Workshop Abstracts

W1 – Increasing students’ success in college preparatory chemistry and in college general chemistry by remediation of requisite basic math skills
William Cary Kilner
University of New Hampshire

Much valuable research has been done to determine why students have trouble solving chemistry and physics problems, why they resort to algorithmic techniques without understanding the concepts involved, and why they cannot transfer acquired problem-solving skills to novel situations.

Such research has shown that many students come to high school and college chemistry with serious gaps in their mathematical understanding. This jeopardizes all attempts to teach them problem solving. A manifestation of this is the unorganized way in which many students set up and execute chemistry problems, despite repeated instruction in good practices. Sloppy work may also indicate sloppy thinking and weak conceptual understanding. Even high-achieving math students can have serious missing pieces of mathematical understanding, which we assume without verification that they have previously acquired.

Knowledge and skill in abstract mathematics will not transfer to chemistry and physics problem solving unless students are assisted in learning explicit procedures that clearly connect to the science involved. And consistently emphasizing these procedures can shore up a fragmented understanding of basic mathematics.

In my current work with college freshmen in general chemistry, and in my previous work in high school college-preparatory chemistry, I have identified 17 sequential mathematical skill areas that must be addressed in order to provide this support for student learning in chemistry. I have also developed concomitant techniques for instruction, including context -rich practice problems and worksheets that provide the necessary drill and reinforcement in the most efficient manner. Student feedback has validated the usefulness of this approach.

In this workshop I will summarize my list of “chem-math” skills, and provide examples of intervention, illustrated with student examples whenever possible. Upon showing each of my slides in turn, we will collectively discuss the validity and effectiveness of my claims. Bring your own list of skills, concerns, and examples to see where they fit into my organizational scheme.

W2 – Exploring ways to visualize mathematics
David Meel
Bowling Green State University

One of the more difficult aspects of teaching mathematics is engaging students in problem solving and one of the most difficult ele ments of this endeavor is visualizing the mathematics. This workshop will explore with participants a variety of potential ways to help students visualize mathematics and make them active participants in constructing their understanding. In particular, participants will be exposed to various tools such as web applets, concept mapping, story telling, and other innovative ways to get students to experience mathematics in new and multisensory ways. Participants will be expected to actively participate in various activities, some of which may necessitate the use of a graphing calculator.

W3 – Two eyes seeing and two eyes hearing
Ed Galindo
University of Idaho

This workshop will be aimed at sharing with folks different points of view on not only science and math instruction, but on life as well. An Elder once said “Teachers don’t teach subjects, they teach people. To teach people, they must make an honest effort to get to know them, spend time with, care about them, and believe in them”. That is what my workshop will be about. Several team building activities that work with students to get to know them.

W4 – Playing cards and thinking about race, class and culture in the classroom
Eric Hsu
San Francisco State University

We will play a silent card game together, which will lead us into a conversation about issues of power and communication. This will be followed by a brief reading of some research and another conversation of the ways issues of race, class and culture enrich and sabotage the classroom learning experience. The intention is for strategies and questions to be shared in a safe workshop environment.

W5 – Science fiction in the science classroom
Kelly McCullough
Author

Are you interested in using science fiction as a tool in the classroom? Just interested in science fiction? Kelly’s an author who has written science fiction short stories specifically for educational purposes as well as novels for Penguin/Putnam. Both reading and writing science fiction can help build student excitement about science and teach valuable lessons. In this workshop Kelly will talk about his experiences working with an NSF-funded middle school science curriculum with a science fiction context and help you explore some of the ways you can use science fiction in your own classrooms. Please bring a topic or unit that you think might be fun to explore with the tools of science fiction.

W6 – Symmetry and patterns in contemporary Native American art
Michelle Zandieh
Arizona State University

This hands-on workshop is intended for anyone who likes patterns. No formal knowledge of symmetry will be assumed. We will begin by considering the symmetries of simple shapes (e.g. letters) and use this to lead into a discussion of the symmetries possible for a belt or rug border (strip patterns). Both types of symmetries will be used to characterize and classify pictures of Native American artis try of the southwest (e.g. Hopi pottery, Navajo rugs and Navajo sand paintings).

W7 – Inquiry-based, hands -on in-class Astronomy activities
Rebecca Lindell
Department of Physics and Office of Science and Mathematics Education
Southern Illinois University, Edwardsville

At Southern Illinois University Edwardsville, we have recently restructured our introductory astronomy course to include hands-on inquiry-based in-class group activities. These activities utilize a learning cycle approach to cover specific astronomical concepts that traditionally resist conceptual change, such as phases of the moon and seasons, or that students have difficulty mastering, such as Hubble’s law and the Hertzsprung-Russell diagram. Each group activity is designed to be completed during one 50-minute class period and utilize hands-on equipment whenever possible. In this workshop, we will discuss the design and implementation of these group activities into our introductory astronomy course, as well as allow participants a chance to explore some of the activities.

W8 – Using the Conceptual Change Model (CCM) of learning in the science classroom: Implications for engendering robust nature of science (NOS) understandings
Scott Sowell
Cleveland State University

The nature of science (NOS) is essentially, a set of underlying principles determining what makes science “science.” Instead of seeing science as merely a body of knowledge to be memorized (i.e., the products), students should also acquire an understanding of how that knowledge was produced (i.e., the process). In order to make informed personal and societal judgments, one must understand how science works and how those processes shape the nature of scientific knowledge. This workshop is designed to provide science teachers with instructional strategies, each influenced by the conceptual change model of learning, that are specifically designed to improve students’ understandings of the nature of science (or more accurately, to change students’ prior alternative NOS concepts). In addition to an overview of the conceptual change theory, we will be working with a variety specific teaching tools (e.g., hand-held technology) as well as related pedagogies (e.g., journaling) which promote students’ reflection on their changing ideas.
Target audience: pre-service and in -service middle/secondary science teachers

W9 – Teaching physics and mathematics using critical agency: A hands on workshop for teachers
Apriel K. Hodari
The CNA Corporation

Many students find learning mathematics and physics challenging. For students from groups whose participation in physics and mathematics courses is significantly lower than their representation in the population – minorities, low-SES students, girls, and students with disabilities – these challenges are even greater. Critical agency is one way both to create learning opportunities for all students (equity in education) and to empower students to improve the conditions in which they live (equity through education). In this workshop, we will provide an opportunity for the participants to experience sample exercises involving critical physics agency and critical mathematics agency.

W10: Science in Native American communities
Eric Riggs
Purdue University

In this workshop we will discuss issues in Native American teaching and learning and how school curricula can be adapted to suit local needs and learning styles in indigenous communities.

W11: Experiencing math in a cultural context: From everyday activities to videotape analysis
Jerry Lipka
University of Alaska, Fairbanks

To provide participants with an overview of this complex project, the workshop will begin with videotape footage (different from the talk) showing Yup’ik elders creating patterns used in clothing. The two-way process of the collaboration will be highlighted as well as the Interdisciplinary nature of this project. After the context of the project is established, participants will engage in a few activities. Debriefing the activities will include a few components: where /what is the math; how can it be extended; and bringing the pedagogy to light.

Additional classroom data will be shared with the participants as well as classroom videotape that highlights how and why we believe that MCC has improved students’ math performance.

W12: A constructive approach to teaching trigonometric functions
Keith Weber
Rutgers University

In a talk that I am giving at this conference, I argue that students need to understand trigonometric operations, such as sine and cosine, as functions that map angles to real numbers if they are to fully understand trigonometry. However, most students only understand sine and cosine as ratios of lengths of right triangles.  In this workshop, we will examine and complete a series of activities that can be used to help students understand trigonometric operations as functions. These activities are hands-on constructive activities involving the construction of geometric figures and taking measurements of figures that are constructed. For each activity, we will discuss what it is that children are expected to learn from completing it, how the activity will enable them to learn effectively, and how the activity can be implemented in the classroom.

W13: Creating gender neutral problems
Laura McCullough
University of Wisconsin, Stout

Want to find out how to change your homework problems to be more gender-neutral? In this workshop we will discuss what makes a problem more inviting to everyone, I will show examples of traditional textbook problems that have been edited to be more inviting, and workshop participants will make changes to their own problems with guidance from the workshop leader. If possible, participants should bring some example problems to the workshop.

W14: A modified approach to lesson study for secondary science and math teachers
Nicole Gillespie
Knowles Science Teaching Foundation

The 1999 Trends in International Math and Science Study (TIMMS) revealed striking differences between math and science education in Japan and in the United States. One of the key differences found was that Japanese teachers routinely spend time working together to improve their teaching through a process of cooperatively planning, observing, analyzing, and refining actual classroom lessons. This process, known as “lesson study” is widely credited for the steady improvement of Japanese elementary mathematics and science instruction. Since the release of the 1999 TIMMS results, the practice of lesson study has emerged in many schools in the U.S. Typically the practice of lesson study involves commitment at the school level in order to give teachers time away from teaching requirements in order to plan, observe and revise the research lesson. Additionally, lesson study is most often practiced in elementary schools, where multiple teachers in the same school teach the same content at the same grade level. Thus, secondary math and science teachers who want to practice lesson study face challenges at multiple levels. The  Knowles Science Teaching Foundation Teaching Fellows are secondary math and science teachers in schools across the U.S. who practice a modified lesson study process during the five-year tenure of their fellowship. Their process is adaptable to small groups of teachers who want to begin a lesson study process on their own but don’t yet have the buy in from their school, or may want to work with colleagues teaching the same subject in different schools. This workshop will introduce participants to the practice of lesson study and what research shows are the effects on teacher practice and student learning. Participants will have the opportunity to engage in a lesson study sequence with lessons and classroom evidence from KSTF teaching fellows lessons and will leave with strategies and resources for beginning their own lesson study process.

W15: Project Lead The Way: A solution to increasing student interest in math and science
Patrick Leaveck
Project Lead the Way

Project Lead The Way (PLTW) is The National Alliance for Pre-engineering Programs. As a non-profit organization, it helps public schools across the country implement a high school pre-engineering program and a middle school technology program. This workshop will explain the PLTW program, and show why over 1800 schools in 46 states have joined. PLTW helps students learn about technology careers by providing a project based learning curriculum that integrates math, science, language arts, and technology standards. The PLTW program have invested over 8 million dollars in a fully developed curriculum at both the high school and middle school level that is free to schools. A complete teacher and counselor training program is also provided to participating schools at a leading national college of engineering/engineering technology. The PLTW program provides support to bring together community leaders from schools, colleges & universities, and industry, to help students achieve higher academic success. At the same time addresses the nation’s need for a technology workforce. Find out why the National Academy Sciences designed PLTW as a “World Class Curricula” and said that PLTW fosters high quality teaching, standards, and assessments of student learning.

W16: That ain’t no way to treat a lady: Gender equity in the science and math classroom
Stephanie Blaisdell
Consultant

A good teacher treats all their students the same, right? This workshop will challenge that belief. Students have all kinds of individual needs, and among them are gender-based differences that affect the interaction and learning in a classroom. This workshop will provide illustrations of how gender affects your classroom, and how you can respond to gender-based needs.

W17: AER 101: A beginners’ guide to conducting astronomy education research
Rebecca Lindell
Southern Illinois University – Edwardsville

Astronomy Education Research (AER) is a science and as a science it is bound by the same traditions and expectations of any other science. Teaching and modifying class instruction should be a common practice, however
rarely are accurate and precise measures made which could be peer reviewed and replications conducted. Therefore instructional modifications, assessment creations, and curriculum development are not sciences unless they follow a rigorous scientific process, like AER. Participants in this workshop will receive a quick overview of AER standards and practices and then explore how to design and execute meaningful AER, if only for their own classrooms.