

# Graduate STEM Fellows in K-12 Education (GK-12) Annual Conference

## Group I Workshops / 8:30 a.m. – 9:45 a.m. / March 17, 2012

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### **A Road Map for the Integration of Research-Level Mathematics into the Classroom**

**Room: Congressional A (Lobby Level near Bell Stand)**

**Presenters:** Minerva Cordero (PI), James Epperson (co-PI), Jason Gilgenbach (Fellow), Scott Lacy (Fellow), Alice Lubbe (Fellow), and Charlie Nguyen (Fellow) University of Texas Arlington; Kimberly Helixon (Mentor Teacher) and John Juneau (Mentor Teacher), Sam Houston High School

The University of Texas at Arlington GK-12 Mathematically Aligned Vertical Strands (MAVS) Project Professional Development Institute (PDI) provides a process for bridging research-level mathematics ideas to school mathematics curriculum. The process involves GK-12 fellow and mentor teacher pairs along with guidance from faculty with expertise both in mathematics education and mathematics research. The goal of the PDI is that fellow and mentor teacher pairs develop a sequence of six research mathematics lessons for the upcoming year and develop a keen sense of the vertical connections in the mathematics curriculum.

This session provides the guiding principles of the GK-12 MAVS PDI and its targeted activities for achieving a seamless integration of research-level mathematics into middle and high school mathematics classrooms. To enhance understanding of the components in this process, we present real examples of how a lesson evolves from foundational work early in the PDI to its finalized form. This session may be useful to anyone interested in understanding how to maintain the integrity of the research mathematics while supporting the mathematics curriculum in the schools.

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### **Creating Student Excitement for the Nature of Science**

**Room: Capitol B (Lobby Level at top of escalators)**

**Presenters:** Allie Kellie (Fellow), Catherine Ueckert (PI), Northern Arizona University; Curt Craig, Teacher, Mount Elden Middle School

Biotechnology is a great way to capture the interest of young students and explore life science in a new and exciting way. Biotechnology Integration Opportunities for Teacher Education and Content (BIOTEC) places Northern Arizona University (NAU) graduate students in middle and secondary classrooms, including those on the Navajo reservation as well as in culturally diverse classrooms in Flagstaff, Arizona. The fellow-led activities include: a murder mystery in which students were engaged in extracting DNA, simulated gels, fingerprint labs, mystery powders, pH labs, skeletal remains analysis, etc.; ecological exercises (soil analysis, plant census, bird surveys); techniques used in isolating DNA and identifying genes; investigations of Physarum slime molds; evolution simulations; micro-techniques and electrophoresis labs; and bacterial transformations.

The goals of this workshop is to 1) engage participants in various activities that demonstrate how the NAU Fellows have incorporated their research and the processes of science in middle and secondary classrooms, 2) identify challenges and solutions, and 3) generate strategies for implementation by other GK-12 projects. Participants will learn about activities and strategies for implementing Fellows' research and the processes of science into middle and secondary classrooms.

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### **Engineering Design across STEM Disciplines: Interdisciplinary Student Teams at Multiple High Schools Collaborate to Solve a Significant Engineering Design Problem**

**Room: Congressional B (Lobby Level near Bell Stand)**

**Presenters:** Scott Kindt (Teacher), Berthoud High School; Matt Duwe (Fellow) Colorado State University

In fall 2011, our GK-12 program challenged four classes (physics, engineering, mathematics, and computer technology) at two high schools in Northern Colorado to collaborate on an interdisciplinary engineering design project to test, analyze, and optimize a iPod MP3 Player/Amplifier. The interdisciplinary high school teams were bound by one goal: reverse engineer, build, and test amplifier circuits. Each class had seven different groups led by a student called a junior fellow. At the end of this project, the junior fellows and their teams created project research posters that were presented at the Engineering Exploration Days at Colorado State. GK-12 fellows in electrical engineering and chemistry created the curriculum material. Teachers organized and planned their components of the project. Students learned about specialization, communication, and engineering design; they were also introduced to material typically not included in a high school curriculum.

Workshop participants will learn how to design long term interdisciplinary STEM design problems that include multiple STEM teachers and students across several schools. Assessment data from student pre and posttests measuring student STEM content connections will be presented.

**Two Presentations:**

**Linking Watershed Research with GK-12 Education: Effectiveness of Place-based Learning**

**Room: Concord (Ballroom Level)**

**Presenters: Natsuko Merrick (Fellow), Richard Moore (PI), Ohio State University**

Ohio State University's Sugar Creek Watershed GK-12 program brings watershed science in a place-based educational context, a farming community with high levels of phosphorus, nitrogen, and bacteria in the streams. In this session, fellow-teacher pairs will share how they've drawn from available rural resources to tie graduate student research into an integrated scientific approach to environmental educational experiences, while meeting K-12 state standards. Working within Amish, Mennonite, Catholic, and rural public school communities, the presenters will demonstrate both struggles and successes of how they integrated fellows' research into simple, replicable, place-based lessons from which students, teachers, and fellows benefitted. We will present our five years of involvement, strategies, and achievements in this watershed that provide a unique opportunity to incorporate scientific principles from many different STEM disciplines that bridge the social and natural sciences. We will provide specific examples of how we applied watershed research into the classrooms of different grade levels and place-based approaches. Examples will focus on how to use streams nearby the school in STEM research. Agroecological examples such as garden mulching and rain water catchment systems that relate to stream health will also be included.

**Integration of Fellows' Scientific Research in Outdoor Areas Near Schools**

**Room: Concord (Ballroom Level)**

**Presenters: Margaret Collins (Fellow), Sunni Taylor (Fellow), Texas State University; Sandra Baker (Teacher), Goodnight Jr. High**

Project Flowing Waters integrates doctoral research into middle and high school science lessons through the use of previously underutilized natural areas in the schools' backyards. Fellows bring extensive scientific knowledge of outdoor flora and fauna, as well as research methodology and experience that teachers may lack. Natural environments present the opportunity to address many science standards and develop an appreciation for nature through unique learning situations. Furthermore, using natural areas close to the school allows secondary students to return often to research areas and see changes throughout the school year. We will discuss the use of outdoor learning areas to enhance students understanding of science standards and will share lessons that involved natural areas such as ponds, fields and woods next to campuses utilized by Project Flowing Waters fellows and teachers.

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**Pedagogy in the STEM Classroom: Skip the Lecture and Experiment with Methods that Work**

**Room: Bunker Hill (Ballroom Level)**

**Presenter: Michelle Paulsen, Program Director, Northwestern University**

An increasing body of literature is making a strong case that the traditional science lecture is very ineffective at helping students achieve the critical understanding of scientific principles they need. The appeal of the lecture is clear—it is direct, straightforward, and familiar. Other pedagogical techniques can take a lot of time to plan, prepare, and execute, and they can push teachers well outside their comfort zones. In this session, while acknowledging that an occasional lecture is sometimes needed, I will briefly review the literature that indicates we need to consider other alternatives. I will then demonstrate that these alternatives do not need to be painful ones, and will introduce graduate students and new teachers to five specific pedagogical techniques that will make their classes more dynamic:

- (1) Inquiry helps students ask questions about the lesson topic, and it helps them creatively explore the issue in their own way;
- (2) Constructivism encourages the students to build their own knowledge and shows them that finding answers on their own is a valuable and exciting skill;
- (3) Discrepant events confront students with surprises that challenge what they think they know; as they try to explain the phenomenon, their curiosity takes over,
- (4) Writing to learn allows the students to craft their own understanding of the concept by composing brief paragraphs or essays;
- (5) Discussion/questioning helps teachers ask probing, genuine questions of the students; these questions push the students to come up with their own answers.

I will provide concrete examples of the use of each of these, and participants will leave with fresh approaches to their classes that will effectively engage their students and help them grasp the concepts in new, more productive ways.

**Set up Roots to Create Branches: Expand Project Impact Through Outreach**

**Room: Congressional CD (Lobby Level, near Bell Stand)**

**Presenters: Alexandra Lau (Project Manager), Michelle Manes (Co-PI), University of Hawaii**

With a relatively small number of Fellows working in a small number of schools, how can a GK-12 project have a substantial impact on local schools and teachers? How can relationships built with partner teachers and schools be maintained after a GK-12 project ends? Which threads of work can continue past the life of the grant? We will share what has become a major piece of our project work: outreach activities in local schools and community organizations. In this roundtable discussion, we'll share what we've learned about the potential for these activities, including building local capacity to continue the work indefinitely. Bring your project's outreach experiences (both good and bad) to share, so that we can all learn from best practices.

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**Two Presentations:**

**Steps and Challenges in Planning an International Trip (India) for Graduate Students**

**Room: Lexington (Ballroom Level)**

**Presenters: Rajesh Ganesan (PI), Phil Henning (Evaluator), GK-12 Fellows, George Mason University**

Following on a visit to India by the PI in 2006, the SUNRISE international trip to India took place in December 2011-January 2012. The objective of the international partnership was: 1) to provide the Fellows and PIs a unique opportunity to acquire new research collaborations, understand teaching methods at the university and school divisions, and improve communication skills through a process of learning, investigation, engagement, and self-evaluation of their current research and pedagogical knowledge at a global level by interacting with international researchers and educators, and 2) to gain a global perspective of the social, economic, and cultural values of the international destination in relation to their own through involvement and direct experience. The workshop will share the steps and challenges in planning an international trip and also share the outcomes and experiences of the graduate students.

**International Collaboration: GK-12 Transforming Experiences in China**

**Room: Lexington (Ballroom Level)**

**Presenters: Michael Jacobson (PI), Mark Anderson (Co-PI), Timothy Morris (Fellow), University of Colorado Denver; Scott Wallace (Lead Teacher), Englewood (CO) School District**

Middle school is the time when the US takes a sharp dive in STEM amplitude as compared with the rest of the world, including China. For this reason, the GK-12: Transforming Experiences project at the University of Colorado Denver chose to seek international collaborations and an understanding of STEM education principles in China in pairing with our project participation in American 7th and 8th grade math and science classrooms. The project has made two trips to China to observe middle school classrooms and to facilitate fellows' building academic collaborations with Chinese faculty and graduate students in their respective fields. We are working with Jiangsu Institute of Education in Nanjing, Central China Normal University (CCNU) in Wuhan, and Hunan University in Changsha.

In this workshop we will describe our project's work in China, as well as how international collaborations are beneficial to fellows and to the greater understanding of how STEM education is tackled globally. We hope to share our experiences for the benefit of other projects with similar interests.

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**Sustainable Schools Program and Practice: Partnership Building with the Tempe Union High School District**

**Room: Regency D (Ballroom Level)**

**Presenters: Auriane Koster (Fellow), Brendan Denker (Fellow), Arizona State University; Jessica Hauer (Teacher), Tempe High School**

Our goal in the Sustainability Science for Sustainable Schools program is to engage individual science classrooms, the larger school campus and district, as well as the local community in sustainability projects. The evolution of our efforts and relationship-building with Tempe Union High School District's community is a working model for meeting this overarching goal. We started with two fellows at one high school and currently have six fellows working across all six high schools within the District that serves 13,260 students. We have transitioned from working directly with individual teachers to working with larger school-based Professional Learning Communities, and with district leadership on multiple district-wide sustainability initiatives. This session will provide an overview of our two years of work with the Tempe Union High School District on development of classroom sustainability science activities, teacher professional development sessions, district-wide sustainability surveys, student projects, a new sustainability course, campus improvements and annual Earth Week

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events. We will highlight lessons learned in relationship-building and project management for sustaining this important institutional partnership for several years to come.

### **Two Presentations:**

#### **Using Twitter to Connect Students and Scientists**

**Room: Yellowstone/Everglades (Third Floor, take elevators on Lobby Level near Bell Stand)**

**Presenter: Adam Taylor (Teacher), John Overton High School**

Twitter is not just for finding out what celebrities have had for breakfast. Twitter is being used by scientists, teachers, and students around the world to connect, collaborate, and learn with each other. We will share why Twitter is a powerful tool for meaningful communication. We will also share how we have help students connect with scientists and start professional dialogues.

There are three levels of Twitter use: 1. Without a Twitter login, 2. With a Twitter login but without tweeting, 3. With a twitter login and tweeting. We will take time to show you each level and help you learn how to make Twitter a powerful learning tool.

#### **Use iPads to Extend the Reach of Your Project**

**Room: Yellowstone/Everglades (Third Floor, take elevators on Lobby Level near Bell Stand)**

**Presenters: Cara Wiblemo (Fellow), Thomas Servantez (Fellow), University of Wyoming**

The goal of this session is to share one way the University of Wyoming's Science Posse uses technology to make project resources more widely available and user-friendly, helping us achieve our goal of reaching as many students as possible. This presentation has two parts, both focusing on the use of iPads in the Science Posse project.

Part 1: iPads as Organizational Tools

We discuss how the Science Posse is currently using iPads for communication, collaboration, activity tracking, etc. We'll also talk about apps we use that benefit us as grad students.

Part 2: iPads as Educational Tools

With the recent release of iBooks Author, it has become easy to create free, interactive, digital materials for the iPad, and distribute them on your project's web site. In this part, we discuss how the Science Posse is using this tool to make popular lessons more widely available to students the Science Posse may not be able to reach in person. Participants will see a before-and-after example of an online, interactive Science Posse lesson, first as a web page and then as an iBook.