, Summer Workshops
The Green Awakening: A collaborative program between the Pratt School of Engineering GK-12 Program and Communities in Schools of Orange County
The primary purpose of the MUSIC GK-12 program is for Fellows to work with their partner teachers on the creation and delivery of lessons and activities that integrate engineering problem solving (including the engineering design process and project building) with the North Carolina Standard Course of Study. During summer 2008, David Kahler, a Pratt School of Engineering graduate student, worked with Dr. Paul Klenk, GK-12 Program Coordinator, to create and implement an environmental engineering curriculum for a four-week summer program for rising 9th-grade students called The Green Awakening. This program was a partnership between the Pratt School of Engineering GK-12 Program and a North Carolina non-profit focusing on dropout prevention called Communities in Schools of Orange County (CISCOC). The Green Awakening provides a year-long experience for rising freshmen who are at risk that is run by CISCOC. The training and curriculum for the summer program were provided by MUSIC primarily through Dr. Klenk and David Kahler. In addition, David Kahler was the Curriculum Director for the program during its implementation. Our poster will highlight this program and the partnership between MUSIC and Communities in Schools of Orange County.

North Dakota
North Dakota State University
Graduate Student-University-School Collaborative for Science, Mathematics, Engineering & Technology
Kim McVicar / kim.mcvicar@ndsu.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms, Marketing Your Project, and Summer Workshops
NDSU GraSUS-II
Bringing Fellows' research into the classroom:
GraSUS fellows are encouraged to bring their research into the classroom. In a math classroom, students learned about the concept of
Ohio
Ohio State University
NSF GK-12 Fellows Program
Karen Irving / Irving.8@osu.edu
Theme: Communicating STEM

The Ohio State University GK-12 Fellows Program: Science Fellows Supporting Elementary School Teachers
Our GK-12 Program is one of the few projects focused on elementary-school classrooms, specifically, grades 3-5 in Columbus City Schools. Some elementary-school teachers have the challenge of teaching all subjects including reading, writing, math, social studies and finally science. For this reason, many teachers welcome science experts into their classroom in order to broaden their science knowledge. Columbus City Schools have also recently added Math and Science specialists to their 4th- and 5th-grade classrooms. These teachers also welcome science experts as they are tasked to teach math and science to two grade levels. Many teacher-fellow teams incorporate other disciplines into their science lessons. For example, they do not pass up an opportunity to have their students practice note-taking in their science journals or add key math skills into their science lessons. Columbus City Schools is an urban school district with many schools not far from downtown Columbus, OH.

Ohio State University
Linking Watershed Research and GK-12 Education Within an Ecosystem Context
Lois Grant / grant.47@osu.edu
Theme: Integrating Research into K-12 Classrooms

Linking Watershed Research with GK-12 Education in a Watershed Context
The GK-12 Fellowship Program is part of an interdisciplinary project that teams researchers with the local farming community to study the headwater streams of Ohio’s Sugar Creek. The fellowship program extends this long-term project into the schools in the Sugar Creek watershed. In keeping with the premise that each headwater stream is complex and unique: physically, biologically and socially, the program emphasizes place-based education. Each of the eight fellows is conducting research in the watershed and is partnered with a high school teacher with the expectation that they will share their research with students and in doing so, create learning opportunities that encourage appreciation of biocomplexity and advocacy of good
environmental stewardship in the local communities. Most schools in the program have a local headwater stream that can serve as an outdoor laboratory. Fellows are expected to integrate their own project into their host school’s curriculum and meet the needs of their teacher partner. As a result, the means of introducing their own research to students vary, but fall into two basic approaches. The first is a stand alone unit modeled on the fellow’s own field work. This requires the dedication of a block of several days to the project and has a seasonal requirement that can prove challenging during the school year. It has been an effective approach as a class research project in advanced biology classes. The other approach is for fellows to work the methods and principles of their interest areas and research projects into the on-going class curriculum. This approach provides more challenges for graduate fellows and has been used in lower level biology and environmental science classes.

University of Cincinnati
Science and Technology Enhancement Program
Andrea C. Burrows andrea.burrows@uc.edu
Theme: Integrating Research into K-12 Classrooms

Exploring How Urbanization Affects the Water Cycle
The lesson explores how man-made infrastructure in urban/metropolitan areas alters the “Natural Water Cycle.” Most (if not all) of the students in Project STEP classrooms live in either an urban or sub-urban setting, so the water cycle going on around them is modified and not quite the same one found in rural settings. The overall goal of the lesson was to have the students explore how man-made structures would alter the processes that go on within the water cycle and in the process solidify their understanding of these individual processes and how they come together to form the water cycle. The instructional strategy employed was a teacher guided discussion using an interactive power point demonstration to illustrate the water cycle as the class discussion went on. Instead of labeling the processes on the slides, arrows were inserted showing the movement of water as each process was discussed. Students were divided into groups and correct answers to the instructor’s questions were recorded as points for the group. The class activity on measuring infiltration as a function of soil composition was also done in groups and the group that was able to come up with the most retentive composition, as well as the most accurate and well thought out responses to the teachers questions was recognized as the winning group. Multiple Intelligences are addressed in this lesson: for visual learners, there is the power-point discussion, for auditory learners the teacher verbally addresses the information on the slides and for kinesthetic learners, there is the hands-on activity. This is an interesting lesson directly related to the Fellow’s research that can help facilitate communication of STEM concepts to students.

University of Toledo Lake Erie Research Center
Environmental Science Learning Community at the Land-Lake Ecosystem Interface
Carol Stepien / carol.stepien@utoledo.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms

Establishing a GK-12 Environmental Science learning community at the land-lake ecosystem interface
Graduate fellows in our program encompass the fields of aquatic ecology, hydrology, and environmental engineering. We are building a learning community and interfacing with an existing High School Student Watershed Watch (SWW) program; to which the fellows bring varied and synergistic research experience. SWW has been in place for 18 years, was formulated by a former University of Toledo professor (Dr. Peter Fraleigh, now deceased) and is coordinated by the Maumee River Remedial Action Plan (http://www.maumeerap.org/SWW.html). The SWW annual program features water quality and macroinvertebrate data collection on a designated fall collection date from schoolyard stream sites, and the high school students then present their findings at an annual conference that is held at the Toledo Zoo. We are enhancing this program by increasing the quality of the student presentations and sampling, including additional classroom activities, and sponsoring science fair projects. Another novel aspect of our program is that
we are planning a high school student poster show at the International Association for Great Lakes Research annual conference (which University of Toledo is hosting) in May 2009, which features posters by high school students across the Great Lakes Region of the U.S. and Canada. This is proceeded by our own high school student poster show with 50+ posters on April 30 for students, parents, teachers, superintendents, and university administrators. Our GK-12 program not only teaches students about water quality assessments and interests them in science careers, but more importantly it creates citizens who are informed about the environment.

Oklahoma

University of Oklahoma
Engineering in Practice for a Sustainable Future
Deborah A. Trytten / dtrytten@ou.edu
Theme: Integrating Research into K-12 Classrooms

Engineering in Practice for a Sustainable Future: GK-12 Fellows Bridging the University and Rural Schools
We will present biographies of four successful GK-12 Fellows and a summary of one of the activities that each Fellow has implemented in a rural Oklahoma secondary classroom or summer academy as part of our grant. Rural schools can be challenging for outreach; the combination of low population and distance from universities can result in a low return on investment. We leverage our unique access and relationships with rural schools. Activities are implemented as hands-on, authentic, inquiry-based science lessons focusing on engineering content. Authentic activities include student construction of knowledge, disciplined inquiry, an implicit view of students, and value beyond school. We have developed activities in the physical sciences (including physical science, chemistry and physics), the biological sciences (including biology, anatomy & physiology, and botany) and the environmental sciences. Each activity is mapped to state achievement standards to help K-12 teachers meet important Annual Yearly Progress (AYP) in No Child Left Behind (NCLB). Each is summarized according to our format of: Introduction, Exploration, Concept Development, Concept Application, and Authentic Assessment. During the exploration phase, students are given scientific equipment and encouraged to use it to develop intuition about a relationship that is meaningful in engineering that can be established scientifically. During concept development, they form a theory about relationships they explored, often using tools like arithmetic and graphs. Students apply their theory to engineering situations during concept application. A list of our developed activities and the prepared materials are available at http://eip.k20center.org/activities.

Oregon

University of Oregon
Intra-State Partnerships for Improved, Sustainable K-12 STEM Instruction in Remote Schools
Anae Rosenberg / anae@uoregon.edu
Theme: Summer Workshops
Training GK-12 Fellows For Remote Outreach
The University of Oregon program puts Fellows into classrooms 300 miles distant from campus for 2 weeks per term. Our challenge with
training is to get new Fellows ready during the summer to hit the ground running for their first Fall 2-week visit to their schools. We combine workshops for the Fellows with hands-on work with the curricula and joint teacher/fellow workshops and in-school mentoring to help them achieve our goals.

University of Oregon Institute of Marine Biology
Improving STEM Content for K-6 Grades in Coastal Rural Schools in Oregon
Jan Hodder / jhodder@uoregon.edu
Theme: Integrating Research into K-12 Classrooms

Incorporating the Research of Oregon Institute of Marine Biology (OIMB) Fellows into the Classrooms of the “Learning about Where We Live” GK-12 Program
Fellows teach marine science to ~3800 students and 150 teachers in K – 6th grade classrooms in twelve schools in four school districts on the southern Oregon coast. Using the Marine Activities Resource Education curriculum, and materials developed by fellows, the program provides active-inquiry based lessons that integrate classroom inquiry and field activities designed to meet state science standards. Fellows incorporate their research into classroom activities when possible, and several fellows have developed new curriculum based on their research, which they are currently preparing for publication. Several fellows have developed term-long research projects for 4 – 6th grade classes that have a strong emphasis on the process of science. The fellows’ research is also incorporated into professional development activities for teachers who are offered opportunities to work with fellows on their research, and learn about research being conducted at OIMB in a series of science content workshops given jointly by the PIs and fellows. Each spring, we offer an open house for students, parents, teachers, and administrators at OIMB that features the fellows’ research.

Pennsylvania

Drexel University

GK-12: Engineering as a Contextual Vehicle for Science and Mathematics Education
Elaine Garbarine / egarbarine@drexel.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms

A Productive Transfer of Knowledge
The GK-12 program has proven to be an influential experience for the fellows, teachers and students. It has provided the fellows with an arena to excite younger students about science, math and engineering concept. The fellows have done this in two key ways. First, they have been able to bring their research into their GK-12 classroom. Fellows have research that spans a wide variety of engineering areas, providing context to the science and math the students are performing in the classroom. One fellow researches music and speech processing and has brought projects such as building sound booths and educational music games to his classroom. Another fellow studies structural color, specifically in Blue Morpho butterflies. Through this work her students have been able to look at electron micrographs of Blue Morpho butterflies and learn about their color and structure. The second way Drexel fellows have been able to excite younger students is in their improved ability to communicate STEM concepts and the real world context of them to their students. Fellows have shown students how physics and math play a role in both robotics and in human movement, demonstrated the relationship between mathematical functions and the growth of bacteria and even how simple games such as “Rock, Paper, Scissors” is related to probability. The ability to teach young students in grades 6-8 very complicated concepts is a skill the fellows have developed through their time in the classroom and is a valuable tool in their growth as researchers and educators. This poster presentation will provide illustrative examples from nine current Fellows.

Saint Joseph's University
GeoKids LINS
Karen Snetselaar / ksnetsel@sju.edu
Theme: Summer Workshops

Learning Involving Neighborhoods Kids and Science: The Evolution of GK-12 Workshops in a Museum-University-School Partnership.
GeoKids LINS (Learning Involving Neighborhoods Kids and Science) is a collaboration involving Saint Joseph’s University, the Wagner Free Institute of Science, and seven local urban elementary schools. The core GeoKids LINS program consists of faculty and GK-12 Fellows working closely with museum staff and district teachers to develop and implement hands-on natural science curriculum that is aligned with national, state, and local standards. The year-long curriculum uses urban neighborhoods as a primary source for learning, field trips, and creating interdisciplinary connection as well as utilizing museum and university resources. The service-learning component of the program
consists of a seminar on urban education issues and GK-12 Graduate Fellows mentoring undergraduate service-learning students to learn, modify, and teach a hands-on elementary science unit. One strength of the program is a carefully planned summer workshop that has changed each year to meet the changing needs of participants. During the early stages of the partnership, workshops focused on team-building, curriculum development, and urban education issues. While some time was spent learning science content, many of the activities and discussions were dedicated to program coordination. As the partnership progressed, a science content theme guided the entire workshop schedule and more emphasis was placed on experienced participants training new participants. In our seventh year, we are planning to focus even more on science content and professional development. In addition, we are opening the workshop registration and the opportunity to receive course credit to other teachers not working with GK-12 fellows at our partner schools in order to broaden the impacts of the partnership.

Puerto Rico

University of Puerto Rico Mayaguez
Graduate and Undergraduate Students Enhancing Science and Technology in K-12 Schools
Carlos R. Ruiz-Marinez / crm2002@yahoo.com
Themes: Communicating STEM, Integrating Research into K-12 Classrooms, International Collaborations, and Summer Workshops
GK-12 Fellows: A Fundamental Bridge between the K-12 Education and University Communities
Fellows as researchers and educators provide a mechanism to integrate K-12 students and teachers with STEM research and innovations. Our successful strategy has been to develop and deliver professional activities in sciences and technology for teachers through the Science on Wheels demonstrations, Global Learning and Observations to Benefit the Environment Program, and Graduate and Undergraduate Students Enhancing Science and Technology in K-12 Schools program. The fellows are trained through workshops and seminar in the scientific, technological and educational themes requested by teachers. Fellows contribute to the design of summer and Saturday workshops used to train K-12 teachers and students. The crucial interaction and impact are the visits to the K-12 schools, which create the “Scientific and Technology Bridge” from the university to the K-12 students. Thus topics related with fellow research projects and other areas are also explored. Moreover, from 2001 to date a group of 144 additional fellows trained 534 teachers in 20 week-long summer workshops and 1,199 teachers in 72 Saturday academies, leading to 1,410 visits to schools and training 23,466 students in science, technology, graphic calculator and sensors. In this way, the GK-12 expository program: Implements a cost-effective outreach activities; Teacher advance in science and technology; Students participate in science programs and improve the scientific background of students. Also, the GK-12 model has been expanded to Spain to increase the interest in crystallization and sciences. The impact profiles in Spain were similar to the findings in Puerto Rico which validate the effects of the fellows as a model of excellence in the teaching and learning processes.

Rhode Island

Brown University
Physical Processes in the Environment
Karen Haberstroh / Karen_Haberstroh@brown.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms, Summer Workshops
The Integration of Research in Brown’s GK-12 Program, “Physical Processes in the Environment”
Brown’s GK-12 Program supports nine graduate fellows who work directly with the Providence Public Schools. Fellows and partner teachers participate in pedagogical training and professional development workshops in the summer, which provide the necessary background for developing hands-on activities in line with Rhode Island’s Grade Span Expectations for science. Classroom activities have often been tied to the fellows’ PhD research. For example, fellow Erik Taylor’s thesis work involves understanding mechanisms for removing bacteria on medical prostheses. Erik and his partner teachers (at Martin
Luther King Jr. Elementary School) designed a lab on penicillin and how it is grown from bread mold – students cultured bacteria and examined its viability in the presence of penicillin. Along with these research-based activities, organized laboratory visits and outreach events on the Brown campus have further allowed Providence schools to witness graduate fellow research first-hand, to take advantage of science facilities at the University, and to help bridge the gap between K-12 students and the college experience. A unique component of Brown’s program has been the inclusion of summer research opportunities for K-12 teachers and high school students. Chosen participants work in labs of Brown faculty and engage in cutting edge research projects. Weekly group meetings provide the opportunity to improve communication skills, assess summer progress, and make effective podium and workshop presentations. During the final week of the program, participants present their summer research through a formal mini-conference presentation. Teachers are encouraged to work with Brown fellows and faculty to bring this research knowledge back into their K-12 classroom.

South Carolina

Coastal Carolina University

GK-12 Fellows Linking Marine and Wetland Research with Science Education in Coastal South Carolina Schools
Craig Gilman / gilman@coastal.edu
Theme: Integrating Research into K-12 Classrooms

Linking Marine and Wetland Research with Science Education: The Coastal Carolina University GK-12 Project
A goal of the GK-12 program is to involve GK-12 teachers and students in local coastal science projects. All GK-12 Fellows are active researchers in the Coastal Marine and Wetland Studies (CMWS) graduate program and are required to develop inquiry-based lesson plans based on their thesis research. Besides developing lesson plans, some Fellows have been able to bring their teachers and students to their research sites for exploration of the coastal environment, or have been able to build models or bring equipment into the classroom that is directly related to their research. One option for GK-12 teachers in CCU’s program is participation in summer research with their Fellow. The teachers spend 120 hours during the summer assisting the Fellow in designing experiments, collecting data in the field, and analyzing data in the laboratory. This poster will describe all the strategies used to incorporate coastal research in the GK-12 curriculum.

Tennessee

East Tennessee State University
Science First!
Gordon Anderson / andersgk@etsu.edu
Themes: Communication STEM, Integrating Research into K-12 Classrooms

Science First! Communicating STEM in the elementary school setting
Science First! is a collaboration between East Tennessee State University and North Side Elementary School of Math, Science and Technology, located in Johnson City, TN. Graduate fellows in mathematics, chemistry, biology and paleontology seek to communicate STEM and bring their research into the K-5 classrooms through games and hands-on activities, and by development of on-line resources in science and math. Through a variety of games, fellows have been able to teach, at an elementary level, concepts in animal anatomy and classification, habitat and ecology, and mathematical models including simple graph theory. Games are incorporated into an after-school math club, and a soon to be implemented science club. Hands-on activities have included lessons on clouds, jellyfish, and volcanoes. Through collaboration with the ETSU Natural History Museum and associated Gray Fossil Site, fellows have been able to bring real and cast fossils into the classroom, and a current project is construction of a functional fossil dig pit as part of the school’s enclosed outdoor classroom.
A major goal of Science First! is to allow the fellows to participate in a major curricular revision at North Side to one that is science-focused. This has included development of lesson plans, hands-on activities and demonstrations, and identification of age-appropriate web-based resources. These are being brought together as a series of on-line resources (ORCs), one for each science topic that is part of the state standards for that grade level. The fellows are developing the ORCs, which will be reviewed by the grade-level teachers, with the goal being to provide teachers with resources literally at their fingertips that will allow them to bring science and math to life in their classrooms.

University of Tennessee
GK-12: Enriching Earth Science in Rural Tennessee Middle Schools Through Research-Based Activities on Climate and Environmental History
Sally P. Horn / shorn@utk.edu
Theme: Integrating Research into K-12 Classrooms

The GK–12 Earth Project at the University of Tennessee: Integrating Fellows’ Research into Middle School Classrooms
The GK-12 Earth Project is collaborating with seven rural, East Tennessee schools to bring the excitement of geoscience research into middle school classrooms. This poster highlights four research-based activities developed and carried out by graduate fellows in collaboration with teacher-partners and faculty advisors. In a study of karst landscapes, students at Seymour Middle School investigated a sediment core extracted from a local cave. This project enabled a fellow to share his research on how cave sediments can be used as a proxy for paleoenvironmental change. At Heritage Middle School, students conducted an activity that introduced them to techniques of dendrochronology, and to identifying anatomical properties of various types of wood on a microscopic level. This activity allowed students to gain an understanding of how tree rings are used to reconstruct past environmental conditions, as well as an appreciation for the diversity of wood structural types found in trees. At Halls Middle School, students engaged in authentic research on fire history in Great Smoky Mountain National Park. The students sieved soil core samples to quantify and radiocarbon date charcoal particles produced in past fires. Students at Carpenters Middle School conducted a year-long research project on a schoolyard wetland. Their research focused on how biodiversity changes at different scales and on the water quality of the wetland. Projects such as these expose middle school students and teachers to the individual research of fellows and faculty advisors, and to the active application of the scientific method.

Authors: Grant L. Harley, Jorene L. Hamilton, John Sakulich, Matthew J. Valente, and Sally P. Horn

Texas
Baylor College of Medicine
GK-12 at Baylor College of Medicine
Ron McNeel / rmcomeel@bcm.edu
Theme: Integrating Research into K-12 Classrooms
Bioscience Research and Technology for High School Audiences
Capitalizing on its strengths in biomedical research, Baylor College of Medicine (BCM) is helping to address the critical need for improved teaching and learning in Houston’s life science classrooms. BCM’s GK-12 program is partnering BCM bioscience graduate student Fellows with life science teachers in the Houston Independent School District, which enrolls 202,000 students and is federally designated as economically disadvantaged. Each teacher-graduate student team works together for an entire school year. GK-12 Fellows participate in classroom life science instruction on an ongoing basis and complete a special project in collaboration with their teacher partners. The projects are curriculum-based and hopefully unique and fresh. Projects showing merit will be offered to the district as alternative ways to facilitate that content area. For 2008-09, we have a continuation and refinement of a model from the previous year. One fellow/teacher partner team is using Drosophila melanogaster (fruit fly), to introduce students to the real world of biomedical investigation through an Introduction to Research Design.
and Methods course. The goal this year is to standardize the course curriculum and improve upon last year's achievements. This curriculum will be shared with other schools in the district interested in offering or changing this course in their life science curriculum. BCM’s BioEd Online website (http://www.bioedonline.org) has become an important conduit through which BCM distributes inquiry lessons, content presentations and lab demonstrations—some of which are developed and modeled by GK-12 Fellows and their partner teachers—to other teachers across the US. BioEd Online serves approximately 10,000 page views per day.

**Texas A&M University**

Building Understanding through Research Partnerships and IT

Christi L. Everett / bears@bryanisd.org

**Theme:** Marketing Your Project

**What is a Scientist?**

Texas A&M University-Chemistry has partnered with Bryan Independent School District to bring the real world of science to the K-12 classrooms. Over three years, the project has seen great changes in the viewpoints of teachers and students when considering science. Teachers and students in the K-12 classrooms have engaged in activities which opened the world of science as accessible to all. Teachers have gained confidence in their teaching of science, students have gained an interest in science beyond the classroom, and fellows have gained a drive to enhance science learning through informal interactions. The fellows developed confidence in presentation, communication, and time management through work in the K-12 classrooms translating to enhanced research skills. Key components of the program are evident in "Ask a Scientist;" "Lunch with a Scientist;" family science nights; robotics club; multiplication rap; weekly hands-on cognitively engaging science lessons; and diverse fellows to reach out to minorities and English Language Learners.

**Texas A&M Health Science Center**

Fellows Integrate Science/Math in Rural Middle Schools

Rebecca Rowntree / rebecca_vaughan@tamu.edu

**Theme:** Integrating Research into K-12 Classrooms

**STEM Fellows Share Research With Middle School Students**

Focusing on improving the content of science, technology, engineering and mathematics (STEM) in rural schools grades 6-8, our PEER Graduate Fellows have introduced their STEM research in the classroom to further enhance lessons and activities. By teaching students that the curriculum proves useful in our everyday lives, fellows are able to grasp student attention, which provide them with a greater interest in learning. Ruth Mullins, completing her research in Oceanography, was able to bring the Galapagos Islands to her classroom by showing the students actual science elements from the Islands and using technology software outside of the classroom for communication. Mechanical Engineering major, Ben Lawrence taught his students that combustion is not just a science term, but an important chemical process necessary for airplane and rocket propulsion. Natalie Johnson provided her students with a background in her area of research, Toxicology, by experimentally demonstrating that contaminants may be in our daily sources of consumption. All of these lessons are already taught outside of the realm of graduate level research, but it is the association with the real world and the demonstration that science and mathematics are important outside of the classroom that are what provide students with a desire to learn by retaining information. Graduate level research is quite specific and complex however, the use of simple science and mathematics to perform daily tasks should be emphasized. Our goals go beyond teaching the students a specific lesson plan; they also include relating to and interacting with the students, providing them with the tools to continue learning and leaving them with an excitement and an interest in research and discovery.

**Texas State University San Marcos**

Project Flowing Waters

Alisa Abuzeineh / aa1290@txstate.edu

**Theme:** Integrating Research into K-12 Classrooms

**Where Do You Need Us? Four approaches to integrating scientific learning and interest in secondary education, 6-12th grade**

Enhancing student interest in scientific subjects and incorporating inquiry-based lessons has long been a challenge for secondary education. This challenge becomes even more acute when educators and resident scientists together interact with students in a variety of subjects over several grade levels. Project Flowing Waters was initiated in 2008 as a collaborative program between Texas State University (TXSTATE) and the San Marcos Consolidated Independent School District (SMCISD) to enhance inquiry-based scientific teaching in the framework of freshwater ecology. Doctoral students in the Biology and Geography departments at TXSTATE collaborate with 6-12th grade science teachers (Earth Science, Chemistry, Physics, and Biology) to incorporate their aquatic research into lesson plans, labs, activities, and field trips. Project Flowing Waters doctoral students are embedded at
several campuses in the SMCISD: (1) two middle schools, (2) the main high school and (3) two alternative high schools: PRIDE (Positive, Responsible Individuals Desiring an Education) and Pathfinder. The diversity of student backgrounds, student abilities, and educational settings, as well as the unique format of the program, has provided an opportunity for Project Flowing Waters doctoral students and science educators to find innovative and dynamic ways to increase interest and enthusiasm in scientific subjects while capitalizing on the benefits of inquiry-based teaching techniques. We highlight four educational partnerships within our program to demonstrate similarities and differences amongst our approaches (e.g. field trips, designing of labs, etc.) to address project and fellow/teacher goals under all circumstances as well as the challenges, our successes, and plans for the future.

Texas Tech University
Building Bridges: Integrating Mathematics, Science, and Engineering Education on the South Plains
Jennifer Wilhelm / jennifer.wilhelm@ttu.edu
Theme: Communicating STEM

Building Bridges
The Colleges of Arts and Sciences, Engineering, and Education have collaborated to create the Building Bridges program, a multidisciplinary effort to help bridge the science, technology, education, and mathematics (STEM) disciplines in order to produce integrated curricula for improvement of K-12 education. Program objectives include to foster the relationship between the STEM fields, to develop new contexts and experiences for teaching STEM topics in secondary environments, to produce manuscripts suitable for publication in various academic journals, and to provide enhanced learning experiences for secondary students. The primary purpose of the program is to create opportunities for STEM graduate students to develop communication skills with fellow STEM researchers in other disciplines and teachers in the K-12 environment. We will highlight aspects of the Building Bridges program such as the participants (Fellows and Teachers), the main centerpieces of the program (pedagogy, curriculum development, development of interdisciplinary relationships), and research generated in conjunction with the program.

University of North Texas Health Science Center
Project SCORE: Development of a Permanent Outreach Program Between Teaching Fellows and Science Teachers/Students of the Fort Worth ISD
Rustin Reeves / rustyr@hsc.unt.edu

Themes: Communicating STEM, Integrating Research into K-12 Classrooms

Graduate Fellow’s Research Presentations Using Wimba’s Live Classroom Technology
Last year, several SCORE graduate fellows presented their research projects to their high school classrooms using a Tandberg videoconference unit bridged from the health science center to Fort Worth ISD servers. This technology required a high degree of coordination between the two campuses, and also required for high school students to be located in a room with compatible Tandberg technology. This year, we tried a different approach, and used Horizon Wimba’s Live Classroom, a web conferencing tool (software) that enables users to meet online in a “virtual classroom” using voice video and PowerPoint presentations. This format is much easier to use and does not require a bridge between two servers. With the Wimba software, only an internet hook-up on either end is needed. Web-cams were used so that the fellow could see the high school students, and the students could see inside the fellow’s research laboratory. Brittany Braun, a SCORE fellow in the Department of Cell Biology and Genetics, was the first to share her research with the new Wimba software. She showed students her research using bovine lens epithelial cells, demonstrating how those cells are removed from fresh tissue and then cultured for her experiments. She showed details of her research laboratory and demonstrated several laboratory techniques she uses in her research project. Students were very interested in the presentation and had numerous questions for the fellow, including questions about her research and her career as a scientist. For many K-12 students, this is the first time they have ever seen inside a research laboratory, giving Project SCORE a great mechanism to stimulate their interest in science and expand their scientific literacy.

University of Texas at Austin
Continuing GK-12: From Aquifers to Estuaries--Tracing a Drop of Water Via an Interactive Program Linking UT Scientists with K-12 Students and Teachers
Brian Cowan / BC1774@gmail.com
Theme: Communicating STEM

Tracing a Drop of Water through Science and Society
Our team designed a series of field trips and exploration activities falling within the theme of UT-Austin’s GK-12 program, “Tracing a drop of water.” Our goal was to prepare students to evaluate social policy using scientific data regarding water usage and quality. UT-Austin’s GK-12
field training for teacher and fellows provided us with background for lab activities and field trips around the Edwards aquifer, central Texas caves and Aransas Bay. Students started by learning about the Edwards aquifer, a karst aquifer in central Texas, and ended with a field trip to Aransas Bay, where they observed diversity in coastal and marine ecosystems first-hand. Throughout their experience, students were encouraged to recognize how human impacts on water resources affect water quality and the presence of sustainable ecosystems downstream. Classroom activities were linked to outdoor learning experiences. For example, a lab in which students measured water infiltration (recharge) in artificial plots with different ground cover was followed by a field trip to a nearby creek, where students measured water infiltration rates. Students combined sample collection with GPS data to create a GIS map illustrating the threats of urbanization on the Edwards aquifer recharge zone. In Aransas Bay and the Gulf of Mexico, students compared marine populations to water turbidity and salinity values. Students completed independent research projects linking social policy to environmental concerns. Projects addressed issues such as the effects of protection and conservation of resources in areas where populations are growing rapidly, and how regulatory policies on the Edwards aquifer affect the integrity of the coastal ecosystems along the Gulf of Mexico in and around Aransas County, Texas.

University of Texas at El Paso
GK-12 Partnership for Exploring the Environment on the U.S. Mexico Border
Rebecca Marin / ramarin@miners.utep.edu
Theme: Summer Workshops

Summer Adventures of Fellows and Teachers in the Chihuahuan Desert
UTEP’s GK-12 program tracks middle school science students from 6th through 8th grades. Our unique Summer Institute features a week-long outdoor experience at the Indio Mountains Research Station for fellows and teachers to participate in inquiry-based activities and gives them a chance to bond. Fellows and teachers have the opportunity to work with each other to perform inquiry science as they would as a team in the classroom. Ten fellows rotate among ten teachers to complete 10 Schoolyard Desert Discovery activities that are created for use in desert environments and are good models of inquiry-based instruction. The effectiveness of the Indio Ranch experience helps teachers and fellows have a better grasp of science inquiry while at the same time builds up strong fellow/teacher pairings that allow for the most effective teams possible.

Virginia
George Mason University
SUNRISE: Schools, University ‘N Resources in the Sciences and Engineering
Rajesh Ganesan / rganesan@gmu.edu
Themes: Communicating STEM, Integrating Research into K-12 Classrooms

SUNRISE: Schools, University ‘N’ (and) Resources In the Sciences and Engineering-A NSF/GMU GK-12 Fellows Project
The SUNRISE project poster highlights examples of how GK-12 fellows brought their research into the K-12 setting and the training that was provided to them to effectively communicate their STEM research to a broad audience. The examples of lessons include: 1) studying properties of most superconductors in which students are shown how the fundamental, underlying properties are used in Electronic Structure calculations to help explain and predict the quantum mechanical superconducting trend, 2) learning about the kingdom “Monera,” characteristics of organisms in this kingdom, and how bacteria can be used in research, 3) analyzing spectrograms of marine animal sounds, including sounds made by humpback whales, 4) interpreting real solar wind data taken from a number of different spacecraft, to learn more about their characteristics, 5) growing their own biofilms from pond water to understand the role of biofilms in the health of the water system, 6) understanding galactic evolution, which includes learning about the different types of galaxies and the effects that a black hole
has on the space surrounding it, 7) Performing ‘Modular Arithmetic and Encryption’, in which clocks with a different number of hours were shown to explain modular arithmetic, and 8) leaning ‘Methonine Biosynthesis’, in which students were introduced to amino acids as the 20 building blocks of life, and Methionine was introduced as one of the amino acids. The fellows underwent two month-long training during summer before they began their classroom visits in fall. The training included learning about curriculum development, expressing their research and understanding of STEM topics in simple terms, successful teaching methods and classroom management skills, and the science standards of learning.

Washington

Central Washington University
Yakima Watershed Activities to Enhance Research in Schools (Yakima WATERS)
Susan Brady / belmonts@cwu.edu
Themes: Integrating Research into K-12 Classrooms, Summer Workshops

Yakima WATERS Project: Watershed Activities to Enhance Research in Schools
The Yakima WATERS Project connects rural central Washington K-12 students to interdisciplinary watershed science research and related classroom activities and fieldtrips. Each of the eight WATERS teams includes a CWU graduate student fellow, a CWU faculty mentor and a lead K-12 teacher, who work together to integrate authentic research into the K-12 classroom. Graduate students are selected from four graduate programs: Biology, Chemistry, Geology, and Resource Management. This interdisciplinary collaboration allows fellows, teachers, and faculty mentors to integrate a variety of research topics into curriculum and extend the fellows' research into the classroom. A two-week Summer Institute provides a time for training, planning, and interdisciplinary collaboration within and among teams. The Summer Institute is a valuable time for fellows, faculty and teachers to organize and establish common goals for the year, including fieldtrips and extended class research projects. Fellows meet weekly to exchange ideas and provide support for one another. In addition, quarterly symposia reunite all WATERS teams for discussion of victories and pitfalls in assimilating research, new lessons, labs, activities and fieldtrips into existing curriculum. This year, investigations include: water chemistry analysis, salmon ecology, hydroelectric dams, amphibian ecology and disease, soil and microclimate mapping, water rights and long term data collection. Through the Yakima WATERS program, students are exposed to a variety of scientific problems and research topics throughout their K-12 career. Our program aspires to underline the relevance of science by promoting an understanding of the importance of the Yakima watershed and related science among the K-12 students.

University of Washington
GK-12: Ocean and Coastal Interdisciplinary Science (OACIS) Program
Amanda Bruner / ambruner@u.washington.edu
Theme: Integrating Marine and Environmental Research into Classroom

Integrating Marine and Environmental Research into Classroom Curriculum: From program wide perspectives to successful strategies used in a single classroom
The OACIS GK-12 program brings current marine and environmental science into urban and rural high schools. Research on ocean and coastal environments is, by its nature, highly interdisciplinary. Teachers and fellows can use this interdisciplinary approach to teach basic science (biology, chemistry, physics), mathematics, and marine/environmental science, and increase ocean literacy. UW graduate students and their advisors involved in cutting-edge ocean/environmental research are well suited to bring new research findings directly to schools. During summer training sessions the OACIS GK-12 program supports fellows in the development of inquiry-based presentations of their research to use in the high school classroom. Our poster highlights how teacher-fellow partnerships in the OACIS GK-12 program integrate the fellows' diverse research into the high school classroom. We will present fellow and teacher perspectives on what they have learned through their partnership about how to effectively incorporate research in the classroom, and their perceptions of consequent impacts on student learning. We focus in detail on how one fellow-teacher partnership brought abstract principles from the fellow's highly specialized environmental research into high school marine science classes in concrete ways. We will describe how the partnership used place-based learning to engage students in the topic of human impacts on aquatic systems and highlight how the fellow enhanced student learning by using university contacts to bring resources into the classroom. We will present inquiry-based lessons used to empower a diverse group of students to participate in stewardship of their local waterways.
Washington State University
Culturally Relevant Engineering Applications in Mathematics
Dr. Guy M. Westhoff / westhoff@wsu.edu
Theme: Integrating Research into K-12 Classrooms

Culturally-Relevant Engineering Applications in Mathematics
This project uses culturally-relevant engineering applications in mathematics to energize graduate students, K-12 teachers and students, and university faculty to reform mathematics education and heighten engineering career aspirations. K-12 Teachers with engineering graduate student fellows facilitate pedagogically sound, student-centered, engineering-focused projects in which K-12 students create engineering solutions to local socially-important problems while achieving classroom objectives and state standards. Our eight engineering graduate student fellows work in teams within five geographically-separated schools to develop and deliver lesson activities that transform their research from the lab into the K-12 classrooms, through the implementation of the CREAM-focused projects. These CREAM lesson projects give the K-12 students the opportunity to experience an engineering design problem and work with an engineering mentor to develop a culturally-relevant engineering design solution that can benefit their local communities. Our five geographically-separated schools were selected to allow our project to work with traditional and underrepresented populations to gain a greater understanding and valuing of engineering careers. This poster will highlight the research our CREAM engineering graduate student fellows are conducting and the lesson activities that have been designed, developed, and implemented within the students within the classrooms of our partner schools.

Washington State University Vancouver
Global Change in a Local Context: Partners in Discovery of the Columbia River Watershed
Gretchen Rollwagen-Bollens / rollboll@vancouver.wsu.edu
Theme: Integrating Research into K-12 Classrooms

Partners in Discovery GK-12 Project at WSU Vancouver: Bridging Research and Teaching about the Columbia River – From Cascades to Coast
The "Partners in Discovery" GK-12 project pairs WSU Vancouver Environmental Science graduate students with 6th-9th grade science teachers in 3 SW Washington school districts for year-long, one-on-one partnerships. Our goals are to bring the Fellows’ research and expertise into the classroom and to support the Fellow-teacher partners as they teach science through authentic inquiry. In 08-09, each GK-12 Fellow is conducting thesis research related to the Columbia River watershed, from Cascades to the coast, and each is working with their partner teacher to integrate these topics into the curriculum. For example, Laura Friedenberg (Fellow) and Jennifer Dean (9th grade biology) developed a water quality laboratory and field unit oriented around Laura’s research on larval fish feeding in estuaries. Ray Yurkewicz (Fellow) and Meagan Graves (6th grade earth science) have emphasized systems, using Ray’s research on how burrowing gophers influence nutrient cycling and plant community structure on Mt. St. Helens. Jennifer Blaine (Fellow) utilizes submersibles to study impacts of marine protected areas on benthic invertebrates and their interactions with at-risk fisheries. She and Jeremy Ecklund (7th/8th grade science) developed a set of lessons integrating water pressure, mechanics of vessel operations, and community ecology. Jennifer Duerr (Fellow) and Charlene Shea (7th grade life science) designed an ecosystem unit focused on energy flow and food webs, where students created biomes and connected their knowledge to the Columbia River Watershed. We will be assessing the impact of these partnerships on the Fellows’ communication skills, teachers’ inquiry skills, and on K-12 students’ enthusiasm for and knowledge of science.

Wyoming
University of Wyoming
Science Posse: Enhancing Science Awareness and Understanding in Wyoming
Shawna McBride / smcbride@uwyo.edu
Theme: International Collaborations

The Science Posse Goes to India: Exploring Science and the Local Environment Through Water Quality Investigations
During the 2007-2008 school year, the Science Posse was involved in planning a trip to Northern India to work with Tibetan refugee children. The Science Posse traveled to Dharamsala India in the state of Himachal Pradesh during the Spring semester and was in India for 10 days during March 2008. Collaborations were first established through Don Roth, the Dean of the Graduate School and the PI of the project, who had traveled to the Tibetan Children’s Village schools in India previously and who had a working relationship with the Tibetan international students at the University of Wyoming. Leading up to the
departure to India, the Science Posse spent considerable time learning about the Tibetan and Indian cultures, preparing a water quality lesson plan to take into the Tibetan Children’s Village schools, and developing a survey to address assessment issues. In the schools, the Science Posse worked with middle school-aged children and helped them test their own water sources through a water quality lesson plan developed by the Science Posse. In addition to testing water quality, both the Science Posse and the Tibetan children learned a lot about each other and each other’s cultures and have communicated back and forth since the trip. This was a great experience for all involved.