ARIZONA STATE UNIVERSITY

Poster 1

PI: B. L. RAMAKRISHNA
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Presenters: B. Lahey, K. Seyedmadani, E. Nedow, J. Prichard
Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences, Engineering, Nanoscience, Social & Behavioral Science

Evolution of the Down-to-Earth Science GK-12 project at ASU*

Over the past decade when the GK-12 project has been implemented at Arizona State University, over 100 graduate students have partnered with nearly 100 teachers and brought their research and expertise to over 15,000 K-12 students. Throughout the years, inquiry-based interdisciplinary lessons and integration of research with education and outreach have been the bedrock of the project. The diverse environment at ASU enabled the introduction of a broad spectrum of scientific fields, ranging from anthropology to biomedical engineering, into the standard K-12 curriculum. Under this backdrop, focus has additionally been placed upon mapping "big ideas" of science onto lessons, fostering international collaboration through a partnership with Taiwan, and incorporating nanotechnology into K-12.

The GK-12 project at ASU has most recently been utilizing the Grand Challenges for Engineering in the 21st century. GK-12 fellows have developed inquiry-based lessons centered on the Grand Challenges that are best aligned with their respective research areas. Incorporating these lessons into K-12 classrooms ignite interest in STEM and provide the benefit of exposing students to current and future issues facing communities around the world. The lessons pertained to concepts underpinning the engineering of better medicines, providing access to clean water, engineering the tools of scientific discovery, restoring and improving urban infrastructure, reverse-engineering the brain, and making solar energy economical.

Ultimately, these lessons promoted an understanding of engineering from a societal perspective for students and teachers while allowing the fellows to achieve a broader impact by communicating their research. The outcomes of the program were to help fellows improve teaching skills, serve as role models to inspire K-12 students to think like scientists and engineers, and expose teachers to cutting edge research.

This GK-12 project has laid the foundation to launch a new initiative to create lessons aligned with the standards by translating emerging nanotechnologies that address the Grand Challenges of the 21st century.ainability projects across nine high schools, six of which are within the Tempe Unified High School District.

**Authors: Jeremy Ecton, Byron Lahey, Stephanie Morgan, Eric Nedow, Jason Prichard, Kari Rich, Kimia Seyedmadani, David Skuse Todd Prichard and B.L. Ramakrishna*

Poster 2

PI: CHARLES REDMAN
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Presenters: Anne Marie Raymondi, Omaya Ahmad, and Katie Talbot
Discipline: Ecology, Environmental, & Earth Sciences

Sustainability Science for Sustainable Schools: Sustainability Projects as a Method for Student Engagement

The Sustainability Science for Sustainable Schools' poster presentation will highlight recent work of our project which is currently in its third year of a six-year program. For the past three years, ASU graduate students have worked with Valley High schools to develop sustainability curriculum and projects that impact the classroom, the campus and the larger community. The poster presentation will provide an overview of the Sustainable Schools program mission and goals, with a description of "best practices" that have supported working partnerships with our schools and teachers. The presentation will focus on our current involvement in several innovative sustainability projects across nine high schools, six of which are within the Tempe Unified High School District.

ARKANSAS STATE UNIVERSITY

Poster 3

PI: JENNIFER BOULDIN
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Presenter: J.L. Bouldin
Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences

GK12 Graduate Fellows at Arkansas State University Enhance Science Curriculum in the Arkansas Delta

Increased interest in science begins during the early years of a student's development. Enhancement of science curriculum in grades 6-8 in the Arkansas Delta region is facilitated by the National Science Foundation. The Arkansas State University GK-12 Program targets seven rural public school districts which represents a diverse ethnic student population. In the first two years of our program, 3,661 public school students have been exposed to enhanced science learning. Graduate Fellows are paired with two Mentor Teachers whom they team-teach with one day per week to enhance the science environment and strengthen Mentor Teachers' content knowledge and experience. Hands-on learning for the students is directed by the Graduate Fellows based on their research experiences. Lesson plans written by the Fellows are aligned to the Arkansas Science Curriculum Frameworks, and spark excitement and inquisitiveness in the students.

Increased understanding of their research and improved communication skills are obtained by the Graduate Fellows while middle school students are introduced to active science research. Lesson plans are linked to our website and are available to classroom teachers for further use and facilitate continued enhanced science curriculum to encourage student interest in STEM careers.

BOISE STATE UNIVERSITY

Poster 4

PI: KAREN VISKUPIC
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Presenters: J. Rylee, M. Schmasow, E. Shirley, Y. Tadehara, and B. Ware
Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences, Geology & Geography

Scientists in Learning Centers: Boise State's Innovative GK-12 Partnership with Informal Science Educators

Over the past four years, Boise State University's GK-12 project has established a successful model for placing science graduate students in informal learning centers. This innovative GK-12 model was purposefully chosen with the goal of giving graduate students varied teaching experiences in order to maximize development of their communication skills. Fellows teach in a variety of settings including traditional classrooms, outdoor field trips, and large community events to all grade levels K-12 and to the general community. In addition, the model allows a huge number of students and community members to interact with GK-12 Fellows each year.

Fellows from Boise State's Departments of Geosciences and Biological Sciences are paired with informal science educators at one of three local learning centers: The Morrison-Knudsen (MK) Nature Center, the Foothills Learning Center, and the Boise WaterShed Environmental Education Center. The STEM education foci at these learning centers overlap with the research interests of Boise State faculty and graduate students. They also overlap with science issues of local and regional interest and relevance, and therefore provide important topics for connecting the learning centers and Boise State scientists with the community. In addition, science issues of national and international public interest such as climate change, evolution, water resources, pollution, conservation, and habitat restoration are tied to the fields of biology and geosciences, and sometimes involve overlap between the two. These topics are prime targets for motivating and educating future scientists, and our project provides the scientific and educational expertise, the venue, and the audience to make a meaningful positive impact.
Our Learning Center Partners report that the graduate fellows greatly improve the curricular offerings at the centers by creating exciting new lessons and activities, as well as revising existing lessons to feature more relevant and local science content. The GK-12 project has also allowed the learning centers to dramatically increase program capacity, and has allowed a large audience to interact with graduate fellows. A traditional GK-12 program with eight fellows each year may reach between 200 and 800 K-12 students. During the 2010-2011 year alone, Boise State's eight GK-12 fellows reached over 20,000 K-12 students, 1000 K-12 teachers and 3000 community members.

BOSTON UNIVERSITY

Poster 5

PI: SUCHI GOPAL
Contact: Rose Abramoff, rza@bu.edu
Presenters: Stephanie Selznick, Rose Abramoff
Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences, Geology & Geography

Integrating Technology and Geolocation into the 5th Grade Science Curriculum

The purpose of the GK-12 GLACIER program is to incorporate the fundamentals of climate change into the K-8 curriculum. Graduate students are partnered with teachers in Boston public schools for 10 hours a week of teaching with additional curriculum development. In The Curley School K-8 in Jamaica Plain, technology had traditionally not been incorporated into the curriculum, both due to funding restrictions and instructor expertise. Our goal was to incorporate technology and tech literacy into the science classroom at Curley, and to develop curriculum that uses these new tools. The Curley School has some computers for the students to work with, and two Smartboards shared among all the classes, but no other resources for teachers.

We organized a fundraiser at Boston University to raise money to buy a projector, digital cameras, a color printer, and supplies related to these purchases in order to have technology resources in the classroom. The fundraiser was a Garage Sale, selling donated items from graduate students and faculty. We raised nearly $1000 dollars and used this money to supply the science class at Curley. Armed with a projector and occasional use of the Smartboard, we developed curriculum using interactive powerpoints, and lessons involving student research and word processing on the computers. Students developed skills that they did not have at the beginning of the school year. They became proficient with word processors, internet searches, cameras and Smartboards. Our tech-centered projects such as Question of the Day, Field Guide to the Outdoor Classroom, Solar System Weather Report, and Earth as a Closed System helped prepare the students for MCAS, while emphasizing climate change and plant ecology, which is Rose Abramoff's area of research in her graduate program.

PI: SUCHI GOPAL
Contact: Benjamin Carr, bencarr@bu.edu
Presenters: Benjamin Carr and Greg Porter
Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences

Climate Change as Expeditionary Learning

Greg and Ben have crafted a year-long expedition for their 25 fifth-grade students. The touchstone for every subject, and also the focal point of the GLACIER project, is climate change. Global Change Initiative Education and Research is a Boston University GK12 program placing graduate students in 4-8th grade classrooms around Boston. Ben and Greg have the luxury of bringing climate change and scientific thinking into every aspect of the curriculum.

We are able to not include just traditional STEM education, but bring critical reasoning and climate topics into other aspects of the classroom, such as English Language Arts and Social Studies. You can think of it, as we often do, as a Venn diagram on a Cartesian plot with each subject occupying one of the quadrants.

The obvious connection between the GLACIER program and the curriculum of course fall in science class, we'll call this Quadrant I. Brookline Public School has adopted the Cornell Lab of Ornithology bird curriculum for its fifth grade. Ben's expanded on this in the classroom, including aspects of his research on the oceans animals, particularly those of the North Atlantic, a body of which all the students were familiar but none extremely knowledgeable about its fauna. They discussed fish and mammals and the effect that warming ocean's would have on the ranges of the fish, something that they had considered with their bird projects but was a foreign idea for an animal that lived in the ocean. Optics was the next unit to be covered and introduced the ideas of transmission, absorption, and reflectance. The connection between optics and climate change may not appear obvious at first blush, but Greg and Ben were able to relate the three central topics of the optics unit to the climate changing effects of greenhouse gases. Once a student had experience with a laser and a prism and other traditional objects they were able to draw the corollaries to the trapping of greenhouse heat in both a traditional man-made greenhouse, and the atmosphere of the planet. Ben and Greg also introduce the idea of citizen science through the bird curriculum, but also with the very tangible spills of Nikes and Rubber Ducks in the Pacific in the 90s which were used to create more accurate current maps of the region.

In Quadrant II we find the "M" in stem, Math. Students are using real world data to learn about graphing on both paper and computers, as well as the topics of mean, median, mode, and decimals; fundamentals to the 5th grade education. These topics are made more engaging through student ownership of the data. Bridging the Math-Science quadrants is our very own school weather station purchased with PTO funds. Every day at 2pm, shortly before dismissal, two students are sent out to record the temperature and barometric pressure and record and dump the precipitation gauge; they then come in, and for the first time for nearly all of them input this data into a rapidly growing excel sheet. This tradition will last much longer in Greg's classroom beyond Ben's one-year tenure. Engineering also finds itself at this midpoint between math and science and in the classroom where students have designed and built a range of things from birdfeeders (some successful, some not) to wind-up-pencil-bottle cars.

We now begin bridging climate change into the non-traditional subjects or quadrants, English Language Arts. Ben and Greg are engaging students through a variety of mediums, sourcing some reading material from age appropriate publications on climate change, to using climate change as the subject for "persuasive essays" a new experience for them, and even engaging them in a debate project on various topics relevant to climate change research.

Social Studies is the fourth main subject, and thus the fourth quadrant in our Cartesian plot. Much of the focus this year is on Colonial America, where we have tied climate change to the planting of crops, successes and failures in colonial history, and the effect that climate change will have on pushing planting zones toward the poles. Finally we are fortune to have a school garden, which bridges the social studies and science curriculum. Students are learning and planting both local crops and colonial crops, as well as learning about the USDA Hardiness Zones and the effect that warming may have on them.

We feel that the NSF GK-12 program has truly allowed us to enrich every aspect of the curriculum and that ideas spawned this year will have a lasting effect on Greg's classroom and the students for years to come.

BROOKLYN COLLEGE CUNY

Poster 6

PI: LOUISE HAINLINE
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Presenters: Brooklyn College GK-12 Fellows
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Geology & Geography, Social & Behavioral Science

The Urban Environment - Making Sense of Our Unique Surroundings by Using New York City as a Lab

Brooklyn College GK-12 Fellows, students, and teachers collaborate on field-based experiments in New York City public high schools. The projects expose students to exciting science experiences using the diverse environments throughout the five boroughs. Many students rarely explore beyond their own neighborhoods; these projects provide students with an expanded knowledge of their city. The projects create a full picture of the urban environment by having students collect

and analyze air, water, and soil data as well as assessing the correlations between green space exposure and perceived anxiety levels. A unique feature of our program is our established relationships among schools through project collaborations. This allows the broadening of our datasets as multiple schools compile common field data, for example, on tree measurements and water quality. Students present their findings to their peers and community, fostering a local awareness of environmental conditions. Through interaction with GK-12 Fellows, students are also encouraged to set future academic goals.

Teachers receive assistance in science curricula planning and implementation. The materials developed by the Fellows are accessible online to all participating schools, providing a framework to sustain these projects after the GK-12 program ends. Graduate Fellows gain experience with new pedagogical methods and mentoring skills. In addition, Fellows participate in professional development workshops, including grant writing, presentation and communication skills, and responsible conduct of research. In the participating schools, GK-12 Fellows have taken leadership roles in the integration of active learning techniques into science curricula.

BROWN UNIVERSITY

Poster 7

PI: TIMOTHY HERBERT
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Presenter: Karen Haberstroh
Disciplines: Engineering, Geology & Geography, Physics

A Successful Model for Hosting a Scientific Conference in a K-12 Urban Setting
We will present a successful event where scientists from Brown University present their research at a scientific conference held in our partner elementary schools. The conferences begin with a keynote address in the school auditorium. Students and teachers then attend three presentations of their choice on topics such as nanotechnology, “seeing” an atom, and return to the moon. Brown researchers bring photos/videos, data, demonstrations, and their enthusiasm for science, while the students bring clipboards, questions, and much curiosity. Successes and challenges of this model will be presented with a myriad of expected and unexpected benefits for Fellows, students, teachers, and presenters. A guide will also be provided for organizing a scientific conference in a K-12 environment, from ideas and invitations to materials and implementation. We believe that these Science Conferences serve as an example of the enthusiasm for science shared not only among the country's best researchers, but also by our students and teachers.

CALIFORNIA STATE LOS ANGELES

Poster 8

PI: NANCY WARTER-PEREZ
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Presenters: M. Ortega, P. Vincent, E. Bautista, J. Zamalloa
Discipline: Other

The Benefits of a Multidisciplinary Fellow Team & The IMPACT LA Open House
One of the unique aspects of the IMPACT LA NSF GK-12 Program at California State University Los Angeles is that graduate fellows are conducting research in varied disciplines in science and engineering. The 2011-12 fellows study local adaptations of sea slugs, anti-freeze proteins, asteroid characterization, ground water system modeling, reconfigurable computing, and binding in microfluidic devices. The benefits of a GK-12 model that pulls fellows from different STEM disciplines are: 1) fellows can be partnered with teachers in areas directly related to their research; 2) teachers can learn about a broad range of STEM research at workshops and the IMPACT LA Conference; 3) fellows are exposed to different research techniques; 4) fellows improve their communication skills by not only learning how to communicate their research to middle and high school students and teachers, but also to fellow researchers from different disciplines; and 5) fellows broaden their understanding of STEM while deepening their understanding of their own research.

Another unique aspect of the IMPACT LA NSF GK-12 Program is the IMPACT LA Open House held in late May that provides a culminating experience for the middle and high school students. Throughout the year, fellows act as visiting scientists and engineers bringing their research into middle and high school classrooms. Through fun activities, experiments, and demonstrations, students learn about their fellows’ research. The IMPACT LA Open House provides an opportunity for the middle and high school students to come to campus to visit their fellows’ research laboratories. On the lab tour, they also visit other fellows’ laboratories exposing them to research in other areas of engineering and science. One of the goals of the open house is to make a college education tangible to the students and something that they feel is obtainable. In addition to the laboratory tours, students attend workshops on how to get to college, college life, and STEM careers. Students also participate in a fun hands-on activity that illustrates that the university is a friendly place where creative minds solve problems.

CENTRAL WASHINGTON UNIVERSITY

Poster 9

PI: CAREY GAZIS
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Presenters: Steve Wagner, Carey Gazis
Disciplines: Ecology, Environmental, & Earth Sciences

Watershed Activities to Enhance Research in Schools: The Yakima WATERS Project
The Yakima WATERS Project integrates interdisciplinary watershed science research and related classroom activities and field trips into K-12 classrooms in Central Washington State. The project is structured with eight WATERS teams includes a Central Washington University (CWU) graduate student fellow, a CWU faculty mentor and a lead K-12 teacher, who collaborate to integrate authentic research into existing curricula. The Yakima WATERS theme provides a framework to educate K-12 students to meet the future challenges of managing the economically and ecologically important Yakima watershed. Graduate students are selected from four graduate programs: Biology, Chemistry, Geology, and Resource Management. This interdisciplinary collaboration allows WATERS teams to incorporate a variety of graduate student research topics and provide a real world context for inquiry-based learning. Team activities range from investigating stream morphology to amphibian biology.

COASTAL CAROLINA UNIVERSITY

Poster 10

PI: CRAIG GILMAN
Contact: Craig Gilman, gilman@coastal.edu
Presenters: Katie Altman, Jamie Brusa, Mandy Cuskelly, Erin Cziraki, Bryana Libby, Moriah Moore, Louie Schoetle, Kim Trinkle
Discipline: Biology, Chemistry and Chemical Sciences, Ecology, Environmental & Earth Sciences, Geology & Geography

Linking Marine and Wetland Research with Science Education
All Fellows in our GK-12 program are active researchers in the Coastal Marine and Wetland Program Masters Program at Coastal Carolina University. The thesis degree program encompasses a wide range of disciplines focusing on the coastal zone, including biology, ecology, chemistry, geology, marine science, and environmental science. Their research occurs in a variety of coastal freshwater, estuarine, marine, or wetland environments. A main goal of our GK-12 Program is to integrate coastal research into the classroom as the Fellows develop inquiry-based activities focusing on their research. Also, the teachers and students obtain a deeper understanding of their local coastal environment by conducting hands-on investigations in a wide array of settings including salt marshes, freshwater swamps, and an undeveloped barrier island.

COLORADO STATE UNIVERSITY

Poster 11

PI: TOM CHEN
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Presenters: Chris Schuamberg, Katherine Kiwimagi
Disciplines: Chemistry & Chemical Sciences, Engineering

Development of Electo-chemical Biosensor for Detecting Nitric Oxide (among other compounds) in Biological Systems
An electro-chemical bio-sensor is being developed to help scientists look into the chemical compositions of their biological systems. The different patterns of electron flow collected from the system via redox reactions of molecules, such a nitric oxide, provide signatures for different types and concentrations of compounds. Sensitivity and selectivity tests have been conducted to continue to improve this bio-sensor.

Our experiments have shown detection of nitric oxide in the nano-molar rage far below a concentration of 170nM, using Diethylenetriamine NONOate, a nitric oxide donor. Currently these tests are being repeated with a nitric oxide saturated solution for a more precise observation of the detection limit. Sensitivity tests are also being paralleled by other research teams using macro electrodes as well as chemiluminescence. Results from the collaboration of these experiments should provide a more precise concentration detection limit in the tens of nano-molar range or better. Few other projects have observed such low detection limits. Likewise the selectivity tests are currently looking into differentiating nitric oxide from dopamine using dual electrode techniques, which again is fairly novel. These selectivity tests will be expanded to include ascorbic acid among other compounds found in the biological systems. Developing the biosensor is a trans-disciplinary research that involves 3 teams of fellows. Each team working on this biosensor has data and results that affect other teams. The design process of the engineering teams integrating the potentiostate to be on the biosensor has to merge with the research methods of the life science teams looking at nitric oxide donors and biological systems.

This process was paralleled with our biosensor findings and integrated into a 9th grade Biology and 9th grade Ed Tech class through short lessons / demonstrations and a cross class room project. Students were asked to create a hypothesis about pine bark beetle infestation methods that could be tested by beetle catchers that the Ed Tech class built. The Ed tech class was required to build catchers to the Biology student specifications. This real world application of team management and the merger of the scientific method with the design processes worked well. The teachers are excited to repeat the project with the picture taking bird house this spring. These types of projects mirror what researches and

design teams do every day. Along each step of the process, from research proposal to specification design, students were shown data and examples from our research. Examples included florescent cell migration videos, cellular signaling in the body and much more. This experience showed the students the interdisciplinary aspect of life science and engineering.

CORNELL UNIVERSITY

Poster 12

PI: MICHAEL SHULER
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Presenters: Shivaun Archer, Donald Lee, Cassie Guarino
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Engineering

Using Biomedical Engineering as an Interdisciplinary Connection for Science Classes
The unique aspect of the CLIMB GK-12 program is that it capitalizes on the strengths of Cornell's biomedical engineering (BME) graduate students in research as well as the education experience of local science teachers to create and implement new interdisciplinary curricular materials focused on BME topics. This allows us to connect basic science to a tangible human health problem, thereby increasing student interest in STEM fields. We will highlight 2 activities developed by GK-12 fellows and their partner teachers based on the fellow's research and show how connections can be made between the core science classes using biomedical examples.

In Fellow #1's classroom, AP Biology and Regents Chemistry students studied how viruses enter the body. The fellow?s research characterizes the entry behavior of enveloped viruses with tools that allow one to see individual virions interacting with membranes in real time. Knowing how viruses work and cause disease is an important 1st step in anti-viral treatments. Using this as motivation, the fellow developed a unique working model of a bacteriophage. The model was made with affordable materials, such as a water-soluble tablets, balloons, syringes, and magnets. The resulting product was a self-injecting syringe that magnetically binds to another receptor magnet and activates upon the dissolution of the tablet in water. Students were able to build the model and witness the injection of the syringe contents (food coloring) across a plastic bag, similar to a bacteriophage delivering its genome. They then were asked to design a strategy to block viral entry. This module connects chemistry, biology, and physics to a real problem of viral diseases.

Fellow #2's research enhances the protein production of the bacteria E. coli by improving its post-translational modification capabilities. In her 6th grade General Science class students were asked to hypothesize "Where in the Middle School can we find the most bacteria?" Groups of students got together to share their ideas and agree on their team's hypothesis. Next, students were given materials and were sent to sample the location they hypothesized would contain the most bacteria. The bacteria were incubated at room temperature for 3 days, and then the students were asked to qualitatively and quantitatively observe the plates. The data from 3 different classrooms were compiled and presented. Once the initial data set was reviewed, many of the students had new hypotheses they wanted to test. Students were challenged to improve the experimental design, including adjusting the number of samples and presenting ideas on more accurate ways to quantify the number of bacteria recovered. This module connects biology and earth science to the ubiquitous nature of bacteria and how they can both harm and help us.

DARTMOUTH COLLEGE

Poster 13

PI: CARL RENSHAW
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Presenters: Erica G. Ferland and Jennifer Stainton
Disciplines: Ecology, Environmental, & Earth Sciences

Twin State Mercury Project
Through The Twin State Mercury Project, students from two high schools in Vermont and New Hampshire participated in a long-term student-driven science research project on mercury in the environment. The project incorporates field work in National Parks and National Historical Sites. Science research help is obtained through connections with Dartmouth College, The University of Maine at Orno, The Schoodic Education Research Center in Acadia National Park, the Vermont Institute of Natural Science, the Vermont Center for Ecostudies and New Hampshire Fish and Game Department.

Through this project, students in grades 9-10 ask an original research question related to mercury in the environment, and with the help of GK-12 fellows from Dartmouth, use scientific methodologies to obtain and analyze data. Students make posters based off their findings which they then present at an evening poster session at Dartmouth College.

In 2012, around 120 high school students presented their research to members of the public. What makes this project distinctive is the connection between middle/high school students and multiple science organizations, the collaboration between two high schools for a better understanding of mercury in the environment, the incorporation of a GK-12 fellow into the classroom as a scientist expert, and the poster session where every student presents original science work.

We would certainly brand or publish the steps taken to incorporate a long-term, authentic research project into a classroom of any age. We have several lesson plans and activities that facilitate group work, understanding data, how to make a poster, and how to present to the public.

We want people to remember students of any age have the ability, when properly guided, to conduct authentic research that is presentable to the public. This research can be done in class, and all students can feel successful through the process.

We consider ourselves experts in how to facilitate long-term research into middle and high-school classrooms. We are now experts in this area because we have worked with GK-12 fellows on developing the process we use for two years.

PI: CARL RENSHAW
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Presenters: Zak Gezon, Sue Jukosky
Disciplines: Ecology, Environmental, & Earth Sciences

Hydroponics in the Classroom: Could Uptake of Copper by Flowering Plants Affect Bees?

Inquiry based learning is recognized as an under-used yet highly effective method of teaching. Students, especially young students, are more likely to retain knowledge they discover on their own, rather than facts that are told to them. As part of the NSF GK-12 partnership between the Indian River School (Canaan, NH) and Dartmouth College (Hanover, NH), we are allowing three classes of 6th grade students to conduct an inquiry based science experiment; one where they are performing real science, with unknown results. Our goal throughout the project has been to allow the students to design as much of the project as possible, from asking a relevant question, designing methods for testing this question, carrying out the investigation, collecting and plotting the data, and interpreting the results. We will encourage the students to work together to present and/or publish their findings in an appropriate fashion upon completion of the project. Our inquiry based science project has also led to further research by a Dartmouth undergraduate involved in the Women In Science Program (WISP).

Our 6th grade students decided to investigate how heavy metal pollution could affect pollinators. Some species of plants are known to accumulate metals from the soil into their tissues. High metal concentration in leaves is an effective defense against insect herbivores, but the effect of metals on plant-pollinator interactions has not been thoroughly investigated. The objective of the students research is to determine if heavy metals in soils are transported into floral tissues, nectar and pollen, as well as determine if these metals affect floral characters known to affect pollinator preference. As part of the project, we designed a simple, inexpensive hydroponics system that can be used in the classroom to grow plants under various experimental conditions—an excellent venue for inquiry-based learning. The hydroponics system can be built with products purchased at any home depot/grocery store, and costs less than $100. Our hydroponics design is also ideal for classroom investigations because each plant has its own fluid reservoir, meaning that each plant can be used as a statistically independent unit of replication for many experimental designs. Most store-bought hydroponics set-ups have one fluid reservoir for all plants, causing statistical independence issues. Although ensuring statistical independence is more advanced than is necessary for most middle-school science classes, it leaves the door open for publishing results found in inquiry-based science projects should the students be motivated to make their findings public.

PI: CARL RENSHAW
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Presenters: Vicki V. May, Cynthia E. Tobery, and Carl Renshaw
Disciplines: Biological Sciences, Chemistry & Chemical Sciences,C omputer Science & Information Management, Ecology, Environmental, & Earth Sciences, Engineering, Geology & Geography, Mathematics & Statistics, Physics, Social & Behavioral Science

Building Permanent GK-12 Programs Campus-Wide

The two main aspects of the GK-12 program at Dartmouth that set it apart from other programs are: 1) All science, math, and engineering departments across campus are involved in the programs, and 2) From the outset, we have focused on developing permanent GK-12 programs on campus.

Because Dartmouth is relatively small with less than 2000 graduate students, we wanted a theme for our GK-12 program that would draw students from all of the science, math, and engineering disciplines. Thus, rather than select a theme focused on a narrow topic or a single department we chose the broadly applicable theme of “Fostering Scientific Creativity by Building Connections and Improving Communication Skills.” We are currently in our second year of funding and have successfully attracted graduate students from the following departments across campus: Physics and Astronomy, Molecular and Cellular Biology, Ecology and Evolutionary Biology, Engineering, Psychological and Brain Sciences, Chemistry, Physiology, Pharmacology and Toxicology, and Mathematics. Through weekly meetings and training, graduate fellows from the different departments have been able to interact, share ideas, and learn from their colleagues in other departments; the diversity of ideas and backgrounds has enriched the program and helped to build connections across departments.

Several programs that were initiated through the GK-12 program have been highly successful with the intention of continuing them beyond the five years of the GK-12 program. The success of permanent programs at Dartmouth is due to several factors including the diversity of the administrative team, institutional support, and close collaborations with teachers. Successful initiatives generated by the Dartmouth GK-12 program include:

Science Cafes Graduate students and faculty discuss science in informal settings with K-12 students. We recently obtained additional funding to expand the science cafe program to target adults through informal discussions in local cafes.

Science Roundtables Faculty, graduate students, and teachers come together each term to discuss current research topics and how this research may be brought into the classroom.

Inquiry-Science with Dartmouth Faculty and graduate students develop and document inquiry-based module that incorporate hands-on activities for use in K-12 as well as undergraduate classrooms. The modules remain with the faculty advisers and are advertised on the Outreach website to local teachers.

The GK-12 program at Dartmouth is characterized by a broad theme that cuts across all departments and is focused on building permanent GK-12 outreach opportunities.

DREXEL UNIVERSITY

Poster 14

PI: ADAM FONTECCHIO
Contact: Jessica Ward, jward@ece.drexel.edu
Presenter: Jared Coyle, Eleanor Small
Discipline: Engineering

Catalyzing STEM Education via the NAE Engineering Grand Challenges

Ten teams composed of a Drexel University College of Engineering GK-12 Fellow paired with a teacher from the School District of Philadelphia began intense work in August 2011 to develop engineering-based modules for inclusion in the high school curriculum. These modules serve to enhance the math and science education of high school students through the context of the National Academy of Engineering (NAE) Grand Challenges (www.engineeringchallenges.org) while concurrently illustrating the global nature of these societal issues.

The teams have implemented their modules into the otherwise very prescribed traditional science curricula of five area high schools. The schools selected provide a good opportunity to bring engineering perspectives and a contextual framework for the study of math and science to a student population generally underrepresented in science and engineering. Modules are typically derived directly from each fellow's research and laboratory activities and matched with one or more relevant NAE Engineering Grand Challenges. From there they are adapted to their students' grade level to generate excitement about engineering and in the fellow's field of study.

Teachers have developed new perspectives on innovative ways of teaching science. Fellows, in turn, have learned to meet the challenges of a high school classroom and have gleaned insight and experience by teaching to an audience much different than their traditional peers. The fellows, teachers and their students have all discovered the excitement of math and science when explored through hands-on interactive exercises and experiments. As a result, students have been exposed to science and engineering in ways that both complement and enhance the standard curriculum.

This poster illustrates a variety of the creative module lessons developed by each of the fellows during the first two years of the program and provides some evidence of the impact the NSF GK-12 program has had on the high school students. Topics on the current poster include urban hydrology and environmental regulation, restoring and improving urban infrastructure, population dynamics, oil spill clean-up, water treatment and clean water access, solar and alternative energy, preventing nuclear terror and the art of science writing.

EAST TENNESSEE STATE UNIVERSITY

Poster 15

PI: GORDON ANDERSON
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Presenters: L. Vinson, C. Sterling, M. Liendo, D. Ressler
Discipline: Biological Sciences

Science First! Adventures in an Elementary School Classroom

Science First! is a collaboration between East Tennessee State University and Johnson City Schools. Our graduate fellows are focused in a single school, North Side Elementary, which is a racially and ethnically mixed, low income school. Fellows are assigned by grade level and work with the teachers to develop and deliver lessons, provide experiments, games and hands-on activities, and bring science and math, including their own research, into every classroom in the school. The most distinctive and effective aspect of our model is the consistent involvement of the fellows in their students' education, with weekly meetings of fellows and teachers to plan lessons. Every student sees one or more of the fellows every week of the school year, which allows for real mentorship and the building of meaningful relationships. The students are attentive because they know their fellows, who serve as role models for them. This is so important for many of these students who initially could not imagine themselves pursuing careers in STEM areas, or even attending college.

The graduate fellows not only bring their research into the classroom, but they are also actively involved in presenting and enhancing the curriculum, they have informally increased many of the teachers' STEM knowledge, and they have interacted with families through activities such as Star Night and science fair projects. Their communication skills have developed dramatically as they have learned to quickly gauge their audience, and make adjustments as needed. They can adapt their approach depending on whether they are addressing elementary school students, teachers, parents, or their graduate student peers. The fellows are a team and their relationships with each other, as well as with their students

and teachers, are an important part of the success of our program.

EMORY UNIVERSITY

Poster 16

PI: PAT MARSTELLER
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Presenter: Pat Marsteller
Discipline: General

Getting the Career You Want: A Professional Development Program for Graduate Students

Since 2003, the Emory University Problems & Research to Integrate Science & Mathematics (PRISM) GK-12 program has sought to develop future faculty members with the skills and confidence in engaging diverse learners in science. A valued component of graduate fellows' professional development in our program is participation in biweekly Reflection Sessions that include career/professional development topics and peer-led journal club discussions. Professional development topics include reflective teaching through journaling and discussion, developing a teaching philosophy statement, applying and interviewing for jobs, and negotiating salary and start-up costs. Graduate students rate these sessions as highly valuable, because such topics are typically not otherwise included in their graduate training. In our journal club, graduate student pairs select a journal article from the education literature and lead a group discussion. We have found the journal club to be extremely rewarding; it provides the students with some agency over what is discussed in the sessions, and has seemed to increase the students' interest, engagement, and communication and leadership skills regarding issues of pedagogy, equity, and diversity in science education. Our intent is for these activities to help students obtain the kind of career they desire, and to foster within future scientists an awareness of the issues facing K-12 science education and a sense of responsibility to address those challenges. Our poster will share the syllabus, readings, and activities included in this professional development program for graduate students.

FLORIDA ATLANTIC UNIVERSITY

Poster 17

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Presenters: Mari Heghinian, Ahmad Hijazi, Vishala Maharaj
Disciplines: Chemistry & Chemical Sciences

SQER3: An FAU GK-12 Innovative Model for a Student-Driven, Teacher-Guided Science Demonstration

Improving the effectiveness of classroom demonstrations and increasing student participation has been a long-lived challenge in science education. While scientific demonstrations can assist in explaining concepts, students tend to be on the sidelines watching as opposed to being directly involved. Experience has shown that success in science education comes from students' ability to be involved in the thought process leading to the demonstration (1). In the following study, an interactive, question-driven framework for demonstrations that draws clear parallels to science practices has been developed and implemented. The framework, defined as SQER3 (Survey, Question, Explain, Recite, Reflect, and Review), allows for a departure from a one-sided demonstration to a cyclic questioning process that lets students extend their investigations. Because of its flexibility and adaptability to all levels of science, this SQER3 model has proven to be effective so far in high school chemistry classrooms, where it has been implemented at the regular, honors and advanced placement chemistry levels. The study of a demonstration utilizing the SQER3 framework will be presented along with a discussion of its effectiveness in the high school classroom.

(1) Roadruck, M.D. J. Chem. Educ., 1993, 70 (12), 1025-1028

FLORIDA INSTITUTE OF TECHNOLOGY

Poster 18

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Presenter: Richard Tankersley
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Physics

Legacy of InSTEP: Institutionalization and Long-term Impact of GK-12 Programs at Florida Tech

Over the past six years, Florida Tech's GK-12 program (Integrate Science Teaching Enhancement Partnership; InSTEP) has sought to institutionalize many of its initiatives aimed at improving the teaching and communication skills of young scientists and engaging faculty and students in K-12 educational outreach. InSTEP's legacy includes:

1. SEAS Laboratory: A modified RV that serves as a mobile research platform for educational outreach activities and inquiry-based lesson plans at local field sites.
2. Presenting Science Course: Semester-long interdisciplinary course for graduate students focusing on effective communication and teaching skills.
3. Presentation Boot Camp Workshops: Intensive two-day workshops for scientists (all career stages) focusing on presenting scientific concepts and research findings more effectively to both scientific/technical audiences and the general public. Through a series of interactive sessions, participants receive training in planning and preparing presentations that communicate messages more clearly and that have a lasting impact on the audience.

4. Lunch With a Scientists: Teams of graduate students visit classrooms to have lunch, discuss their research, and demonstrate their excitement for science.
5. Science is a Verb Lab Manual: Copulation of inquiry-based lessons developed by InSTEP Fellow-Teacher teams that focus on science integration using "ocean science" as an overarching theme.
6. Ocean Science Bowl District-wide Competitions: Sponsorship and coaching of Ocean Science Bowl teams at local elementary and high schools. In the spring, teams compete in a series of district-wide Ocean Sciences Bowl competitions that follow the format established by the Consortium of Oceanographic Research and Education (CORE).

Each of these programs will continue beyond the period of our InSTEP award and represent the long-term impact of the GK-12 program on the training of graduate students and integration of science and education at Florida Tech.

GEORGE MASON UNIVERSITY

Poster 19

PI: RAJESH GANESAN
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Disciplines: Ecology, Environmental, & Earth Sciences, Engineering, Mathematics & Statistics, Physics

SUNRISE: Schools, University 'N (and) Resources In the Sciences and Engineering-A NSF/GMU GK-12 Fellows Project
The objective of SUNRISE is to build a unique model of collaboration among elementary and middle schools in Northern Virginia, school division administration, and GMU to foster systemic efforts in implementing Information Technology (IT) rich STEM content-knowledge into grade 4-6 education by graduate Fellows. The SUNRISE project poster highlights the Fellow's current research and provides several examples of how GK-12 fellows brought their research into the K-12 setting. It also describes the two-month long Fellow training, which culminates in a summer camp for the children. The Fellow training is a unique feature of the SUNRISE program, which provides the foundation for successful transitioning into classrooms. Over the past three years, the summer camps for kids ranged from topics in science and engineering. They were titles, Oceans in Motion, Space Robotics, and Green Engineering. The poster presents some of the highlights of the camp as well. A summary of various Fellow activities are also described in the poster. Finally, a description of the International trip to India and its highlights are provided.

GEORGIA SOUTHERN UNIVERSITY

Poster 20

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Discipline: Biological Sciences

Molecular Biology Initiative: Delivering Accessible Biotechnology
The Molecular Biology Initiative (MBI) Program focuses on flexible delivery of hands-on biotechnology and biology in high schools. Fellow-teacher teams work together to generate exciting, relevant activities for biology, chemistry and physical science classrooms. Materials are disseminated via the program website (www.georgiasouthern.edu/mbi).

Rural, under-funded schools have historically reported low student achievement in STEM, including advanced/technical areas such as biotechnology. The MBI Program is tackling this problem in partner schools by providing in-service teachers with professional development, sustained content support (MBI fellow), and multi-source funding for resources (e.g. professional leave time, supplies, equipment). The MBI fellows are supported by extensive professional development that complements the service-learning opportunity (e.g. seminars, workshops, intensive mentoring, and teaching practicum and molecular biology courses). Project management relies heavily on "real-time" formative evaluation via a digital platform for informed decision making. Mixed-method program evaluation has demonstrated benefits for all participants.

GRADUATE CENTER at CUNY

Poster 21

PI: GILLIAN SMALL
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Discipline: Other

The Legacy of Authentic Research Modules in New York City High Schools
Graduate fellows in the CUNY Science Now GK-12 Program have developed Authentic Research Modules (ARM) that leave an impact on New York City (NYC) High Schools even after fellows move on. The project is preserving and disseminating these ARMs through the lasting technology of its website (www.cunygk12.net), Moodle, and the CUNY College Now Program. STEM research projects in urban biodiversity, molecular biology, and neuroscience have informed the curriculum and goals of multiple science research programs and classes around NYC. The ARMs provide high school

students with an opportunity to think like scientists through genuine research experiences that can be applied in schools with limited laboratory resources. The modules also have specific components that focus on basic scientific literacy and computational skills. This poster highlights the methods and tools that GK-12 fellows have brought into NYC high schools, and emphasizes the results and lasting impact of fellows' participation. It also presents an overview of the unique projects that focus on the living urban environment as a research theme for high school students. The project's multiple collaborations across NYC, have introduced novel ways for high school science students to perform authentic research that teaches science process skills, content knowledge, science literacy, and allows student researchers to be more competitive in science research competitions city, state, and nationwide.

INDIANA U PURDUE U INDIANAPOLIS

Poster 22

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Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences

IUPUI GK-12 Urban Educators Program

The IUPUI GK-12 Urban Educators program is centered around 2 themes: Medicine and Human Health and Discovering the Science of the Environment. Throughout the 4 years of the program, we have brought those themes to the K-12 students of urban Indianapolis successfully and triumphantly via our amazing and creative Fellows. We have had graduate students from the medical school bringing cutting edge genetic engineering work into the classroom, a microbiologist Fellow that works on the bacteria in Cystic Fibrosis patients, a biologist bringing stem cell research to her students, as well as Down Syndrome research, Fetal Alcohol Syndrome, all the way to health psychology research as it relates to obesity and health—just to name a few. In addition to our health focus, the IUPUI program has been instrumental in the execution and development of a ground breaking high tech environmental science trailer called, Discovering the Science of the Environment, which travels to middle schools across the Indianapolis area bringing engaging, innovative and interactive lessons involving all aspects of the environment to the students including but not limited to soil composition and contamination, nutrient and herbicide removal in wetland ecosystems, and using GPS in environmental assessment. With all of the Fellows' success, it was not achieved alone; each Fellow was paired with a dedicated and eager Teacher Partner. It is the Fellow-Teacher pairing that can change a mediocre team to a dynamite team. The IUPUI GK-12 Urban Educators have developed a pairing strategy that allows for everyone to get to know each other and participate in the pairing process. Through this process and these techniques, we have mastered this process and documented the impressive increase in productivity and creativity from the teams.

KANSAS STATE UNIVERSITY

Poster 23

PI: CAROLYN FERGUSON
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Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Geology & Geography, Physics

From Evidence to Inference in the Kansas Science Classroom: Enhancing Graduate Student Scientists' Understanding and Communication of Nature of Science Through GK-12 Experiences*

Scientists are sometimes challenged in communicating with general audiences due to public misconceptions regarding the types of evidence accepted within scientific disciplines as well as the manner in which scientists move from evidence to inference. Understanding how available data can inform us of objects or events that we cannot directly experience or manipulate (e.g., evolution, climate change, modeling) is particularly challenging. Moreover, scientists are not always cognizant of assumptions they make and their processes in moving from evidence to inferences. Evidence-based inquiry into the distant, remote, or past (EIDRoP) serves as a unifying theme for professional development activities for a Kansas State University (KSU) GK-12 program, which partners fellows in the biological sciences, chemistry, geosciences and physics with USD 475 (Geary County, KS) teachers. While various aspects of the EIDRoP program have contributed to its success, the program theme in particular marks a unique enhancement of graduate training.

This presentation focuses on development of EIDRoP graduate fellows relative to the project theme, and includes data from Summer Institute surveys (pre- and post), journal entries and interviews, as well as adviser comments. Examples of how fellows have related their research to the project theme, and how the thematic focus and training have affected their views of their research are presented. Preliminary general findings and ongoing study are discussed. Ultimately, the project team will develop recommendations for incorporating nature of science training into graduate training programs, with aims of improving young scientists' reasoning and communication skills, and advancing science education generally.

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Poster 24

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Presenters: Joseph Lancaster, Brent Ware, Spencer Kipley
Disciplines: Computer Science & Information Management

INSIGHT in the Classroom
The Kansas State University INSIGHT project brings a wide variety of sensor-based technologies into the classroom environment. See how WiiMotes are being used to teach physics, how the Kinect can help kinesthetic learners, how digital probes can make science more interesting, how instrumenting athletes can help performance, and many more.

MIGHIGAN STATE UNIVERSITY

Poster 25

PI: TOM GETTY
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Discipline: Biological Sciences

Kellogg Biological Station's GK-12 Schoolyard Research Network: Bringing Fellow Expertise to Classrooms and Engaging Fellows, teachers, and K-12 Students in Sustainable Inquiry Activities in SW Michigan Schools
In 2010, Kellogg Biological Station's GK-12 BioEnergy SusTainability Project established the BEST Schoolyard Research Network, in partnership with 13 K-12 districts in Southwest Michigan. The network of 38 replicated blocks of plots, each with eight experimental treatments, is designed to mimic aspects of the Great Lakes Bioenergy Research Center (GLBRC) Sustainability Research Project at KBS. Fellows, teachers, and students work together to ask research questions, establish experimental design and protocols, and develop lesson plans that capitalize on the inquiry opportunities the network creates. Our overarching question is, "Can We Grow Our Fuel and Save Our Flowers and Butterflies Too?" Under this broad umbrella, we address many basic and applied issues in science and ecology. We are particularly interested in understanding whether we can have high plant productivity, which could be converted to fuel, and maintain other "ecosystem services" related to plant and animal diversity. Teachers and students collect data annually using common protocols, submit their data to the KBS GK-12 project team via google docs, and can then access the larger network-wide dataset to make comparisons across school districts and research network sites. Fellows use their own scientific knowledge and skills to engage students in projects related to Fellows' research on the schoolyard plots, work with teachers to improve their science skills, integrate long-term inquiry-based research into their classes, and design materials that will make research on the BEST plots network sustainable beyond the life of our GK-12 grant. You can find more information and access our project materials (experimental design, protocols, lesson plans) at http://kbsgk12project.kbs.msu.edu/best-research-network/.

MICHIGAN TECHNOLOGICAL UNIVERSITY

Poster 26

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Presenters: Brenda Gail Bergman, Brian Rajdl, Alex Mayer
Disciplines: Ecology, Environmental, & Earth Sciences

Global Watershed GK12 Program: Using Scientific Inquiry to Promote Stewardship and Sustainability*
In the Global Watershed GK-12 program, graduate Fellows in watershed science work with students and teachers in grades 8-12 to enhance learning through place-based scientific inquiry. We facilitate explorations of the connection between human communities and the natural world in local watersheds. Fellows empower middle and high school students to realize their own capacity to conduct watershed research and to be engaged citizens while they learn. Meanwhile, fellows' enthusiasm continues to deepen for educating, communicating science to the public, and conducting meaningful research. This reciprocal experience takes place in beautiful Northern Michigan, a rural, natural resources-rich region which encompasses a diverse population and environment, including multiple Native American Reservations and Treaty-ceded territories.

In the second year of the program, Fellows work with five middle and high school classrooms. Our research is wide-ranging and includes: framework development for collaboration amongst State and Tribal Natural Resource agencies, the interrelationship between large terrestrial herbivores and aquatic ecosystems, the effect of service learning on students' environmental attitudes and behaviors, the effects of chemical deicers on amphibian communities, and cultural perspectives and impacts of environmental policies. Fellows deliver original lessons in their placement schools that incorporate and expand beyond their research and the curricula. Lessons fellows have developed and implement with partner schools emphasize hands-on experiences in the natural world and with local communities, and employ inquiry as the primary teaching method. These lessons involve activities such as visiting a Tribal fish hatchery where students released sturgeon during a cultural ceremony, assessing the relationship between land use and water quality (ground and surface) using GIS, water chemistry and field techniques, and conducting independent studies of biological and physical changes in leaf litter packs in streams. Michigan Tech has designed two graduate-level courses in which Fellows learn to develop and deliver lesson plans, offer science instruction rooted in the latest findings in cognitive science, and communicate science to the public. These courses will

now be available to graduate students beyond the GK-12 program, thus expanding the impact of the initial grant.

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MIDDLE TENNESSEE STATE UNIVERSITY

Poster 27

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Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences

Prevalence and Intensity of Gill Parasites Collected from *Fundulus Grandis* in Oiled and Non-oiled Locations Associated with the Deepwater Horizon Oil Spill
Shifts in parasite prevalence and intensity resulting from the 2010 BP Deepwater Horizon Oil Spill could indicate spill-related changes to water quality, abundances of free-living organisms, and estuarine food webs. Ectoparasites typically have direct life cycles (do not require food-web mediated transmission) may be indicators of acute spill effects (i.e., water quality) because they remain immersed in seawater, are typically small, and have high surface area to volume ratios. In an ongoing study between labs at MTSU and Auburn University, we compare parasite biodiversity in Gulf killifish, *Fundulus grandis* among four oiled and non-oiled estuarine sites in Louisiana across four sampling periods. Fish were captured using baited minnow traps, injected with formalin, and individually immersed in formalin-filled bags. In the laboratory, the skin, fins, eyes, gill, stomach, intestine, mesentery, liver, spleen, kidney, body cavity, somatic musculature, and brain were examined for metazoan parasites. As parasites were encountered their locations and intensities were recorded. As part of my TRIAD GK-12 fellowship, preserved fish were brought to the classroom where students examined them for parasites using stereo and compound microscopy. Students also calculated and analyzed parasite prevalence and mean intensity pertaining to two parasite taxa (Monogenea and Copepoda) infecting the gills of fish collected from two locations (1 oiled and 1 non-oiled) across all sampling periods.

PI: ANTHONY FARONE
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Presenters: A. Carey, P. Cusaac, J. Folks, O. James, E. Mattison, J. Matz, K. Sadler, T. Saul, C. Suttle
Discipline: General

Teaching, Research and Industry Application to Deepen Scientific Understanding*
The MTSU GK-12 program, TRIAD, is integrating scientific research, education, and biotechnology industries in Middle Tennessee. A two-week summer workshop introduces graduate fellows, high school partner teachers, and biotechnology industry partners to one another, a unique feature of this GK-12 project. Visits to participating Industry Partners allow graduate student-teacher pairs the opportunity to meet and interview local biotech industry scientists. These real-world science companies are invited to high school classrooms where they share with students their industry goals and educate them about possible careers in science. Partner teachers also spend a day in the lab with the graduate fellows, learning about their research and methods. The MTSU and TSU Graduate Fellows represent a variety of scientific research fields. Each Fellow incorporates his or her own research into the high school classroom by serving as a Scientist-in-Residence and presenting introductory lessons and hands-on lab activities. Graduate fellows attend workshops throughout the year that focus on improving communication skills and have many opportunities for practice and professional critique of their presentations. Graduate STEM fellows mentor student research projects and utilize their connections with Industry Partners to form research mentor connections between students and the community. With a diverse group of Graduate Fellows, unique connections with community Industry Partners, and a variety of urban and suburban teachers and high schools, the TRIAD GK-12 program presents an exciting project aimed at integrating Teaching, Research and Industry Applications to Deepen scientific understanding.

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MISSISSIPPI STATE UNIVERSITY

Poster 28

PI: KAREN MCNEAL
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Presenters: Sarah Radencic, Donna Pierce
Disciplines: Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Engineering, Geology & Geography, Physics

Initiating New Science Partnerships In Rural Education: Identifying Sustainability
A distinctive aspect of INSPIRE's GK12 project is the training and guidance provided to our Fellows through the INSPIRE summer graduate course that introduces the concept of "backwards design" of learning experiences to help Fellows better communicate their research while in the classroom. Other exceptional accomplishments of INSPIRE are the incorporation of technology into the classroom (Benchtop SEM, Proscope handheld microscopes, Portable Spectrometer); development of lesson plans relating STEM Fellows and teachers international research experiences into the classroom; creation of real-world scenarios for National

GIS Day Events at Mississippi State University (MSU); and publication of developed lessons created by STEM Fellows and teachers participating in INSPIRE on project web page *(www.gk12.msstate.edu).*

A strategy INSPIRE would like to "brand" is the training process of our graduate Fellows as a future graduate teaching assistant course for STEM fields at MSU. Key features of the INSPIRE training process include incorporating Understanding by Design principals to develop lesson plans and activities, observation and feedback of communication of research using the Mathematics and Science Classroom Observation Protocol System (M-SCOPS), and communication skill development using "Presentation Bootcamp." The MSU Geosciences department has begun discussing incorporating our training methods into a future teaching assistant course to be offered this coming fall. Students would be required to practice their teaching skills with K-12 students in the classroom. This model offers sustainability of GK-12 like activities beyond the funding period.

INSPIRE's influence on the large number of at-risk students in rural Mississippi is likely to be remembered for years after the project has concluded. Some of the positive impacts noted from teachers and administrators have been increased interest from students in STEM fields and activities, increased participation of at-risk students, and an increase in lab based inquiry activities in participating classrooms. Other important accomplishments of INSPIRE to be remembered will be the enhancement of Fellows research and communication of their research; the expansion of use and understanding of new technologies and science content of participating teachers; and the number of partnerships formed (school districts, interdepartmental between STEM departments and centers on university campus).

An area that INSPIRE has strived to excel is linking the STEM Fellows' graduate research into lesson activities that meet the required state and national standards which the participating teacher must cover. INSPIRE Fellows have used a variety of delivery methods to communicate their research connections in the classroom including inquiry, hands-on, didactic, use of technology, game based activities, and outdoor field experiences.

NEW JERSEY INSTITUTE OF TECHNOLOGY

Poster 29

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Presenters: Khady Guiro, Brooke Odle, Chichi Ofoma, and Bruce Bukiet
Discipline: Computer Science

Bridging the gap: Integrating Computation, Science and Technology into the Newark Public School System*

The Computation and Communication: Promoting Research Integration in Science and Mathematics (C^2PRISM) project is a National Science Foundation Graduate Teaching Fellows program designed to bring, a greater understanding of computational thinking, computer science, research and mathematics to high school students in Newark, New Jersey. The program pairs doctoral students (Fellows) studying for degrees in science, technology, engineering and math (STEM), with high school teachers. During these interactions, Fellows bring their doctoral research into the classroom while improving their communication, leadership and teaching skills and enriching STEM content and instruction for their high school teachers. Each year, 8 Fellows from New Jersey Institute of Technology (NJIT), work one on one with a teacher at one of several Newark, New Jersey high schools. Fellows introduce computational ideas into the school curriculum through the use computers to relay understanding of scientific principals and solve scientific problems with the use of numerical techniques, mathematical models, and computer simulations. Before going to the classroom, Fellows and teachers go through an intensive three week long summer training workshop. During these sessions, Fellow and teacher use the teacher's curriculum to determine where to integrate the fellow's research. The training sessions also address communication skills, classroom management, pedagogical and leadership skills, and other competencies related to teaching. Twice weekly, Fellows visit that teacher's classes throughout the school year. The main project goals are to provide students with math and science role models and exciting educational experiences. The program also benefits the teachers by offering knowledge about cutting edge areas of science; thus enhancing their competency in using computational and technological resources in their classrooms. As for the STEM graduate students, they get the opportunity to communicate their research and to enhance the integration of computing into existing high school curriculum, thus preparing current students for future jobs. Moreover, C2PRISM has developed several methods to bring in ideas of science and math research and computational methods into the classrooms.

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NORTHERN ARIZONA UNIVERSITY

Poster 30

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Discipline: Biological Sciences

Bringing Science to Northern Arizona Students
Multicultural students are the priority in the Northern Arizona University, BIOTEC project. Our partnerships with Flagstaff, AZ area schools and the Jeddito School on the Navajo Reservation, AZ enables our Fellows to impact students of multiple ethnicities by engaging them in a stimulating array of classroom explorations. Each one of the 8 Fellows travels to our partner K-8 school in Jeddito, AZ for a 2 day science adventure with the 6 and 7 grade classes. This unparalleled experience is a defining characteristic of the NAU BIOTEC project. The infusion of the Fellows' enthusiasm and content knowledge has proven invaluable to our partner teachers in Jeddito and Flagstaff. The openness and flexibility of our partner teachers has allowed for field trips comparing the differences in ecological zones, a multitude of lab investigations that include examining fungi, studying the properties of Oobleck, and checking the paternity of "Todd" using gel electrophoresis. Woven throughout these experiences is the genuine excitement of the Fellows and Teachers as they explore the world through the eyes of a scientist. Northern Arizona is a complex mix of socioeconomic groups, ethnic diversity, public charter schools and traditional public district schools. The BIOTEC project has become a model of success across all of these facets and has engaged students in a high quality, enriching scientific experience. As the BIOTEC project enters its 5th and final year we look forward to our ability to continue to answer the following question: "When is the GK-12 Fellow coming next?"

OHIO STATE UNIVERSITY

Poster 31

PI: RICHARD MOORE
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Presenter: Natsuko Merrick
Disciplines: Ecology, Environmental, & Earth Sciences

Integrated Watershed approach: Place based Learning at Sugar Creek Watershed, Ohio
NSF GK-12 Sugar Creek Watershed project at the Ohio State University is part of an interdisciplinary project that teams researchers with the local farming community to study the headwater streams of Sugar Creek Watershed, Ohio. The fellowship program extends this long-term project into the schools in the Sugar Creek watershed. The project emphasizes place-based education, and most schools in the program have a local headwater stream that can serve as an outdoor laboratory. Every year, eight fellows from various research fields is partnered with a K-12 school teacher with the expectation that they will share their research with students and introduce a scientific approach with hands on activities and in doing so, create learning opportunities that encourage appreciation of biocomplexity and advocacy of good environmental stewardship in the local communities. Fellows work with paired teachers to introduce the methods and principles of their interest areas and research projects into the on-going class curriculum. Because fellows come from a variety of research areas including Forest Ecology, Soil Science, Agronomy, Molecular Biology, Aquatic Ecology, and Sociology, communication among fellows through bi-weekly meetings is essential and this interdisciplinary atmosphere successfully generates fellow's innovative and successful leadership. Besides each fellow's research specializations, all fellows have been certified for the Headwater Habitat Evaluation Index (HHEI) developed by the Ohio EPA to use this watershed assessment tool as a means to form common ground for the fellows, teachers, and students.

OHIO UNIVERSITY

Poster 32

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Disciplines: Biological Sciences, Engineering

The Boat of Knowledge in the Science Classroom (BooKS)
The BooKS project (Boat of Knowledge in Science Classroom) has taken high school students for on-boat water sampling trips in the Ohio River and its tributaries of Muskingum and Kanawha Rivers, through which nine graduate fellows and nine high school teachers have collaboratively developed lesson plans for their respectively science classes. Not only have high school students been thrilled by real-world researches conducted in their backyard, but discovered many related water quality problems by their own data sampled. Furthermore, graduate fellows have developed a virtual boat, a portable replica of the physical boat, and plan to simulate on-boat sampling trips for the purpose of science classroom education when the physical boat is not in use.

PENNSYLVANIA STATE UNIVERSITY

Poster 33

PI: RENEE DIEHL
Contact: Carla Rosenfeld, cer196@psu.edu
Presenters: M. Szedlmayer, S. Barnhart, L. Powell, A. Hunt
Disciplines: Ecology, Environmental, & Earth Sciences, Geology & Geography

CarbonEARTH: Teaching Energy and Environment in Central Pennsylvania

Fellows in Penn State's CarbonEARTH GK-12 program run the expertise gamut from entomology to mechanical engineering, each united by carbon-related research. In the classroom this translates to a focus on environments (both built and natural) and the link between energy and the environment. Fourteen fellows work with rural and urban 5th-8th grade students in Phillipsburg and Harrisburg, PA using hands-on activities, experiments, and field trips to study a wide variety of topics.

In rural Phillipsburg, students in fellow Mike Szedlymayer's 7th and 8th grade classes examine the built environment through tower building and small machines, and explore energy forms and sources through focused activities. Sixth graders in Shaunna Barnhart and Andrew Hunt's classes mix ecology, genetics, and technology through designing a Martian colony (Hunt), and units on forests, water systems, energy, and biomimicry (Barnhart). Lastly, fifth graders working with Ian Grettenberger and Tracy Conklin study the natural environment and its human interactions. To do this, they utilize beehive and hissing cockroach observatories to understand insect behavior, build flying seeds to discover seed dispersal, and mine chocolate chips from cookies to describe renewable and non-renewable resources. In urban Harrisburg two fellows, Carla Rosenfeld and Luke Powell, work with 4th and 5th graders to investigate various scientific disciplines in an environmental context. Powell's fourth grade class has sampled bottled water, pipes, and streams to learn about water quality chemistry and biology of living organisms. Fifth graders in Rosenfeld's class are exploring chemistry, biology and physics through the use of terrariums to understand how factors such as water availability and pollution impact plant growth, microbiology, and water quality.

CarbonEARTH fellows bring knowledge of natural and/or engineered environments to the classroom, and the interdisciplinary nature of the science involved in these fields. The fellows are experts in interdisciplinary collaboration, connecting scientists from various fields to solve problems. Students working with the fellows experience this first-hand through their own experiments and activities, and gain a better appreciation for the interaction between humans and the environment.

POLYTECHNIC INSTITUTE OF NYU

Poster 34

PI : VIKRAM KAPILA
Contact: Vikram Kapila, vkapila@poly.edu
Presenters: Jasmin Hume and Jeffrey Laut
Discipline: Engineering

Applying Mechatronics to Promote Science (AMPS)

The AMPS project exploits the fascination of K-12 students with robots to capture their interest in STEM subjects while simultaneously broadening the training of graduate students and providing STEM professional development to K-12 teachers. Fellows and teachers partner to engage, mentor, and challenge students through mechatronics, robotics, and engineering activities. Robotics-related activities in both the classroom setting and competition training enable students to develop, apply, and enhance their STEM skills. Our recent efforts have focused on a seamless integration of robotics-based lessons within the Common Core Standards curriculum while enhancing students' learning. These activities offer students authentic experiences that reinforce traditional classroom instruction, support deeper understanding of the subject matter, and promote active learning through discovery.

Statistical analysis of the effectiveness of robotics-based science and math lessons has been performed. Results reveal that the improvement in students' academic performance following hands-on robotics-based curriculum is statistically significant. Moreover, since spring 2010, teachers have reported that, during or directly following the program, of 1,822 students in the program, 68 % saw their overall grades jump one-half or one full letter grade, and 72 % saw their science and math grades improve one-half or one full letter grade. We have also examined the effectiveness of robotics training (using LEGO Mindstorms) to enable teachers to build, program, and operate robots: skills that allow them to create and sustain LEGO-based activities for formal STEM education.

Support for the AMPS project is supplemented by the Central Brooklyn STEM Initiative (CBSI), which has received over $1.79M in funding from six philanthropic foundations. This public-private partnership has allowed the project to scale-up from nine schools (in 2008-2009) to 23 schools in (2011-2012), and now involves 14 fellows and 23 teachers reaching over 1,650 students. To expedite the migration of out-of-school LEGO robotics programs into STEM classrooms, since fall 2010 the project team has conducted five daylong workshops at NYU-Poly attended by over 140 K-12 teachers and volunteer robotics mentors. Finally, project activities have received broad coverage in major media outlets, including television and newspaper (Wall Street Journal, New York Daily News, Brooklyn Daily Eagle, News12 TV, ABC, etc.).

PORTLAND STATE UNIVERSITY

Poster 35

PI: LINDA GEORGE
Contact: Patrick Edwards, patrick.edwards@pdx.edu
Presenter: Patrick Edwards
Disciplines: Ecology, Environmental, & Earth Sciences

Environmental Inquiry: The Cascade to Coast GK-12 Project at Portland State University

The Cascades to Coast GK-12 project has established partnerships between Portland State University's School of the Environment and three Oregon school districts toward the goal of enhancing middle, high school and graduate STEM education around the theme of environmental sustainability. The project's geographic breadth, from Oregon's Cascade Mountains to the Pacific Ocean, provides an opportunity to create a learning community across diverse school districts and ecosystems. This abstract describes our unique approach to generating in-depth inquiry about environmental issues and sustainability.

A major goal of our professional development workshop for teachers and Fellows is to demonstrate how simple data exploration of publically available data sets can be used to generate high quality research questions and stimulate student inquiry. These exploratory techniques are frequently employed by scientists but rarely experienced by teachers. To accomplish this, we asked teacher/Fellow teams to explore publicly available environmental data sets and use patterns observed in the data sets to generate research questions. At the end of the workshop, each group summarized their exploratory analysis and presented specific research questions and hypotheses their students could investigate. Without the exploratory analysis activity, these in-depth questions would have difficult, if not impossible, for teachers and Fellows to develop. The workshop activities stimulated several in-depth inquiry activities in partnering middle and high schools. For example, at Mt Tabor middle school, students examined air pollution levels in front of their school, near a busy road, to the back of their school in the community garden. They found air pollution to be much higher near the road and in bus waiting zones. Based on their findings, students proposed no idling zones during student drop off and pick up times.

There are several considerations when planning a similar activity. Data from public agencies is rarely in a format that allows for simple analysis. Be sure to simplify data sets and organize them in a way that allows for uncomplicated analysis, otherwise teachers and students may be overwhelmed with data organization. Also, to avoid unseen problems with students' research, it's helpful to use data sets related to Fellows' research focus. This can be accomplished by having the Fellows submit the data for the training activity. Finally, make sure the data can be explored with simple graphing and statistical techniques such line charts, bar graphs and averages. Doing so will reduce the amount of time needed to analyze the data and emphasize the data exploration aspect of the activity.

RENSSELAER POLYTECHNIC INSTITUTE

Poster 36

PI: DEBORAH KAMINSKI
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Presenters: Debbie Kaminski, Mimi Katz
Disciplines: Ecology, Environmental, & Earth Sciences, Engineering, Geology & Geography

Using Games to Reinforce Scientific Concepts

The DAEE (Discovery-based Activities in Energy and the Environment) Program's theme is Energy and the Environment. One of the goals of our program is to make high school students more aware of their current and future role in the sustainability of the Earth's environment. We hope that greater awareness will lead to greater interest in pursuing STEM in higher education. One method our Fellows have used is the development of board games that reinforce certain scientific concepts to the players/students. Our program has seen three board games proceed from concept to development to implementation, and in one case, to publication. Our most successful game is Energy Bingo, which is a Bingo-style game that forces students to think about and decide upon appropriate forms of energy for various situations. This expereince resulted in a paper being published in an academic journal. Our program has also developed two games appropriate for earth science classes. One is Gold Rush, a Monopoly-style game that encourages students to think about how their decisions can affect the Earth and also gets them to see how mining practices can affect the environment. The last game is still in development and will also result in a paper. This board game teaches students about the evolution and extinction of species throughout Earth's history. One of the things that students will learn from this game is how to read and use information found on a document that is used on the New York State earth science Regents exam. The Fellows and teachers who created these games have found that the high school students enjoy the games and do retain the knowledge and skills that the games are meant to emphasize.

SANTA CLARA UNIVERSITY

Poster 37

PI: DAN LEWIS
Contact: Dan Lewis, dlewis@scu.edu
Present: Dan Lewis
Disciplines: Computer Science & Information Management

New GK-12: A Symbiotic Exploration of Computer Science in High School Classrooms

It has been estimated that the number of U.S. computing graduates will fill only 29% of the 1.4 million computer specialist job openings projected between now and 2018 [1]. Over the last decade, however, many high schools in San Jose, California have eliminated many or all of their computer science courses due to budget cuts and a diminished student demand driven by a fear of 'off-shoring' and the dot-com bust of 2000. In response, this GK-12 project is part of a larger effort to revitalize computer science in the high schools by establishing a new introductory computer science course designed to bring students back to the discipline.

Originally developed for the Los Angeles Unified School District, "Exploring Computer Science" (ECS) is a one-year curriculum [2] covering Human Computer Interaction, Problem Solving, Web Design, Introduction to Programming, Computing and Data Analysis, and Robotics. ECS is a socially-relevant and engaging curriculum that introduces high school students to the breadth of computing with the goal of ultimately increasing the number and diversity of students entering the IT workforce. Teacher training and equipment for our project was provided by a three-year NSF Broadening in Participation (BPC) grant that began in the summer of 2010; the three-year NSF GK-12 grant (funded by the NSF CE21 program) began in summer of 2011 and supports graduate fellows who are providing classroom technical and moral support for the teachers while simultaneously improving the fellows, own organizational, communication, instruction, and teamwork skills.

Graduate fellows receive training in the ECS curriculum as well as appropriate pedagogy and the challenges of the high school classroom. Since the summer of 2010, we have trained 14 teachers and 5 graduate fellows. Ten high schools in three school districts are now offering the course in the 2011-12 academic year. Each fellow is assigned to two teachers and spends about 15 hours a week assisting two teachers both inside and outside the classroom.

We will have more data at the end of the course in June, but our 60-day evaluations and written feedback already show progress toward the project goals.

Sample teacher comments:

- I feel more confident teaching the class without worrying that I would not be able to answer questions regarding syntax or commands in the programming language.
- It's been very helpful having someone to discuss what the kids are working on - how they are doing and how the material should be covered
- I feel less on my own. I feel like I have support. Just having anyone knowledgeable to talk to is a great help. This makes me more confident about giving assignments to the students.

Sample graduate student comments:

- I think the students are impressed that someone like me is in engineering and knows the material as well as the teacher. This gives them confidence and motivation. In addition, the only female student in one class is motivated to continue in engineering as I am also a female and sees that I have made it as well.
- The greatest impact my participation has had on high school students is allowing them to see the connection between what they are learning and what's done in industry and in real life. For example, one lesson described sorting methods. Although the lesson was relatively simplistic, students grasped that sorting is essential and nearly everywhere in computing.

Sample high school student comments:

- When the GS gave a brief history about herself of how she told me on how many classes she had to take (a lot of Calculus classes). Now I know that I need to prepare myself for the road that lies ahead and need to take down all those classes.
- She is very approachable and nicely goes over any questions or concepts whenever asked for assistance.
- She inspires me to make my class work, better, and more presentable.

In addition, this partnership is informing the creation of a set of materials to ease adoption in additional schools. These materials include additional notes for students and for teachers, recruitment materials, and promotional materials aimed at administrators, teachers, students, and parents.

[1] http://www.ncwit.org/pdf/BytheNumbers09.pdf
[2] http://csta.acm.org/Curriculum/sub/CurrFiles/ECS_v4.pdf

SAVANNAH STATE UNIVERSITY

Poster 38

PI: CAROL PRIDE
Contact: Carol Pride, pridec@savannahstate.edu
Presenters: SSU GK-12 Ocean Literacy Fellows
Disciplines: Ecology, Environmental, & Earth Sciences

Changing the Climate: Integrating Ocean Literacy into the Science Classroom

The NSF GK-12 Ocean Literacy Program has helped to create a culture of outreach and public engagement in the Savannah State University (SSU) Marine Sciences Program. Marine science GK-12 fellows are engaged in multiple levels of public education ranging from elementary through high school. GK-12 fellows partner with teachers in diverse settings including a Montessori school and an outdoor educational center, in addition to suburban and urban schools. Our GK-12 fellows are experts in their fields, which range from bacterial processes in the Arctic to interactions between humans and wild dolphins. They incorporate marine science concepts into fundamental lessons such as: geography, history, math, and ecology. In addition, the fellows expose students to issues associated with anthropogenic impacts to the environment with emphasis on the local setting of coastal Georgia. Because of the diversity of our fellows, we are able to impact a broad range of students allowing us to effectively fuel the pipeline of young researchers. We provide examples of how SSU fellows incorporate topics related to marine and environmental change into their research and subsequently into diverse K-12 classroom settings. Also presented is our success in developing publishable lesson plans with both GK-12 fellows and teacher research interns, and engagement of teachers and high school students in ship-based oceanographic experiences.

SAINT JOSEPH'S UNIVERSITY

Poster 39

PI: KAREN SNETSELAAR
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Presenters: Caitlin Fritz, Karen Snetselaar, Dana Semos
Disciplines: Biological Sciences,Ecology, Environmental, & Earth Sciences

GeoKids LINKS: Collaborative, Place-based and Interdisciplinary

GeoKids LINKS (Learning Integrating Neighborhoods, Kids and Science) is a collaboration involving Saint Joseph's University, the Wagner Free Institute of Science (WFIS) and the School District of Philadelphia. This poster addresses the exceptional features that have made the project successful during the first 10 years.

The strength of the project is the partnership between a university, a museum, and four Philadelphia elementary schools, which is a model for how expertise, initiative and creativity can make science come alive in a community. SJU faculty and GK-12 Graduate Fellows work closely with WFIS staff and school district teachers to develop and implement inquiry-based, natural science units in grades K-5 that are aligned with national, state and local standards. Each partner makes essential contributions to the partnership. The project uses expertise of the WFIS and classroom teachers in K-5 education while SJU faculty and fellows bring enthusiasm and science content knowledge. Effective communication and a strong commitment from all parties are the driving forces for the success of this complex partnership.

GeoKids was founded with the view that in order to foster interest in the natural sciences, especially within young children, learning must be rooted in the child's surrounding environment. Working in inner city Philadelphia, GeoKids LINKS' yearlong units embrace urban neighborhoods as a primary source for learning, field trips and creating inter-disciplinary connections. The project focuses on local ecosystems such as woodlands and wetlands and makes natural science accessible in an urban environment. An example can be seen in the first grade spring unit, where graduate fellows lead students on a neighborhood walk to help them observe the different types and uses of rocks.

Working with grades K-5, GeoKids LINKS recognizes the importance of not only learning science but also the necessity to draw connections to reading and writing. Establishing a strong foundation in reading and writing is key to mastering the language of science. Each unit includes a journal with writing prompts and follow-up activities to challenge the students to articulate their observations as they engage in scientific processes. These efforts culminate with GeoNews, an annual publication of student-created work that highlights the achievements in science, reading and writing that occur throughout each GeoKids LINKS unit.

STEVENS INSTITUTE OF TECHNOLOGY

Poster 40

PI: CONSTANTIN CHASSAPIS
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Presenters: Constantin Chassapis, Alfred Zeisler
Discipline: Engineering

New Jersey Alliance for Engineering Education: Promoting Innovation & Inventiveness

The Stevens Institute of Technology GK-12 Program supports the New Jersey Alliance for Engineering Education (NJAEE), a partnership to promote the integration of engineering innovation, invention, and problem-solving within mainstream STEM curricula. Recruited from various engineering and science disciplines, the research projects of all GK12 Fellows

fall with the area of Multiscaled Engineered Systems. In their role Fellows provide high school STEM support, with an emphasis on the delivery of modules based on their research and its relationship to, and use of, STEM fundamentals covered at the high school level. Lessons developed to date have covered topics such as environmental remediation of hazardous materials, cell-biomaterial interactions, microchemical reactors, plasma chemistry, and nanotechnology.

For example, a past NJAEE Fellow was pursuing the use of interference lithography to pattern uniform nanoscale surface features over large areas. Such surfaces have potential application in a wide range of areas, including friction-free surfaces for drag reduction and nanostructured surfaces for control of the interaction of biological cells on a prosthetic implant surface. To support a high school Physics classroom, the Fellow adapted his research in interference lithography to design and develop simple experimental methods that measure the speed of light using common, everyday items such as a microwave. Other examples of experimental systems that NJAEE Fellows have designed and built include a wind tunnel, a fractional distillation apparatus, and a homemade spectrometer. It is in the context of the Fellows' cutting-edge research topics that the students see the applicability and excitement of high school science, and how through innovation and invention science can be engineered into devices and systems that they may encounter in everyday use.

As part of the NJAEE the GK12 Fellows and High School teachers have participated in a series of coordinated professional workshops covering subjects such as Patents, Innovation, and Communication Skills. Within the context of the NJAEE the Fellows then have the opportunity to practice and expand these professional skills; for example, by conducting a technology review covering issues related to issued patents and commercialization efforts in their research area, which is then presented within the high school class. In this manner the NJAEE is piloting new ways to augment the traditional technical focus of graduate science and engineering education by facilitating the development of additional attributes and skills that our graduates will need to become the next generation of technology leaders and innovators. In addition, through interactions of the Fellows within the partner classrooms the NJAEE is able to enhance the content technical knowledge of the teachers while providing successful young scientists and engineers as role models for the students.

TEMPLE UNIVERSITY

Poster 41

PI: SHOHREH AMINI
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Presenters: Maria Fitzgerald & Paul Finn
Disciplines: Chemistry & Chemical Sciences

Periodic Table Exploration: Activities to Engage Students

To succeed in chemistry a basic understanding and familiarity of the periodic table is paramount. The periodic table not only helps students learn the elements but also shows them how they are related to each other. It is a great tool for students to identify many properties of elements and compounds, including reactivity, electron configuration, electronegativity, size, and charge. For this, a basic understanding of the structure and format of the periodic table is important. This includes learning about the groups and periods, orbital blocks, atomic number, atomic mass unit, and classification. The student activities described here are innovative ways to engage students in the process of getting to know the periodic table.

The first activity titled "A Periodic Table Exploration" begins with each student being assigned an element. The students were instructed to research their element and prepare a 6 x 6 inch representation of their element. Each elemental block included the symbol, name, atomic number, atomic mass, classification, and phase at room temperature. Upon completion of the activity, each student presented their element along with a few fun facts about that element to the rest of the class. The elements were organized into a wall-size periodic table that was hung in the classroom to not only act as a teaching tool but also as a pleasant reminder to each student of their accomplishment.

The second activity was a "Periodic Table Puzzle." Oversized periodic tables were cut into 118 elements, each containing the symbol, atomic number, electron configuration, and atomic mass. The students were divided into groups of two or three and asked to organize the elements into the proper periodic table format, without the aid of any study materials.

The periodic table exploration promoted researching skills, presentation skills, along with creativity and curiosity, while the periodic table puzzle encouraged student dialogue, discussion, and problem solving. These are all important traits that a student must possess in order to succeed in science and research. Both activities were a welcome addition to the traditional chemistry class.

PI: SHOHREH AMINI
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Presenter: Justin Kaplan
Discipline: Biological Sciences

Why Leaves Change Color
Discussion of why leaves change color many times is glanced over with explanations like, "When the temperature gets cold, the tree hibernates and the leaves die." There is little explanation of what photosynthesis is, cellular respiration, pigments, electromagnetic spectrum, absorption and a general sense of what color is. In Mrs. Anger's class we aimed to answer all these questions and more. An unexpected but interesting result of trying to explain color was a brief art history lesson to help to describe what color is and how as humans, we perceive it.

In the discussion of why leaves change color, an understanding of the pigments found in leaves is important. As an organic chemist, we look at molecular structures all the time. I wanted to show the students what these pigments look like and why they show the colors that they do. So far, all aspects of this subject have been lecture and discussion. I firmly believe that it is very important to have as much hands on learning as possible for concepts that are hard to grasp. This is when I followed up the lecture with a lab that extracted the pigments from plant material. The students learned about organic solvents and chromatography as well as getting a hands-on and visual experience to enhance their learning of the material. They utilized techniques and materials that I use daily but that they may never have and may never again be exposed to. As an educator it is always rewarding to see that many of the students came away from this experience knowing much more about pigments, color and what it is like to be an organic chemist.

PI: SHOHREH AMINI
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Presenter: Matthew Sender
Disciplines: Chemistry & Chemical Sciences

Molecular Modeling in Food Science
Organic chemistry and food science have broad areas of interaction. Introduction of molecular concepts in food science to high school students was facilitated by both computer and physical molecular modeling. Visual representation of molecules throughout the course has allowed students to see the similarities and differences in molecules such as fats, sugars, proteins, and soaps. Students were successfully introduced to these topics with little to no prior chemical experience.

TEXAS TECH UNIVERSITY

Poster 42

PI: DOMINICK J. CASADONTE
Contact: Whitney Green, whitney.green@ttu.edu
Presenters: Erin Oliver, Laci Singer, Dominick J. Casadonte
Disciplines: Engineering, Mathematics, General Science

Building Bridges: Integrating Mathematics, Science, and Engineering on the South Plains
One of the primary themes of Texas Tech University's "Building Bridges: Integrating Mathematics, Engineering, and Science on the South Plains" GK-12 program is the development of deep thinking about the integration of mathematics, science, and engineering in graduate research and in the K-12 environment by STEM GK-12 Graduate Fellows. This is accomplished by the development of "Math/Engineering/Science Bridge Quartets (MESBQ's)" where a scientist (engineer) Graduate Fellow and high school science Teacher Fellow pairs with a math Graduate Fellow and a corresponding math Teacher Fellow at the same school to develop learning/teaching cohorts. The "Building Bridges: Integrating Mathematics, Engineering, and Science on the South Plains" program at Texas Tech University is unique within the National Science Foundation's GK-12 program due to its interdisciplinary nature. Besides integrating math and science/engineering, a secondary goal at Texas Tech is to prepare graduate-level STEM researchers and in-service secondary mathematics and science teachers to thrive in an interdisciplinary environment. The organization of the program at TTU is designed to 1) facilitate the research activities of the GK-12 Graduate Fellows, 2) develop professional experiences for both Graduate and Teacher Fellows, while creating a sense of community among the STEM participants, 3) encourage collaborative design and implementation of an integrated curriculum, and 4) create cyber-capable dissemination platforms for nationwide outreach through a distance-learning classroom environment. Texas Tech's program supports each year approximately 10-12 graduate students who work directly in the Lubbock ISD high schools. Fellows help in both mathematics and science classrooms while working alongside the Teachers, providing a completely interdisciplinary experience. Projects are created and executed by the Fellows with a design that uses both math and science to show high school students that STEM subjects are closely related and are applicably linked. To further promote the Building Bridges concept, Fellows enroll in a seminar course in addition to the regular hours spent in the high school classrooms. During the fall semester seminar, each Fellow has the opportunity to give a presentation to the other Fellows and PI team. The talks are geared towards a general, non-technical audience in order to improve Fellows' abilities to talk about their respective disciplines and research in an informal manner. The spring semester, however, is devoted to the discussion of various topics and questions raised by Fellows and PIs regarding education, STEM subjects,

technology in the classroom, standardized testing, and more. Through their experience in the "Building Bridges" GK-12 program, the STEM graduate students gain an appreciation for the interconnectedness of the STEM disciplines in research. The teachers develop an enhanced understanding of the relationship of math and science in their teaching. The K-12 students benefit through the development of new inquiry-based integrated curriculum modules. Fellows from underrepresented groups have been recruited and an emphasis has been placed on working with teachers from schools with underserved populations. Results will be disseminated nationally in the summer of 2013 through a capstone conference. The model that we have developed is one that can be replicated across the nation to further interdisciplinary STEM education.

UNIVERSITY OF ALABAMA

Poster 43

PI: BETH TODD
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Presenter: Richard Forehand
Discipline: Engineering

GK-12 in Alabama's Black Belt: Sustainability, Water Infrastructure, and Public Health

The GK-12 Project at the University of Alabama is in its 4th year of bringing research related to Sustainable Energy Systems to the Sumter County Schools in the heart of Alabama's Black Belt -- an area known for rich soil and high poverty. Fellows participating in this project have worked on a variety of aspects of energy systems related to transportation, medical devices, and the environment. As an outgrowth of the last broad area, work is being done through a related project to study the water infrastructure in three Black Belt counties, including Sumter County. This year two Fellows are taking their research on water quality into the middle school classroom. They have developed lessons on water quality that relate to science and mathematics. Both the research and the lessons will be discussed in the poster as well as the work of previous Fellows in the broad topic of energy.

UNIVERSITY OF ARIZONA

Poster 44

PI: JUDITH BRONSTEIN
Contact: Kathleen Walker, krwalker@cals.arizona.edu
Presenters: Galen Holt and Brie Hiller-Hannan
Discipline: Biology

Teaching Life Science in the Elementary-School Classroom Using an Evolutionary Theory

The BioME (Biology from Molecules to Ecosystems) program at the University of Arizona encourages its teacher-fellow teams to teach K-12 life science using evolutionary theory as a central theme. The fellows come from many different backgrounds within the field of biology, and this leads to a high diversity of creative ways to integrate evolutionary theory into their classrooms. While evolution is part of the curriculum in the upper grades, the concept is not part of the elementary level science standards. Throughout the five years of the program, however, BioME teams working at the elementary level have found exciting ways to give students a deeper understanding of the components of evolutionary theory, including the concepts of variation within a species, geologic time, adaptation and heredity.

Poster 45

PI: JOCELINE LEGA
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Presenters: Shane Passon, Qiyam Tung
Disciplines: Mathematics & Statistics

Peeling Away the Layers of Mathematics

There is an old Indian legend where several blind men were introduced to an elephant. One ran into the side and said the elephant is very like a wall. One found the trunk and said the elephant is very like a rope, and so on. This is true with mathematics as well. Engineers mostly think about mathematics in terms of using it to optimize some existing system. Scientists use it to discover and describe the world. Mathematicians find the concepts themselves interesting regardless of the applications. Each perspective completes the bigger picture of why mathematics is part of school curriculum. Our group works with elementary, middle, and high school teachers to expose these layers to help students understand and appreciate the queen of sciences. From 'Monster Math' methods in elementary school, Mentos-and-Coke propelled cars and hands-on devices in middle school, to computer programming, optics, and optimization projects in high school, we will show how modeling and real-world applications may be used to develop and promote sound mathematical practice.

Poster 46

PI: KIMBERLY OGDEN
Contact: Kimberly Ogden, ogden@email.arizona.edu
Presenters: Kimberly Ogden, Stephanie Sikora, Hanh Duong, Pei Liang
Discipline: Energy, Engineering

GK-12 Water and Energy Systems: The Key to the Future of Arid and Semi-Arid Regions

The overall vision for this GK12 is to bring innovative research related to water and energy resources into the classroom through the expertise of the graduate fellows that participate in the program. Our fellows are involved in multi-disciplinary research related to solar energy, energy storage, fuel cells, and biofuels, as well as water and wastewater treatment, recycle and reuse strategies. The branding for our project is the integrated fellow research projects. The majority of the fellows are co-advised by faculty from engineering and science. Two lessons will be highlighted. The first involves sensing bacteria in the environment. The second discusses means of integrating more mathematics into technology classrooms focusing on construction and design. All fellows are required to submit their lesson plans to teachengineering.com and currently many are under review. Unique program strengths include our emphasis on STEM-related problems that are critical to continued southwestern development, reliance on existing research strengths in water and renewable energy, and the partnerships formed with 5 different school districts.

UNIVERSITY OF ARKANSAS

Poster 47

PI: ART HOBSON
Contact: Ronna Turner, rcturner@uark.edu
Presenters: R. Turner, J. Hawley, M. Ware, P. Calleja
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Engineering, Nanoscience, Physics

The University of Arkansas KIDS Program Evaluation Model and Resources

The University of Arkansas GK12 KIDS program has supported the training and implementation of fellow-teacher teams in middle school math and science classrooms for ten years. In the development of the first UofA Track I proposal, a comprehensive evaluation component was integrated into the program design and has been maintained, adjusted, and supplemented where appropriate throughout Track I and into Track II. The poster will be a presentation of the project evaluation model, along with measurement instruments and data collection procedures used in the evaluation. The model includes the collection of data on (a) psychological and learning styles, (b) attitudinal / perceptual data on areas such as communication skills, pedagogical knowledge, using scientific technology in the K-12 classroom, (c) K-12 class-time allocation on inquiry-based and traditional teaching methods, (d) classroom observational instrument regarding the use of inquiry-based learning, (e) formative assessments of program implementation, (f) K-12 student attitudinal scales regarding interest and confidence in doing math and science, and (g) the use of K-12 standardized academic assessments. Examples of adjustments made to program evaluation procedures in response to target goal modifications will be provided, along with evaluation reports developed for a variety of stakeholders. Handouts will be provided that will allow participants to access an electronic version of the poster which will maintain links to evaluation instruments and resources used or created by the UofA GK12 KIDS team.

UNIVERSITY OF CALIFORNIA DAVIS

Poster 48

PI: JEAN VANDERGHEYNST
Contact: Larry Joh, ldjoh@ucdavis.edu
Presenters: Graduate Fellows Blunk, Cooperman, Higgins, Jacobs, Leth
Disciplines: Ecology, Environmental, & Earth Sciences, Engineering

RESOURCE: Renewable Energy Research in Elementary School Classrooms

The UC Davis RESOURCE project pairs engineering graduate students pursuing renewable energy research with 5th-6th grade teachers to spark student interest in STEM subjects at an early age. Unique features of RESOURCE include (1) a partnership with a K-12 STEM support organization, (2) teaching general renewable energy modules plus Fellow-specific research modules, and (3) classroom rotations by Fellows to maximize program impact on students. RESOURCE is strengthened by its partnership with the Sacramento State/UC Davis MESA (Mathematics, Engineering, Science Achievement) Program. MESA provides an opportunity for educationally disadvantaged K-12 students to become actively engaged in the exploration of STEM careers. MESA teachers already have demonstrated their commitment to science and engineering learning, and are thus ideally suited to co-develop a renewable energy curriculum with RESOURCE Fellows. As Fellows entered their classrooms in our program's first year, they discovered the students lacked a good understanding of basic energy concepts. To enhance learning, a General Energy Module (GEM) was devised. Fellows collaborated to develop the GEM lessons with input from their teachers. The GEM teaches students the fundamentals of energy, energy transfer, renewable versus non-renewable resources, and reasons for using renewable energy. The lessons can be customized to fit the needs of the classroom and the style of the Fellow. Fun and memorable hands-on activities accompany the lessons. A variety of assessment techniques gauge student interest and learning. Fellows then teach their Fellow-Specific Modules (FSM) to provide more in-depth coverage on their fields of renewable energy. The key lesson from the FSM is shared with

wo other RESOURCE classrooms. The rotations enable students to see role models from additional renewable energy disciplines while Fellows can practice communicating in different environments. The curriculum is designed to be flexible while helping to meet California Science Standards. At the Summer RESOURCE Institute, Fellow-teacher pairs create roadmaps to integrate the GEM, FSM, and rotations into their science and math curricula. All the lesson elements from our first year were combined into a RESOURCE Compendium. These serve as building blocks for future lessons, making subsequent years less time intensive. We believe the MESA-GEM-FSM-rotation model could be useful for other university-K-12 partnerships.

Poster 49

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Presenters: S. Riddle, R. Eberl, J. R. Bean, B.Ludescher, S.Williams
Disciplines: Biological Sciences, Computer Science & Information Management, Ecology, Environmental, & Earth Sciences

Mapping Scientific Research Experiences: Activities and Computer-based Tools

Research scientists understand the complexity of the scientific process and that new questions and discoveries result from continuous data analysis, reflection, and peer review. Students often fail to grasp this complexity and instead treat the scientific process as a linear progression wherein a question leads to a hypothesis that is tested via an experiment with (predicted) results and conclusions that are published. We explore how independent scientific investigations develop in middle and high school classrooms using a scientific process mapping strategy.

Mapping the scientific process helps students visualize the progress they have made towards their research goals and understand what must be accomplished to answer their scientific questions. We are developing electronic versions of scientific process maps for student use in the classroom that will also allow educators to summarize and compare student learning progress and pathways in open inquiry curricula among participating schools and grade levels. A modular design for the computer-based system provides flexibility in analyzing data collected from student responses. Currently, the system supports analyses based on element frequency and path length, and detects illogical steps taken; for, example the student chooses “data supports hypothesis” before having formulated a hypothesis.

The process maps track student progress through an open inquiry curricula during which graduate student fellows and classroom teachers facilitate the development and execution of independent research projects. Students work collaboratively to develop their research questions, design and execute their experiments, analyze data, and present and discuss their findings with mentors and peers. Students experience five main components of the scientific process: exploration and discovery, gathering data, interpreting data, receiving and giving feedback, and reflecting on benefits and outcomes of their research. Students thus become familiar with the complexities of scientific research and learn to think and act like scientists. After the completion of student projects, scientific process mapping serves as a tool to illustrate individual pathways through the scientific process and summarize similarities and differences among student experiences while conducting scientific investigations.

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Discipline: Other

CAMEOS Fellows’ Research Helps Students Meet the Challenges of Scientific Inquiry

Teaching secondary students the scientific process in educational systems that all too often prioritize content coverage over skills development is challenging. The strength of CAMEOS (Coastal, Atmospheric, and Marine Environmental Observing Studies) comes from fellows’ use of their diverse research experiences to teach students how to conduct scientific investigations. Through classroom activities, graduate students in mathematics, marine ecology, and terrestrial ecology share with students their varied research experiences, such as modeling internal ocean waves, studying coastal moth metapopulation dynamics, and using noninvasive sampling methods to assess the health of sea turtle populations. Although each fellow brings a different collection of research experiences into their classes, all of these experiences are effectively employed in mentoring students during their own scientific investigations. The different research projects of the graduate fellows provide models for how to implement the scientific method and provide material with which students can practice scientific skills such as question formulation, experimental design, and data analysis. Learning from a researcher and his or her real, unfinished, messy, and interesting science engages students in a way that their textbooks simply cannot. Through this collaboration, students gain insight into the scientific process and develop the skills they need to pursue their own scientific questions and overcome the obstacles that arise in the process.

UNIVERSITY OF CALIFORNIA LOS ANGELES

Poster 50

PI: TERRI HOGUE
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Presenter: Janice Daniel
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Engineering, Physics

Development of the Scientist in Residence Program through UCLA's Science and Engineering of the Environment of Los Angeles (SEE-LA) GK-12

The Science and Engineering of the Environment of Los Angeles (SEE-LA) GK-12 program at UCLA, now in its fourth year, places graduate fellows in two pairs of urban, Title 1, middle and high schools within Los Angeles Unified School District (LAUSD) and Culver City School District (CCUSD). Fellows, acting as scientists-in-residence, are partnered with master science teachers in their respective classrooms and spend two-days per week interacting with students and the school community at large. Our program theme is the environment of Los Angeles, and all Fellows must develop and implement at least one major lesson (of three) directly addressing this theme. The strengths and unique contributions of the UCLA SEE-LA GK-12 program lie in: 1) the tremendous talent, creativity, expertise, and energy of the Fellows themselves, 2) our emphasis on creating a collaborative, collegial community among GK-12 participants (Fellows, management team, and teachers), 3) the relevance of our theme to the daily lives of K-12 students, and 4) the provision of specific support and training on communication and teaching skills for our Fellows throughout their one year of Fellowship.

As advanced PhD students immersed in independent, original research projects at an R1 university, our Fellows are already professional scientists and engineers engaged in cutting edge research. No other outreach program at UCLA (outside of GK-12) has enabled a diverse group of high caliber scientists to have such a large impact in any one particular school setting. Unlike a traditional research fellowship, the SEE-LA GK-12 program emphasizes collaboration and team playing in addition to independent achievement, both important skills for success throughout a scientist's career. Through ongoing training and practice, Fellows learn to communicate science in a way that is understandable as well as directly relevant and applicable to a variety of audiences. Very few other training programs at UCLA provide this depth of experience on communication skills. Finally, the GK-12 presence at UCLA helps to validate to the local, scientific community that public outreach by scientists is a worthy endeavor. It forges links and connections among scientists and the surrounding Los Angeles community, and improves understanding about science and scientists by the public at large.

UNIVERSITY OF CALIFORNIA SAN DIEGO

Poster 51

PI: MAARTEN CHRISPEELS
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Presenter: Johnnie Lyman
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Physics

UCSD Socrates Fellows: Bringing Cutting Edge Research to High School Classrooms

University of California, San Diego is a cutting-edge research university in a city with a high school population that is highly diverse and largely underrepresented in the sciences. PhD candidates at the university, through Socrates GK-12 STEM Fellows in Education, have brought their cutting edge research classrooms across San Diego County. These projects are in a variety of disciplines: Biology, Bioengineering, Biomedical sciences, Bioinformatics, Chemistry, Neuroscience, and Physics. This poster highlights how each fellow has brought one of these subjects into the high school classroom. These projects include how stem cells are grown in a lab, how the brain works (and how it talks to computers!), and how to build a circuit that can make a leech twitch.

The Socrates program has one more year on its grant, and this poster also highlights where projects have gone outside of schools. Our fellows have the opportunity to participate in the San Diego Science Festival, a large science expo for the public in March. This year fellows are participating in two booths, one which focuses on cancer disparities, the other developed by the fellows to highlight the science of sports. Under this theme, fellows will highlight how the brain senses a baseball pitch, how a mouse can run a marathon, what your genetics can say about how good you are at sports, and what makes a sports ball bounce.

Poster 52

PI: HERBERT STAUDIGEL
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Presenter: Cheryl Peach
Disciplines: Ecology, Environmental, & Earth Sciences

The Scripps Classroom Connection Web Portal: Creating an Enduring Digital Legacy of the Scripps GK12 Program

The Scripps Classroom Connection (SCC; http://earthref.org/SCC/) is based on a close collaboration between Scripps Institution of Oceanography (SIO), a world-class research institute in earth and ocean science, and the San Diego Unified School District (SDUSD), the 8th largest urban school district in the US. Key efforts and outcomes of our project include: (1) Development of an enduring, pedagogically-robust curriculum in earth sciences through a collaboration between scientists, teacher-educators, teachers,

graduate students, and their graduate advisors; (2) Training of a new breed of graduate students that is equally comfortable communicating their science to their specialist peers, and to the media and lay audiences; (3) Raising earth science literacy in schools, thus fostering effective stewardship of our very fragile planet.

One of our key objectives is having all SCC GK-12 fellows leave a professional legacy in the form of well-designed, peer reviewed digital library objects (labs, activities, project websites) and templates that may be used by future fellows. These units of study are anywhere from 3 days to 2 weeks in duration and are either taken from the graduate students' primary research or a field that is closely related to their thesis work. As graduate fellows are chosen as a representative spread across the science disciplines at Scripps, activities and labs cover a large range of themes in earth sciences, oceanography and marine biology.

The units of study are permanently archived at http://earthref.org/SCC/, providing a rich set of earth, ocean and environmental science resources for middle and high school teachers, as well as scientists and graduate students interested in engaging in outreach.

UNIVERSITY OF CALIFORNIA SANTA CRUZ

Poster 53

PI: GREG GILBERT
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Presenters: Y. Wang,* K. McCully, G. Gilbert, D. Johnston
Disciplines: Ecology, Environmental, & Earth Sciences

Inspiring Scientific Inquiry and Building Connections to the Local Environment

The SCWIBLES GK-12 program helps build relationships between Watsonville High School students and their local environment. Watsonville High School is located in a rural area and is comprised of primarily Hispanic students from low-income homes. By introducing students to environmental sciences through inquiry based lessons, we help them recognize that studying environmental sciences is important for the future of the planet, leads to numerous green career prospects, and contributes to a informed community invested in the health of its local ecosystem.

To accomplish these goals, our GK-12 program pairs fellows and teachers to create inquiry-based lessons designed to reach out to a large number of students, emphasize student accomplishments, and build connections to the local environment. Here we discuss four projects we successfully implemented this year with special emphasis on student products.

Insect Posters: Fellow Joe Sapp engaged students in Agriculture and Natural Resources classes with a module studying local insects. Students learned how to collect, preserve, identify, and draw insects in several local habitats. They also assembled their own dichotomous keys to standardize identifications and constructed posters showcasing basic ecological information for local focal insect species.

Scientific Illustration: Fellows Jennie Ohayon and Yiwei Wang created a module in which Marine Biology students learned how scientific illustration differs from artistic drawings and how scientists use them as a tool to understand the natural world. In class, students created at least four drawings of a specimen and a live subject. For their final product, the students produced a drawing that was exhibited in the Expanding Your Horizons conference at Berkeley, CA.

Kelp Forest Ecology Unit: Fellow Kristin McCully modified the entire ecology unit of the 9th grade Integrated Science (IS1) curriculum to focus on one local ecosystem, the kelp forest, while maintaining the required standards of the ecology curriculum. Students observed and interacted with a variety of kelp forest organisms, built a kelp forest food web and energy pyramid, and learned to create graphs, interpret maps, and use equations to solve word problems. This module has been adopted by all IS1 teachers and reached over 500 students.

Watsonville Area Teens Conserving Habitats (WATCH) program: In collaboration with Monterey Bay Aquarium staff, all SCWIBLES fellows mentor students from two local high schools (Watsonville and Pajaro Valley) on long-term projects in the local environment. These include evaluating the effectiveness of wildlife corridors, investigating endangered red-legged frog habitat, and many more projects. Students create both a poster and presentation for the scientific community and creatively disseminate the results of their research to the local community through an Earth Day fair.
**Primary author*

UNIVERSITY OF CINCINNATI

Poster 54

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Presenters: Brian Ervin, Mike Borowczak
Discipline: Other

GK-12 at the University of Cincinnati: A Model for Success

The University of Cincinnati's (UC) GK-12 program, in 11 years, has directly worked with more than 45 GK-12 Fellows, 5,000 high school students, 10 unique school and at least 50 in-service teachers, all while creating over 200 STEM related lesson ranging from single day activities to multi-day modules . Our model has been one of continued, increasing partnership. UC GK-12 fellows remain in a single school throughout the academic year, instilling the practical applications, career and societal impacts STEM has in our local and global communities

not only to students, but to teachers who remain in the classroom long after the GK-12 program ends. In 11 years, the UC GK-12 program has become a well-oiled machine, capable of effectively training fellows (through a rigorous 3-credit hour course during the summer, and weekly practicums throughout the year), and it has become extremely effective at disseminating content, not only to current GK-12 teaching participants, but to a vast network of education professionals. In this, our last year, we're rolling out our final library of the 200 lessons, cataloged and refreshed, in a new easy to use format – while the process is on-going, you can catch a glimpse at *http://bit.ly/ucstep*.

UNIVERSITY OF COLORADO

Poster 55

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Presenters: Jason Robison, Charles Dietrich, Jessica Feld
Disciplines: Computer Science & Information Management

ECSite: Engaging Computer Science in Traditional Education
Computing, computational thinking, and computer science have become essential to many fields, but this fact has not been communicated clearly to the public. In particular, K-12 students and teachers are largely unaware of the current ubiquity of computing and the revolution it has on the different areas of science. There are two ways this is apparent - the dramatic decline in the number of students directly entering computing related majors, and the only limited integration of computing into existing curricula.

The ECSite, Engaging Computer Science in Traditional Education, is a National Science Foundation GK12 program at the University of Colorado, Boulder designed to bring greater understanding of Computer Science and Computational Thinking to students in K-12 schools. Through direct contact between graduate students and GK-12 students and teachers, the ECSite project aims to accomplish its short and long term goals: to train future researchers to communicate effectively with the public; to inform and excite K-12 students about the value of computing in fields of research; to prepare teachers to communicate connections in computing and their fields; to teach computational thinking to K-12 students, to develop materials that can be used to replicate our program in other settings; to increase enrollment in Computer Science, particularly amount women and minorities; and to break the stereotypical view of the computational profession.

Poster 56

PI: LESLIE SMITH
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Presenters: Tommy Detmer, Jeff Morton, Leigh Cooper, Lesley Smith
Discipline: Biological Sciences

Project EXTREMES: EXploration, Teaching and Research for Excellence in Middle and Elementary Science
The outdoors provides an excellent stimulus for sparking student interest in the sciences. Through personal exploration of extreme environments our students are not only able to make observations about ecosystems but also become engaged in the dynamic processes of nature. Project EXTREMES (Exploration, Teaching and Research for Excellence in Middle and Elementary Science) traveled with our fifth grade students to the University of Colorado Mountain Research Station (CU MRS) in the Front Range of the Colorado Rockies during the Fall 2011 to learn about high elevation environments. The MRS station offers our socioeconomically diverse students a chance to explore a local ecosystem that otherwise might be inaccessible to them. Through multiple experiential, hands on, and observational activities students discover the effects of mountain pine beetle on lodgepole pines and forest ecosystem processes. Because most of our students were aware of mountain pine beetles due to their high level of publicity, the students were very interested to learn about the changes to Colorado forests caused by mountain pine beetle infestations. The activities taught included lessons on 1) Tree identification; 2) Tree coring; 3) Mountain pine beetle life cycles, and 4) The distribution of tree mortality from mountain pine beetle. Teachers and Fellows have drawn on these common field experiences to expand and develop unique lessons back in the middle school student?s classroom. Project EXTREMES is a collaboration among the Boulder Valley School District (BVSD), the University of Colorado's Cooperative Institute for Research in Environmental Science (CIRES), and the Departments of Ecology and Evolutionary Biology and Computer Sciences.

UNIVERSITY OF COLORADO DENVER

Poster 57

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Disciplines: Chemistry & Chemical Sciences, Mathematics & Statistics

Residents as Rockstars
The University of Colorado Denver's GK-12: Transforming Experiences program is unique in that it brings together graduate students both from the applied sciences and mathematics to work with math and science teachers in

partner middle schools on interdisciplinary STEM experiences in the classroom. Together, they emphasize the interdisciplinary, overlapping nature of math and science. One of the methods used to meet this goal is to increase the profile of participant fellows (referred to as 'Residents') in the middle school, so they can be seen as a school-wide resource for both math and science. Our project does this throughout the year in many interactive ways that engage the middle school students through both entertainment and intellectual curiosity.

At the start of the school year, we build excitement about the Residents themselves, by first having them introduce themselves to the students in a 'Wow!' video, where they give a brief biography and then demonstrate something about their field that they find exciting. Throughout the year, the Residents rotate through all the participant teachers' classrooms to present interdisciplinary STEM lessons. To maintain excitement, the Residents produce a STEM question-of-the-month, and create fun posters to be placed in hallways for all the school to participate. Every month, Residents collect answers, distribute prizes, explain the solution, and present the next poster to every class in the school, even those of non-participant teachers. Through these activities, the Residents have achieved a high profile within the school and among the middle school students.

In the project poster, we will showcase the various ways our residents have become a school-wide resource and attained, 'rockstar' status among the middle school students.

UNIVERSITY OF CONNECTICUT

Poster 58

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Discipline: Engineering

Ingenuity Incubators Develop NSF Fellow Potential and Prepare Tech Students for Engineering

The University of Connecticut GK-12 program focuses on bringing novel science and engineering with a focus on sustainability to high school students at eight of the state's technical high schools. As energy demands rise and traditional energy supplies begin to dwindle, innovative ideas and applications will be crucial to the sustainability of the planet. As the next generation enlisted with solving these problems, it is vital to introduce and motivate high school students in the fields of green engineering and science. The graduate fellows at UConn span the fields of chemical, biomedical, materials, mechanical, and environmental engineering, each with a different expertise in sustainability. Each fellow works with students at their school on a long-term energy sustainable engineering project to enhance their growth and understanding in the field. Examples of engineering projects include a solar water heater, wind turbine, greenhouse, hydroelectric plant demonstration, and solar go-kart. Furthermore, these visits comprise of short, fun activities to excite students and inspire them to continue in the STEM fields, activities such as dye-sensitized solar cells, bottle rockets, fermentation-in-a-bag, and Shrinky Dink microfluidics. Additionally, since all of the technical high schools are run by the state of Connecticut, there exists an excellent opportunity to coordinate activities between schools. Fellows have shown on-campus experiments and presentations to students through long-distance learning tools with a great degree of success. The graduate fellows are also currently organizing a multi-school mouse trap vehicle design contest, with the winners from each school competing at UConn in May. The UConn GK-12 program is unique, as it participates exclusively with technical high schools, which often contain a large percentage of students from demographics underrepresented in the STEM fields. The UConn GK-12 program views technical schools as an untapped resource for developing well qualified engineers, due to the fact that in addition to academics these students are trained in technical skills, essential to well-rounded scientists and engineers. Exciting classroom activities coupled with long-term sustainable engineering projects that students both design and construct leave this program poised to educate students about what engineers and scientists really do and motivate them to pursue science and engineering.

UNIVERSITY OF FLORIDA

Poster 59

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Discplines: Biological Sciences, Ecology, Environmental, & Earth Sciences, Geology & Geography

Science Partners in Inquiry-based Collaborative Education: Innovative Approaches

The SPICE (Science Partners in Inquiry-based Collaborative Education) Program at the University of Florida (UF) is a partnership between middle school science teachers in the Alachua County School System and graduate students at UF studying within the Science, Technology, Engineering, and Mathematics (STEM) disciplines. The graduate student fellows come into the classrooms to conduct hands-on inquiry based learning and serve as scientists in the classroom. Our program starts in the summer with a pedagogy training to introduce fellows to inquiry based learning. After this training both fellows and science teachers attend a Summer Institute. This is a two week long workshop that gives the science teachers and graduates a chance to get to know one another and develop relationships that aids in their pairing. The SPICE program is a two year commitment for both the teachers and graduates. The first year, Type I Fellows are required to teach twice a week which results in strong relationships with both their students and the teacher. Second year fellows, Type II,

teach twice a month, and serve as mentors to the Type I Fellows. These graduates are encouraged to teach the lessons they developed and enjoyed teaching the previous year. One final aspect of the program is the development of Modules by the Type I Fellows, which are published online. These are 2-4 lesson modules under a similar theme, commonly related to the individual research of the fellows. These modules are a defining characteristic of the SPICE program in that they allow the exposure of cutting edge research to middle school students. Additionally, the time spent and knowledge gained in Summer Institute and workshops are exclusive to the SPICE program. All aspects of the SPICE program encourage relationships between middle school students, teachers, and graduate students, with the goal of engaging young people in science through inquiry based education.

UNIVERSITY OF HOUSTON

Poster 60

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Presenter: Dan Burleson
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Engineering, Mathematics & Statistics, Nanoscience, Physics

University of Houston GK12 Program: Making the World of Harry Potter Real

The objective of our GK-12 program at the University of Houston is for engineering and science graduate students engaged in state-of-the-art nanotechnology-related research to develop the skill to articulate complex scientific and engineering issues in a GK-12 classroom environment through interactive demonstrations and activities. Based on the book, The Science of Harry Potter by Roger Highfield, lessons, activities and units are created to engage students in unfamiliar topics. For example, students are exposed to shape memory alloys and current research using the question, "Could Muggles play wizard chess?" The invisibility cloak used throughout the Harry Potter series is sourced to introduce the technology and morality of nanotechnology and invisibility in the real world. Quantum mechanics is introduced to students to theorize how Harry Potter and the Hogwart's students use Platform Nine and Three-Quarters at Kings Cross Station to get to the Hogwarts Express. Fictional plant properties, found in the Harry Potter series, guide students to identify exciting real-life plant properties. And a wizard's wand is used to demonstrate the chemistry (reaction rates, Gibb's free energy, process chemistry, and metallurgy) involved in making low-intensity sparklers. Through this program and our unique use of the world of Harry Potter, we have been able to supplement the science and technology curriculum in middle and high schools through a series of unit plans and activities in classrooms ranging from chemistry and biology to physics and technology.

UNIVERSITY OF IDAHO

Poster 61

PI: BARBARA WILLIAMS
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Presenter: Paul Allan
Disciplines: Ecology, Environmental, & Earth Sciences

Managing a Successful GK-12 Program with an Eye Toward Sustainability

Selecting the right program manager for a GK-12 program can have a huge impact on the susccess and sustainability of the project. Selecting the right person as program manager of your GK-12 program can have a large impact on the success and sustainability of your project. The University of Idaho has purposefully chosen an experienced science educator to manage two separate GK-12 programs. A science educator with experience teaching in K-12 classrooms, developing curricula, and providing professional development can design and provide the training and practice that the fellows need to be successful educators, guide the fellows as they develop high quality science learning experiences, and provide support to teachers and fellows as they negotiate the myriad issues that arise when a university partners with the K-12 school community. An educator recognizes the importance of doing well by the students in the classrooms, as well as supporting the fellows, as that builds a strong foundation for future collaborations among universities, research scientists, and the K-12 community. These long-term impacts that go beyond the fellows and the program are essential for sustained partnerships that can improve science education and communication at all levels.

UNIVERSITY OF KANSAS

Poster 62

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Presenters: Robert Everhart, Sarah Schmidt, Emily Mangus
Disciplines: Biological Sciences, Computer Science & Information Management, Engineering, Geology & Geography, Mathematics & Statistics

Utilizing Social Media for Expanded Communication and Feedback

One of the aims of the GK-12 program at the University of Kansas is to improve both teaching and communication skills among STEM graduate fellows via focused interactions with mentor-teacher partners, inner-city K-12 students, and undergraduate teachers-in-training. One way we have accomplished this goal is through the creation of a public blog (www.gk12ku.wordpress.com), which serves as a means to communicate and share experiences among fellows, teachers, and educators nationwide. This blog primarily contains weekly

summaries of each GK-12 fellow's experiences at his/her assigned school. Content is broad and explores lesson plans, effective and failed teaching strategies, classroom management, and commentary on educational policies both at participating schools and nationwide. It also contains feedback and summaries of GK-12 fellow's experiences working with an undergraduate research methods class that is designed to introduce future teachers to performing their own research. The blog is open to the public and we encourage comments, inquiries, and ideas from anyone interested in the educational system. Furthermore, the blog provides the GK-12 fellows another opportunity to practice relating scientific and mathematical concepts to a general audience. By creating a discussion forum that integrates thoughts and ideas from educators, students, interested parents, legislators, and other members of the general public, we aim to not only hone our communication and teaching skills as future Research I professors, but also to ultimately contribute to improvements in STEM education.

UNIVERSITY OF MASSACHUSETTS LOWELL

Poster 63

PI: KAVITHA CHANDRA
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Presenter: Pratik Gandhi
Discipline: Engineering

Spectrum Sensing for Cognitive Radios
Wireless networks supported by cognitive and software-defined radios rely on the performance of spectrum sensing algorithms for opportunistic access to shared wireless radio spectrum. In May 2004, the Federal Communication Commission (FCC) allowed frequency bands in the 54-862 MHz frequency range that were assigned to analog TV transmission to be utilized by cognitive radios. The licensed users of these bands referred as primary users share the spectrum with secondary users who are allowed access to the bands by the cognitive radio. The standards specify strict constraints on the interference that primary users experience during spectrum sharing. This work examines the spectrum sensing performance in indoor wireless channels, and determines achievable gains against the limiting effects of multipath interference, frequency-selective and correlated fading using commercial software radio transceivers.

Through the NSF Vibes and Waves in Action GK-12 fellowship, students in the Probability and Statistics (11th and 12th grade) class at Lawrence High School for Mathematics, Science and Technology were introduced to various statistical metrics such as the mean, variance, Gaussian noise, correlation, and probability of detection and false alarm. Students were exposed to real world application of analyzing weather related variables such as temperature, relative humidity, and dew point temperature. Using the knowledge of mean, variance and correlation, students were asked to find the dependence of these variables on each other using MATLAB software, and compare them with the theoretical model.

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Discipline: Engineering

Spectrum Sharing Models for Cognitive Radios
This research addresses the spectrum sharing paradigm of cognitive radio networks from a queueing model perspective. The arrival patterns of primary and secondary users to a radio channel bank are modeled using random distributions and queueing disciplines to better understand how spectrum utilization can be improved. In particular, this work examines the blocking probabilities of primary and secondary users considering exponential, Erlang and long-tailed inter-arrival time distributions of secondary users in the presence of Poisson distributed primary user spectrum access.

Through the NSF GK-12 fellowship, this research has been brought to 10-12th grade students in an honors pre-calculus class at Lawrence High School for Performing and Fine Arts in Lawrence, Massachusetts. The students have been engaged in activities centered around exploring probability distributions. This includes activities involving a live video of traffic on the highway and counting cars and mapping inter-arrival times to histograms. The students also conducted a simulation that introduced them to sensitivity of system parameters and how real world processes can be simulated via functions and models and applied for prediction.

UNIVERSITY OF MIAMI

Poster 64

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Presenters: Joanna Weremijewicz, Monica Arienzo, Tamara Monroe
Disciplines: Ecology, Environmental, & Earth Sciences

The University of Miami Science Made Sensible Program: Making Connections through Innovation
There are four elements that, taken together, make our Science Made Sensible (SMS) program unique. The first element is the successful integration of the graduate student fellows' research into the science curriculum. Our success is evidenced by the fact that three of our graduate student fellows over the last three consecutive years were invited to present posters on how they integrated their research into the classroom at the prestigious graduate student STEM poster session at the National Science Foundation atrium. The second element is the incorporation of Web 2.0 technology, a low-cost technology, into the science curriculum. Through the use of video, multimedia programs, and online resources such as

comic-strip creators, blogs, wiki-pages, and social networking sites, students are able to be exposed to and learn science in a familiar technological language. In addition, these technologies provide interaction between teachers and students outside the classroom. The third element is the use of communal science projects across the participating SMS middle schools. Each year of our SMS program we have created a novel communal project that integrates the STEM disciplines in hands-on activities and engages students to become part of a larger community of scientists. The students learn scientific skills, responsibility, cooperation, and collaboration. The fourth element is our sustained international collaboration with South Africa educators and researchers through our international GK-12 supplement.

The SMS international team, composed of the program director and a small group of SMS graduate fellows and Miami science teachers, spent three weeks in South Africa 2009-2011 engaged in terrestrial research in Kruger National Park and in education activities at three middle schools in the inner-city of Pretoria. During our time in the schools, our SMS team collaborated with local 6th and 7th grade science teachers to develop and implement inquiry based lesson plans. Our international collaboration has continued to grow even after our departure from South Africa. Several of our South African colleagues have visited Miami, including a graduate student from the University of Pretoria, one education faculty member from the University of Pretoria and one from University of the Witwatersrand, and six informal science educators from across the country.

UNIVERSITY OF MISSOURI

Poster 65

PI: CANDACE GALEN
Contact: Candace Galen, galenc@missouri.edu
Presenters: Candace Galen and Nicole Miller-Struttmann
Discipline: Other

ShowMe Nature GK-12: It Works Because Great Minds Don't Think Alike
One of the first hints that good things might happen in our MU GK-12 program came at the close of our summer teacher-fellow "boot-camp." One teacher, commenting on her fellow-mentored research experience said, "It reminded me, a teacher, of how learning feels." Bringing together master teachers and scientists with a passion for research is the catalysis for learning in all GK-12 programs. Our program brings fellows as scientists into the teacher's domain to guide students in visualizing and developing their own grant-funded research project; brings elementary school children into the fellow's domain by hosting "Science Safaris" where the most motivated students come to campus and take part in their fellows' PhD research; and connects the two worlds through cyber-infrastructure supporting real-time broadcasts from the lab bench or field site to the classroom. In an elementary school classroom, fellows work with energetic learners and are rewarded with enthusiasm and excitement when they succeed in creating science lessons that stick and communicating them in clear, meaningful terms. To sustain the co-mentoring relationships that develop between graduate students and teachers, we provide stipends to fellows to consult and mentor in a reduced role after completion of their Fellowship year. For our partner schools, we expect that our sustained GK-12 presence, coupled with a commitment from our corporate and governmental partners to supporting student driven research through our mini-grant program will have an enduring legacy. To measure the impact of Fellows' GK-12 experiences on STEM in higher education more broadly, our team is also conducting research on how participation in GK-12 affects graduate student pedagogy at the collegiate level.

UNIVERSITY OF NEW ENGLAND

Poster 66

PI: STEPHAN ZEEMAN
Contact: Henrietta List, hlist@une.edu
Presenters: Amber Thomas, Kylie Bloodsworth
Discipline: Biological Sciences

Connections--Land and Sea: Student and Scientist
The Maine coast and Saco River watershed provide an interdisciplinary platform for integrating current research efforts into local K-12 classrooms in southern Maine. SPARTACUS fellows at the University of New England (UNE) conduct research pertaining to these environs in the fields of chemistry, biology, and physics. The NSF GK-12 SPARTACUS program promotes fellows and host teachers working closely to connect students to their surroundings, including their school, the University, and the community. Through a focus on the environment, important connections between different scientific disciplines are made.

These connections among the branches of science, research, and the local environment, allow the K-12 students to gain a deeper understanding and appreciation of science, making them more invested in the process and more motivated to serve the larger community. SPARTACUS fellows encourage students and teachers to use the scientific process, giving them confidence in their ability to do science and allowing them to become involved in both conducting science and helping to solve problems facing our society. Through these efforts, students associated with a SPARTACUS fellow have spoken to local government officials about reducing waste at their school, have become involved in an online mission to catalog biodiversity nationwide, and have analyzed real data from the Gulf of Maine Ocean Observing System, among many other student-led endeavors. By helping to guide K-12 students and teachers, the fellows gain a better understanding of how to communicate science and the scientific process. Further, fellows learn to better gauge their audience's level of understanding, to fully answer questions, to explain the

process required to successfully conduct an experiment and to more thoroughly explain difficult concepts at any grade level.

The SPARTACUS GK-12 program enables a partnership between graduate students and K-12 schools, allowing for enrichment at all levels. SPARTACUS provides fellows, teachers, and students with a sense of place and purpose within the scientific community and their own community. By allowing students to take ownership of their scientific education and really become invested in it, everyone involved in the SPARTACUS program truly understand the importance of science in today's world.

U OF NORTH CAROLINA GREENSBORO

Poster 67

PI: STANLEY FAETH
Contact: Jacob Turner, jrturne4@uncg.edu
Presenters: Jacob Turner, Alex Congelosi, James Lynch
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Geology & Geography

Transforming Minds in a Transitioning Community: GK-12 at the University of North Carolina, Greensboro
Transforming Minds in a Transitioning Community, the University of North Carolina at Greensboro's GK-12 project, is a partnership with three urban schools located in the city of High Point, NC, in the Guilford County School system. Our GK-12 locations are distinctive in that Montlieu Elementary, Welborn Middle, and Andrews High are adjacent to one another, and connected by a Greenway trail that enables Graduate Fellows and their Lead Teachers to use Boulding Branch Creek and the surrounding area as a living laboratory. As students move along the three schools from year to year, activities on the Greenway provide many learning opportunities, including inquiry-based learning and instruction that relate to the Graduate Fellows' areas of scientific expertise. Our GK-12 approach to education gets our students outside of the classroom, in and around an urban stream, and excited about learning science. Transforming Minds in a Transitioning Community also links Graduate Fellows' activities to the North Carolina Standard Course of Study with current topics in chemistry, biology, and geography. We develop ways to apply these topics to phenomena relevant to the students' everyday lives. Our team members share their expertise and research findings in plant biology, chemistry, geomorphology, Geographic Information Sciences, remote sensing, and soil and water conservation. As a multi-dimensional team of scientists with knowledge of the biotic and abiotic factors affecting the health of urban streams and their surrounding environments, we communicate our science to students of all ages.

UNIVERSITY OF OREGON

Poster 68

PI: DEAN LIVELYBROOKS
Contact: Dean Livelybrooks, dlivelyb@uoregon.edu
Presenters: Dean Livelybrooks, Christine Butler
Discipline: Physics

UO Materials Science Institute
The UO GK-12 program partners with school districts in 4 rural and remote Oregon counties. The 300+ mile distance between the university and the geographic location is a unique factor to our distinctive effort with remote/rural schools.
In comparing the largest urban area, Hermiston to Eugene (home to our GK-12 Fellows), we can delineate a number of key differences. The population of Eugene is 82% white, with 22% of residents having bachelor degrees and 10% having masters. The top occupations in Eugene are educational services, construction, and professional, scientific, and technical services. In contrast, Hermiston residents are 65% white and 30% Latino. Less than 4% of Hermiston residents have master's degrees and 16% have bachelor degrees. The top occupations are labor and agriculture.

The demographic differences in the areas translate into opportunistic differences for school-age children. Many of these rural and remote children (and their families) have never considered higher education as a possibility. The location of our GK-12 program was specifically selected to optimize the potential effects on served students. The student who is afforded a solid and grade-articulated introduction to science throughout elementary school and interacts routinely with graduate science students learns that college and a career (other than labor or agriculture) could be possible.

The articulated elementary science curricula introduced by our program is unique in that it provides consistent and continuing science study on a year-to-year basis. We support classroom use of a nationally developed kit curriculum that was developed with teacher and scientist input, has clear instructions, and all necessary materials. The elementary student becomes familiar with the use and activities of the science kit and then every year thereafter has opportunity to "cycle back" (in the words of Aarons, 1990) through key elements of a scientific process. Students are experienced in studying science by the time they reach middle school. Because of this the middle and high school years can be more productive and can include the study of more advanced science concepts.

The legacy that we will leave is the creation of the InterMountain Education Service District (IMESD) Science Materials Center in Pendleton, OR. This shared resource center was established to support the GK-12 program. The ESD has staff to coordinate the use, transportation, maintenance, and refurbishment of the science kits. This

means that individual schools and teachers are not responsible for this extra work. The science materials center saves money for participating districts by allowing purchased equipment to be shared by many schools and districts. Potential exists for the Science Materials Center to expand it's offering of hands-on science materials as the Lane County center (where GK-12 was piloted) has done. The Lane Center now stocks and supplies many other science resources to schools; including shared probe and sensor sets for use in middle school, and electrophoresis equipment and a scanning electron microscope used in high schools.

We have expertise in working with elementary school teachers to adopt state-of-the-art science curricula, in developing math and writing connections to this science curricula via teacher professional development, in leveraging GK-12 efforts to support expanded activities (for example, the UO Center for Sustainable Materials Chemistry is working with Hermiston School District), and in developing regional centers to support high quality science and related education.

UNIVERSITY OF PUERTO RICO

Poster 69

PI: GERARDO MORELL
Contact: Sofia Burgos, sofia.burgos@gmail.com
Presenter: Sofia Burgos
Disciplines: Ecology, Environmental, & Earth Sciences

Nanoscience and Ecology: An Integrated Approach to Teach Science

Even when Nanoscience and Ecology share similar concepts, the integration of both fields in educational projects can be complex. In this poster, we present a module developed for the 31st Puerto Rico Interdisciplinary Scientific Meeting for a teachers training, where both of these contrasting branches of sciences were incorporated. Teachers participated in two different activities. The first was a plenary given by Dr. Tyrone Hayes, University of California that explained how steroid hormone can affect the development of amphibians. The second was a workshop based on the topics of the plenary after a search about Dr. Haye's interests. This poster is focused on the last topic presented during the workshop: endocrine disruptors in food webs. The activities were developed using cost-effective materials easy to obtain such as: paper, markers and laminated pictures. It started with a background of nanoparticles in water and the human endocrine system was introduced with a uncomplicated lecture. This activity had three main parts. In the first part, they had to construct a simple food web using aquatic organisms to indicate the flow of energy. Then, they had to assume that the population of one organism in the food web diminished, and predict how other organisms would be affected. The purpose of this activity was to help the comprehension of the close connections that exists among organisms. In the second part, they received the description of a substance that had entered a stream and using the same food web they had to predict which organisms were indirectly affected by the contaminant and explain why. To corroborate their predictions, participants modified their food webs based on the elimination of the organism affected by the contaminant. Since not all contaminants were the same, the results among groups were shared. The workshop ended with an activity to apply and reinforce learned concepts. In the third part, they had to identify possible sources of endocrine disruptors in water from a diagram. Participants, teachers of Grade Eight, considered that the activities were appropriate for their students and they also had the opportunity to ask questions regarding aquatic ecosystems, land use activities and the importance of riparian zones in controlling contaminants in freshwater, my area of expertise. If I could brand this activity I will call it Integrative Science for all (ISFA).

PI: GERARDO MORELL
Contact: Raisa Hernandez, raisa.hernandezpacheco@upr.edu
Presenter: Raisa Hernandez
Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences

Impacts of Bleaching on a Caribbean Coral: Bringing Conservation to the Classroom

The viability of coral reefs worldwide is seriously compromised due to the predicted rise in sea surface temperature (SST) and consequent increase in coral bleaching frequency. Given that the preservation of coral reefs is inherently dependent on the persistence of the founder species that build their physical structure--scleractinian corals--understanding the response of coral reef communities, as well as the physiological and population response of principal reef-building corals to bleaching, will allow ecologists to elaborate management strategies that should effectively improve coral reef resilience to climate change-related phenomena.

This study is aimed at answering four questions regarding the impacts of bleaching in *Montastraea annularis* at the different ecological scales: the coral colony, its endosymbionts, and the holobiont (coral-algae symbiosis). My research focuses on answering (1) how does skeletal growth parameters (skeletal density, skeletal extension, and calcification rate) of *M. annularis* located along an environmental stress gradient have varied following historical massive bleaching events, (2) how does the zooxanthellae clade composition of *M. annularis* correlates with specific survivorship and growth rates of colonies following a bleaching event, (3) how does the *M. annularis* population vital rates vary before, during, and after a massive bleaching event, and (4) how does the benthic community composition of different northeastern Caribbean coral reefs located along an environmental stress gradient changed following a massive bleaching event.

Because marine conservation is highly affected by human activities, an inquiry-based teaching lesson has been developed for middle school students designed to explain the

system dynamics involving acidity, the carbon cycle, and the growth and conservation of coral reefs. The module will be based on four different activities that will introduce the student to; (1) the utilization of pH scale, using color indicators, to determine the acidity of different substances, (2) the effects of carbon dioxide on water acidity, (3) the relationship among pH, carbon cycle, and coral reef ecosystems, and (4) critical thinking over human impacts on ocean acidification.

PI: GERARDO MORELL
Contact: Ana Rita Mayol, armayol@hotmail.com
Presenters: Ana-Rita Mayol, Sofia Burgos, Ileana Gonzalez
Disciplines: Ecology, Environmental, & Earth Sciences, Nanoscience

From Hectares to Nanometers: GK-12 Multidisciplinary Explorations of Tropical Ecosystems and Functional Nanoscience: Bringing Research into the Classroom
This GK-12 project builds a strategic interdisciplinary partnership between the University of Puerto Rico's Institute of Tropical Ecosystem Studies and Institute for Functional Nanomaterials, which together provide doctoral research projects to over eighty PhD students in chemistry, biology, chemical physics, and environmental science. It will strengthen 7th-9th teachers and students' scientific knowledge through multidisciplinary explorations of tropical ecosystems and functional nanoscience, while improving graduate students' abilities to communicate and teach science.

This GK 12 project provides training and experience to graduate students to prepare them to be leaders and to communicate and collaborate effectively with colleagues and peer reviewers as well as with teachers, students, and the general public. It also provides training and experiences to teachers in 7th-12th level to broaden their science content knowledge and have a better understanding of nano and environmental sciences. Fellow-teacher teams work together to develop and implement interdisciplinary educational materials that brings research into the classroom that has a connection with the science curriculum. Modules in the topics of: states of matter and phase transition, the effect of water acidification on coral reefs, models in science, and laboratory techniques at the nanoscale including electrochemical techniques, among others have been successfully developed and implemented impacting more than 3000 students and teachers island wide since 2009. The students and teachers guides have been incorporate in the Institute for Functional Nanomaterials (IFN) Lending Library and will be available electronically via the PR-GK-12, htt://gk12.upr.edu, and PR-EPSCoR-IFN, http://www.if.upr.edu, websites.

The PR-GK-12 has created an interdisciplinary community of researchers and educators that enrich the program with their expertise. The PR-GK-12 program has developed a series of workshops in pedagogical skills (such as problem based learning, assessment tools, how to correlate educational modules to the science standards), and science content skills (such as nano and environmental sciences techniques). The PR-GK-12 program has been used as model to implement training programs for science graduate students interested in education and graduate students specializing in science curriculum programs.

UNIVERSITY OF SOUTHERN CALIFORNIA

Poster 70

PI: KRISHNA NAYAK
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Presenters: Krishna Nayak
Discipline: Biomedical Engineering

Body Engineering Los Angeles
The Body Engineering Los Angeles GK-12 project at the University of Southern California emphasizes the concept that the body is a machine that can be studied, experimented upon, analyzed and augmented. The GK-12 fellows are known as "scientists in residence", bringing their knowledge of how engineering and science works to the students as resources. Their mission: "Be a role model. Fuel curiosity." And fuel they have. The current fellows have already exposed local middle school students to topics based on their Biomedical Engineering and Neuroscience doctoral work. The students, grades 6-7, have learned how cat whiskers provide sensory information to the brain, have discussed how electric waves move through the body, and have examined components of sneakers to understand how they are engineered to support the movements of the body. Perhaps one of the most unique aspects of the program is Family Science, an evening offering to the families of the students attending our partner schools. In partnership with Iridescent Learning, a national nonprofit focused on STEM education, our fellows will lead a series of lessons and engineering design challenges to engage the entire family in Body Engineering. Each design challenge is designed to involve every member of the family in the design, test and redesign processes of engineering.

UNIVERSITY OF SOUTHERN MISSISSIPPI

Poster 71

PI: SARAH MORGAN
Contact: Kimberly Wingo, kimberly.wingo@usm.edu
Presenters: Kimberly Wingo, Sarah Morgan
Disciplines: Chemistry & Chemical Sciences

Successful Communication Initiatives for NSF GK-12 Connections in the Classroom
The goal of the Connections in the Classroom: Molecules to Muscles at the University of Southern Mississippi is to improve graduate fellows' communication and teaching skills in an interdisciplinary research and education setting. Fellows learn different approaches to communicate to non-scientific audiences and to relate research advances in a way that is

relevant to high school students. An interdisciplinary team approach between GK12 PIs and the University Speaking Center is utilized to help students develop skills to effectively communicate to different target audiences. Initiatives implemented to improve fellows' scientific communication skills include delivery of a series of presentations with specific topics to different audiences, supervised teaching sessions, videotaping of presentations with individualized feedback for improvement and participating in a three day communication workshop. These and other successful communication training tools implemented will be highlighted.

UNIVERSITY OF TEXAS ARLINGTON

Poster 72

PI: MINERVA CORDERO
Contact: Denise Rangel, darangel21@gmail.com
Presenters: M. Cordero, M., Epperson, J., Gilgenbach, J. Helixon
Disciplines: Mathematics & Statistics

The NSF GK-12 MAVS Project: Integrating Lessons in Mathematics into the K-12 Classroom
The purpose of the University of Texas at Arlington NSF GK-12 MAVS Project (Mathematically Aligned Vertical Strands) is the creation of a seamless transition in mathematics that spans the school curriculum and bridges to research-level mathematics. It involves mathematics research faculty, graduate students, teachers, administrators, and K-12 students. The vertical team concept is the overarching model for carrying out the NSF GK-12 MAVS project goals.

Every summer at the NSF GK-12 MAVS Project Professional Development Institute, each MAVS fellow and mentor teacher pair develops a sequence of six research mathematics lessons. The integration of research mathematics and school mathematics is initiated via a process of examining national and statewide mathematics standards documents, studying the mathematical vertical alignment in the school district, and creating concept splashes that reflect the fellows' mathematical research and the mathematics that each mentor teacher must teach over each of the six six-week intervals of the school year. A focus on active learning strategies, problem solving, and fidelity to the underlying mathematics guides the development of the research lessons. As a result, the lessons fold into the mathematics curriculum in a seamless way by incorporating both the fellow's research and the mathematics that would have normally been going on in the school classroom at that time. The lessons are taught by the fellow at approximately six week intervals throughout the school year. This presentation will highlight the classroom research lessons implemented over the MAVS project year 2011-2012. The pairings of research mathematics and school level mathematics showcased in these lessons include: numerical grid generation and 7th grade mathematics, commutative algebra and 7th grade mathematics, mathematical biology and 7th grade mathematics, finite geometries and 8thgrade mathematics/pre-AP Algebra I, computational neuroscience and Algebra I, mathematical statistics and AP Statistics, partial differential equations and Geometry/Math Models, mathematical statistics and IB Mathematics, and applied mathematics and Algebra II/Calculus.

UNIVERSITY OF TEXAS EL PASO

Poster 73

PI: AARON VELASCO
Contact: Cheryl Storer, clstorer@miners.utep.edu
Presenters: Cheryl Storer, Christian Servin
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Computer Science & Information Management, Ecology, Environmental, & Earth Sciences, Geology & Geography

Scientist in Residence: Bringing Sustainable Science on the Border to the Early College High School
Our GK-12 program features a partnership between UTEP graduate student fellows in STEM fields with Early College High School classes in El Paso and the surrounding areas. The Early College High Schools of Texas were initiated by the Bill and Melinda Gates Foundation in association with community colleges, universities, state and local school districts, to help students in minority communities to gain access and momentum to succeed in college. When students graduate from Early College High Schools, they not only earn high school diplomas, but they can also earn their associates degrees from a partnership with the local community college. The GK-12 Program has granted STEM field graduate student fellows the opportunity to bring our own research into these students' classrooms and to invite them to visit our universities and even participate in our research.

While in the classroom, we employ constructivist and hands-on approaches to teaching the students, helping the students to explore their own ideas while in laboratory settings. We are not just the lab teachers of standard "cookbook labs"; we are the students' exploration coaches and biggest cheerleaders to help them to investigate new ideas and pursue their dreams, extending a hand to students to consider careers in STEM fields with us which they might have previously thought impossible to achieve.

The GK-12 partnership benefits us as fellows to not only increase our abilities as "scientists in residence" to relate our research to a more diverse audience, but it also affords us the opportunity to explore and develop our own teaching styles and to pour our lives and research insights into the next generation of thinkers. I think the biggest strength of our program is an emphasis on developing us as scientists to help students to consider careers and awareness in "sustainable science on the Border." Each fellow brings a completely different skill set and knowledge base from which to educate

the students: systems ecology, aquatic invertebrates, prostate cancer, geophysics of volcanoes, earthquake seismology, computer modeling of uncertainty techniques in the Earth Sciences, and observing nanoparticles' behavior in the environment. Another strength is collaboration between scientists in residence in the different fields on campuses.

For students who are interested in aspects of science advocacy, we engage students in community partnerships. For example, since I perform cancer research, I have brought the students opportunities to participate with me in funding cancer research through the local Susan G. Komen Race for the Cure. In our theme of Sustainable Science on the Border, we attempt to relate our research to the students while also focusing on science themes of Border-specific applications. El Paso is located on the border of Texas and Juarez, Chihuahua, Mexico. We extend an invitation to anyone interested in learning about our approach and the exciting challenges and successes of encouraging minorities to engage early-on in STEM field research, to visit our poster.

UNIVERSITY OF TOLEDO

Poster 74

PI: CAROL STEPIEN
Contact: Rachel Lohner, rachel.lohner@utoledo.edu
Presenters: C. Stepien, T. Brideman, N. Lightle, V. Luse
Disciplines: Ecology, Environmental, & Earth Sciences

Water Quality Monitoring by High School Students at the Land-Lake Ecosystem Interface

Our NSF GK-12 program, Graduate Fellows in High School STEM Education: An Environmental Science Learning Community at the Land-Lake Ecosystem Interface, develops environmental stewardship and exposes high school students to STEM careers and technology. Graduate fellows serve as role models in classrooms to engage the next generation in nature and science, mentoring ~420 high school students each year in urban/rural/suburban schools along the western Lake Erie watershed. Our fellows connect students with nature by guiding them in water quality monitoring of schoolyard streams in conjunction with an existing, local Student Watershed Watch program. Students involved in this program collect and analyze water samples for chemical, biological, and physical parameters and use the data to calculate an overall water quality index value for their stream. The students use this index to directly compare water quality among the streams sampled and over time when they present their results at the annual Student Watershed Watch Summit. Graduate fellows also mentor high school science fair projects, in which the students follow the scientific method and then design and present a science poster. This experience is topped by our own science fair at the Lake Erie Center, as well as Ohio local and regional competitions; many low-income minority students have won awards and university scholarships.

The objectives of this poster are to highlight results of our stream monitoring and showcase the successes of our program. We aim to: 1) Generate student enthusiasm for science careers, 2) Exchange knowledge and pedagogies between graduate fellows and teachers resulting in cutting-edge environmental science content and increased teaching and communication skills, and 3) Develop hands-on solutions to environmental problems and sustainability. By building STEM skills, the learning community and students gain hands-on experience in the role of urban and agricultural influences on watersheds in the history, social development, and future vitality of the Great Lakes region. Research on environmental problems is a real method through which students can give back to their own local communities, thereby helping to build an educational network focused on making our lifestyles more interactive with the natural environment. Our program thus embraces the public scholarship philosophic concept of merging scientific research with civic responsibility to benefit the public and the community.

UNIVERSITY OF UTAH

Poster 75

PI: DONALD FEENER
Contact: Holly Godsey, holly.godsey@utah.edu
Presenters: Holly Godsey, Don Feener
Disciplines: Biological Sciences, Ecology, Environmental, & Earth Sciences, Geology & Geography

TGLL and WEST: Promoting Meaningful Interactions for Lasting Impacts

University of Utah GK-12 projects TGLL (Think Globally, Learn Locally) and WEST (Water, the Environment, Science and Teaching) have been engaging scientists, teachers, and K-12 students in discovery-based science since 2004. The programs have combined forces to impact 89 graduate students, 80 teachers, and over 5,000 K-12 students in the Salt Lake City area. Over the years, dozens of lesson plans, inquiry-based activities, and field trips have been created but the most significant feature of these programs is the personal relationships that have developed between the fellows, teachers, and K-12 students. Of the many programs that involve students in science, few have the continuity and depth of interactions afforded by the TGLL and WEST programs. It is this capacity for long-term relationship building that produces lasting impacts on the participants.

For example, teachers and fellows engage in two intensive training workshops and weekly meetings to facilitate communication, bonding and professional development throughout the year. Fellows learn to develop lesson plans, assess student knowledge, and remove language barriers from discussions of science. Teachers gain a deeper understanding of concepts and scientific problem solving. Fellows and teachers provide each other feedback and capitalize on the other?s strengths, creating a dynamic classroom environment.

Regular classroom visits are a key component of the TGLL and WEST programs. For example, a central goal is to help the fellows understand how to recognize science misconceptions and effectively correct them. By working with the same students on a regular basis, fellows develop a sense of the background that each student brings to learning new material, and how to navigate through their misconceptions. These ongoing relationships also allow the fellows to serve as role models for the students, and as human connections to the University of Utah and STEM disciplines. Likewise, the students make lasting impressions on the fellows as each one brings a unique perspective through which the fellows come to view their own activities and contributions as researchers.

However, it is the interactions among the fellows that have resulted in the greatest impact on the fellows themselves. TGLL and WEST hold a weekly seminar on topics ranging from inquiry-based teaching to proposal writing. The first semester is led by the project management team and focuses on teaching skills and lesson development. The second semester is organized by the fellows and topics are based on their own research and professional development interests. Fellows plan and lead discussions on literature, give practice defense talks, and organize presentations by scientists and professionals. The experience fosters a dynamic exchange of ideas and gives the fellows a sense of community, purpose and direction that guides them as they prepare for their post-graduate careers.

UNIVERSITY OF WYOMING

Poster 76

PI: MAOHONG FAN
Contact: Leslie Roth, lroth@uwyo.edu
Presenter: Leslie Roth
Disciplines: Chemistry & Chemical Sciences, Engineering, Mathematics & Statistics, Nanoscience, Physics

Energy and Environmental Nanotechnology in Rural Wyoming High Schools

Wyoming is characterized by a vast and rugged landscape and tremendous energy assets. Energy research and education is a focus for the University of Wyoming (UW). UW is the only 4 year university in the state. In that capacity it serves as a center of learning as well as a catalyst for education in the state. Our NSF GK-12 project entitled "Dissemination of Nanotechnologies for Energy Production and Environmental Protection Information in Rural Areas of Wyoming" or E E Nanotechnology is unique in that it is in the forefront of rural Wyoming high school energy education. Our E E Nanotechnology NSF grant sends ten graduate student Fellows to travel regularly throughout the year to 5 rural high schools and collaborate with Partner Teachers to insert inquiry-based information about energy, and nanotechnology as well as the Fellows' research into the current Wyoming curriculum. All the lessons are designed to engage students and teachers using real world explanations within the context of authentic research projects in energy, the environment and/or nanotechnology. All individual lessons and activities integrate seamlessly with the current lessons the teachers are teaching in their Chemistry, Calculus, Environmental Science, Physics, Trigonometry or Biology classes.

Nanotechnology is the distinctive and unifying expertise of the project and all Fellows have a nanotechnology component to their research. These include carbon conversion using nano-catalysts, thin film transistors, synthesis and modification of gold particles for use in Raman Spectroscopy assays, vision sensors, carbon capture using nanoparticles, thermoelectric properties of materials, and synthesis of iron and manganese compounds to be applied to nanoparticles for recovery or higher activation purposes. By sharing their knowledge of nanotechnology and its connection with energy in a understandable and engaging manner with the teachers and students in rural schools, Fellows expose and excite students to continue their education in a STEM field. The collaboration with the Partner Teachers encourages the Fellows to gain valuable skills in team leadership, public speaking, communication and collaboration. Confidence in a group and the ability to talk about a unique scientific subject such as nanotechnology in an understandable way are skills that will serve the Fellows as they mature in their scientific careers. In addition, the students and teachers are exposed to cutting edge energy and environmental protection research that is important to the global future.

Poster 77

PI: DON ROTH
Contact: Jan Truchot, jtrucho1@uwyo.edu
Presenters: Science Posse Fellows
Disciplines: Ecology, Environmental, & Earth Sciences, Engineering, Mathematics & Statistics, Physics

The Science Posse: Inspiring Wyoming's Next Generation of Scientists

The Science Posse's goal is to inspire the next generation of scientists by connecting Wyoming teachers and students, no matter where they are, with our graduate fellows. This is accomplished by traveling to classrooms in every corner of our 97,000 square-mile state in person or virtually via the internet. Since the Posse's inception in 2006, we have been invited to 105 schools in 21 of Wyoming's 23 counties. In addition, we have provided summer enrichment to 81 students from 14 districts and summer professional development for 84 teachers from 27 districts. The Science Posse's ability to reach so many teachers and students makes our program unique; we are an on-demand service meeting the unique needs of our large state.

While K-12 students and educators appear to be the main beneficiaries of the Science Posse, our focus is really on our graduate fellows. The program increases their ability to

translate research into relevant and meaningful discourse. Science Posse graduate fellows are experts in creating and presenting lessons employing inquiry and conveying content to students of all ages and academic abilities. The fellows develop the flexibility to adapt to a variety of situations, and they exemplify the enthusiasm, passion and dedication needed to inspire students and create the next generation of scientists, mathematicians, and engineers. The graduate fellows are also involved in interdisciplinary collaborations throughout the year as they work and travel together bringing their science, mathematics, and engineering lessons to the classroom. The Science Posse is creating a generation of research scientists who are able to successfully collaborate with members of not just their own fields, but the scientific community as a whole. They are dedicated to, and well-versed in, communicating their research and its importance to the public.

The Science Posse's innovative approach to outreach, both during the school year and in the summer, is providing a model for the Comprehensive Science Initiative being developed at the University of Wyoming. The goal of CSI-WY is to sustain cohesive, deliberate and organized inquiry-based STEM activities, inform STEM learning assessment and enhance the STEM career pipeline.

The Science Posse's statewide outreach provides teachers a variety of options for inspiring their students to pursue STEM education and careers. For graduate fellows, the Science Posse's unique outreach model instills flexibility in teaching and communication skills—something not always acquired teaching undergraduate courses alone. Although the state of Wyoming is expansive, the Science Posse continues to offer unrivaled support for Wyoming educators, scientific inspiration for Wyoming students, and unparalleled teaching skills for University of Wyoming STEM doctoral students.

VIRGINIA INSTITUTE OF MARINE SCIENCE

Poster 78

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Presenters: J. Spackeen, S. Lake, C. W. Lake, L. M. Kraatz
Disciplines: Biological Sciences, Chemistry & Chemical Sciences, Ecology, Environmental, & Earth Sciences, Social & Behavioral Science

Watersheds, Webs, and WASPs: Experiences from the VIMS GK-12 PERFECT Partnership

The Virginia Institute of Marine Science (VIMS) GK-12 PERFECT partnership is the only marine science focused NSF GK-12 program in the Chesapeake Bay region. The VIMS partnership, currently in its third year, has placed 24 students in 5 schools (2 middle schools and 3 high schools) with the goal of improving the graduate students' communication and teaching skills, while enriching STEM content. Throughout the length of the program, fellows have developed numerous lesson plans that build their research into the course curriculum. Ultimately allowing the students to go beyond basic core content and gain insight into current scientific research. Our poster provides two new examples of lesson plans developed by this year's fellows, along with a first look into the continued evolution of the Draw a Scientist Test (DAST).

One of the lesson plans featured on our poster challenges high school science students to use stable isotope data (δ 13C and δ 15N) to construct an estuarine food web, analogous to the Chesapeake Bay. After a brief presentation on the application of stable isotopes, students are given an activity that provides them with the opportunity to work with real stable isotope data to determine the trophic relationships within an estuary ecosystem. Through this lesson plan, the fellow was able to successfully incorporate her research into the classroom and the students were introduced to a contemporary scientific concept.

Our second lesson plan features a Watershed board game, where students move as a parcel of water throughout a local watershed, acquiring and transferring nutrients to the surrounding environment before entering the ocean. This activity builds off of nutrient and water cycles SOL subject areas, and links in biological processes, human influences, and current environmental concerns. These large (2.5 ft by 4 ft) board games allow 4-5 students (7 - 12 grade) to compete against each other with the ultimate goal of having the least impact on the environment.

Lastly, we provide a preview into a new take on the classical DAST activity, which we have named the Who's A Scientist Project (WASP). We have retooled DAST to determine the type of scientist that students would aspire to be if they were to become a scientist. Additionally, we focus on what they think it would take to become that scientist, and why they would or would not want to be a scientist in the future.

WASHINGTON STATE VANCOUVER

Poster 79

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Disciplines: Ecology, Environmental, & Earth Sciences

Partners in Discovery of the Columbia River Watershed GK-12 Project: Building Lasting Collaboration through Scientist-Teacher Partnerships

The "Partners in Discovery of the Columbia River Watershed" GK-12 project pairs Washington State University Vancouver

(WSUV) Environmental Science MS and PhD students with 6th-9th grade science teachers for year-long, one-on-one collaborative partnerships. Our goals are to bring the Fellows' research and expertise into the classroom and to support the partners as they teach science through authentic inquiry. Now in our fourth year of the project, we are building upon our base of experience in developing effective partnerships and shifting our focus toward establishing sustained collaborations between individual scientists and teachers, as well as between Washington State University Vancouver and the local K-12 educational community.

The Partners in Discovery GK-12 project has always been centered around the unique and often transformative professional relationship that develops when a practicing scientist and a practicing science teacher work closely together in a middle school classroom. However each year we have increasingly directed our professional development activities toward helping the Fellows and teachers transition from side-by-side partnership to true collaboration around developing, implementing, and assessing classroom lessons and activities, and then reflecting upon the effectiveness of their approach to science learning. As a way to support that transition, over the course of the academic year each Partners in Discovery GK-12 scientist-teacher pair is expected to develop a collaborative curriculum project and then a "product" that communicates to a specific educational audience the results of their collaboration. This has been an effective approach for all pairs, but an especially beneficial project for the partners whose collaborative relationship has taken a longer period to develop. We will present examples of the products developed by past and current GK-12 partnerships, and their reflections on the process, as well as discuss how this process has shaped our plans for sustainability of the partnership model beyond NSF support.

WASHINGTON UNIVERSITY in St. Louis

Poster 80

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Presenter: Jameson Lee
Discipline: Engineering

Engaging Middle School Students with Design, Construction, Programming, and Application of Robotics In and Outside of the Classroom

Washington University in St. Louis has utilized the unique opportunity with the GK-12 Graduate Fellowship Program to provide Brittany Wood Middle School students a chance to interact with Robots. The program consists of two activities, the robotics program that is integrated with the Science and Engineering curriculum and the after school Robotics Club. The curriculum-based robotics activity takes modern problems, such as exploration in hazardous environments, and asks how robots can be utilized to solve the problem. The students are introduced to programming with the LEGO Mindstorm and the problem is simulated through a line tracing robot, in semblance of navigation. The students are lead to focus on solving the problem. They are also challenged to consider other applications for robotics in our daily lives. The Robotics Club is for more advanced students where we mentor and direct the students in solving variety of difficult puzzles for First Lego League. The students are free to build their own robots and to program the robots to accomplish variety of tasks. The tasks range from pushing levers to collecting objects. The program has provided a large number of robotics kits. Every student has their own robot to design, build, and program. This has allowed us to not only work with the after school program, but also integrate robotics into the 8th grade curriculum for Science & Engineering. The program has been remarkable in allowing all the students to interact with his or her robot, and introducing programming concepts early in their education. We believe learning programming concepts early on has become critical as we continue in the digital age. The skills that the students have learned will be crucial not only in education but also professional careers. Some students were very enthusiastic about programming that they eclipsed what we originally designed for them. This allowed us to expand the original scope of the program, encompassing more advanced programming techniques for the advanced student. Through the exposure through the GK-12 Program, the graduate students have become proficient in integrating robotics into the general science curriculums. Some activities we touched are disaster recovery, water cycle, and resource acquisition. We have also had success in teaching basic and advanced programming concepts in a format that is easier for students to comprehend.