Leslie Atkins, Assistant Professor Science Education & Physics
California State University , Chico

Invited Talk
Inquiry As Argument: Debating Our Way Into Science
In this talk I will be presenting strategies and techniques for getting students debating scientific ideas in classrooms.  But scientific debates can be pretty unpredictable and often seem to work against the very ideas we hope students to learn.  For example, students might voice misconceptions, or misuse evidence; they can get out of hand, with heated arguments, or encourage students to challenge well-established scientific ideas.  What evidence do we have to suggest that these debates are actually worthwhile?  In this presentation, I will focus on the research on scientific discourse and debate: why it matters, what it looks like, and what we know about improving scientific debates in classrooms.

Interactive Workshop
Structuring Scientific Debates

Research continues to suggest that learning how to do science involves learning how to “talk science,” and one important way in which scientists talk is argument—posing different claims about how the world works and supporting and critiquing those claims with evidence, logic, representations and consistency.  This workshop will engage participants in a scientific debate, and then discuss ways to incorporate debate into your own instruction, from choosing questions to laying the ground rules, to incorporating argumentation into labs and lab write-ups.  This workshop will be decidedly “low tech” and should be easy to integrate into existing instruction.

Anita Bernhardt, Science & Technology Specialist
Maine Department of Education

Interactive Workshop
The Importance of Talk and Argument in the Science Classrooms
Greater instructional attention must be paid to talk and argument in the Science classroom.  The research base behind the recommendations related to talk and argument outlined in the National Academy of Sciences 2008 publication Ready, Set, Science! assists educators in understanding what it means to engage in talk and argument in science classrooms and describes why talk and argument are so essential to the practice of science. The session offers specific instructional strategies to support talk and argument. The research that supports the recommendations in Ready, Set, Science! are derived from grade K-8 research and contexts, however the recommendations and many of the strategies are applicable to classrooms across the K-12 continuum.

Patricia Bernhardt, Life Science Teacher
James F. Doughty Middle School , Bangor , Maine
Elizabeth Haynes, Mathematics Teacher
Troy Howard Middle School , Belfast , Maine

Tracy Vassiliev, Applied Science and Accelerated Physical Science Teacher,
Bangor Middle schools, Bangor Maine

Interactive Workshop
Wood Your Students Use Real Data?
This workshop will focus on wood, one of Maine ’s most important resources. The workshop will include a Wood Composite Activity that uses saw dust and flour.  Participants will predict and test the strength of different baked plank mixtures. The directions for making the planks and baking them will be provided as well.  Information for the uses of composites and the University of Maine ’s research with these materials will be provided.  Methods for testing the Antimicrobial Effects of Wood Extracts will be demonstrated. Wood extracts are relatively easy to make using a rice cooker. Teachers will be asked to predict which extract they think will have an antimicrobial effect on E. coli bacteria. Proper microbiology techniques and disposal concerns will be discussed and practiced. Sample Petri dishes will be available.  Tree cores will be collected, measured, and plotted on Data Studio. One of the goals of this workshop is to provide inquiry based activities with meaningful data that feature wood.  Development of these lessons was made possible by FBRI, Forest Bioproduct Research Initiative at the University of Maine .

Diane Ebert-May, Professor, Plant Biology
Michigan State University

Invited Talk
Breaking the Mold: rethinking professional development in K-16 STEM education
As the call to reform undergraduate science, technology, engineering, and mathematics (STEM) education accelerates nationally, we use ‘scientific teaching’ to describe active learning strategies and teaching methods that have been systematically tested and shown to reach diverse students. Emphasis on assessment assists us in determining not only if our students understand key principles, demonstrate basic scientific skills, interconnect ideas, and exercise critical thought, but also why students can do so or not. Intensive faculty development activities to achieve improvement in undergraduate science education have occurred in universities and colleges for nearly two decades. Our laboratory group is engaged in research driven by two questions:  (1) How has faculty teaching changed in response to professional development? and (2) Do levels of student learning and academic achievement also change significantly in response to the changes in instruction? We use design research methodologies and structural equation modeling to identify and analyze the variables that correlate with faculty and student change. In this seminar, we will examine the dimensions of pedagogical change that enable students to advance from rote learning toward higher-level thinking.

Interactive Workshop
Teaching for Understanding in Science: Active Learning and Assessment
The workshop is based on current research about K-16 science curriculum reform, how students learn, and how assessment improves student learning. Biology is the most complex, interdisciplinary field in science and requires learners to move across scales and systems to solve problems. A limiting factor in students’ preparation for learning biology or any science is the ability to connect concepts and processes. How do learners build cognitive networks and reasoning skills to understand complex systems? What tools facilitate complex system learning? How to we do this and how do we prepare future teachers to do this? We will use a genuine biological problem to (1) move from a teacher-centered to learner-centered classroom, (2) actively engage students in learning, (3) develop model-based assessments based on objectives that provide substantive data about student learning, and (4) analyze the data that should inform subsequent instruction.

Mary Madden, Associate Research Professor
University of Maine

Interactive Workshop
Inspiring Girls in the STEM fields: From Research to Practice.

Women remain under-represented in Science, Technology, Mathematics, and Engineering in colleges and workplaces.  So, how can educators inspire girls to explore and consider opportunities in STEM fields?  This session will present an overview of research-based practices for encouraging girls in STEM and facilitate discussion on how the research applies to informal and formal education settings in Maine .  Also, information about the Maine Girls’ Collaborative Project and how to apply for mini grants to support projects designed to introduce girls to the possibilities in STEM will be shared.

Carolyn Malstrom , Director of Curriculum for Biomedical Sciences
Project Lead The Way, Inc.

Invited Talk
Project Lead The Way® Curricular Programs Promote STEM achievement

Project Lead The Way® curricular programs are being implemented in over 3000 schools located in all 50 states. The Engineering program consists of eight high school courses and five middle school units. The Biomedical Sciences Program™, in the final stages of development, will consist of a sequence of four high school courses. The highly contextual, hands-on curriculum developed by Project Lead The Way, Inc. was cited in the 2007 National Academy of Sciences report Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future as the model for developing world-class standards-based curricula. Students enrolled in the engineering program scored higher on the NAEP-referenced High Schools That Work Assessments for reading, mathematics, and science than students enrolled in other CTE programs. Students enrolled a PLTW® curriculum program are significantly more likely to complete at least four college-preparatory mathematics courses and at least three college-preparatory laboratory-based science courses than their peers. In student surveys, students enrolled in a PLTW®curriculum program were significantly more likely to rate their high school experience as important in preparing them for the future. The presentation will provide an overview of the Engineering and Biomedical Sciences curricular programs and discuss how the courses in these programs promote student achievement in science, technology, engineering, and mathematics.

Interactive Workshop
Project Lead The Way® Biomedical Sciences™ Program—Hands-on Investigative Science

Working in pairs or small groups attendees will complete a variety of activities selected from the Project Lead The Way® Biomedical Sciences™ courses: Principles of the Biomedical Sciences™, Human Body Systems™, and Medical Interventions™. Multiple lab stations with different hands-on activities will be set-up for the session. Participants will be able to select several different activities to complete, and then discuss how the activities could engage and challenge their students. Participants have the opportunity to:

* Measure blood pressure, EKG, and lung capacity using Vernier® sensors and the LabVIEW™ computer program.
* Estimate the height of a person using measurements of leg bones.
* Examine visual perception, including color vision, depth perception, peripheral vision, and effects of astigmatism.
* Design and build a 3-D model of an enzyme’s active site.
* Plan a genetic engineering experiment using paper plasmids.
* Design and build a simple prosthetic hand and arm capable of picking up an empty cup.

W. Tad Johnston, Mathematics Teacher
William S. Cohen School , Bangor , Maine

Interactive Workshop
Guiding the discovery of y = mx + b, y = abx, and y = x2 + b
If the record of mathematics history is to be believed, much of what is called “algebra” was developed to model physical observations or solve “real” problems.  We can attempt to provide our students with scaffolded opportunities to invent some mathematics on their own and experience, in a small way, what it is like to work as mathematicians.

Participants will play (guided by lab sheets) with some physical activities and discuss others that can be modeled with linear, exponential, and quadratic equations. These situations will be analyzed in terms of rate of change, slope, y-intercepts with special attention to the link between physical context, graph, equation and tabular representation.  Suggestions for orchestration of classroom activity, formative assessment, summative assessment, and moving to formalism will be shared as well as some student work produced this year. It is hoped that participants will also share their experiences, discuss the balance between free exploration and proscribed procedures, and develop a set of guidelines for designing mathematical labs that promote student inquiry.

Edward Prather, Associate Research Scientist and Senior Lecturer
Director of the Center for Astronomy Education
University of Arizona

Keynote Address
An Astronomer Walks into a Buddhist Temple and Asks…..
During the Summer of 2007 I was fortunate to have been asked to travel to northern India to teach classes on topics in Physics and Astronomy to a group of Tibetan Buddhist Monks. For a month, I shared morning tea and meditation, ate all meals and lived with a cadre of Monks at the Dzongsar Institute for Advance Studies of Buddhist Philosophy and Research in a small Tibetan village located high in the foothills of the Himalayan mountains.  I have no doubt that this time with the Monks will stand out as one of the most personally and professionally profound experiences in my life.  I am honored to have the opportunity to share with you the beauty, compassion and incredible perspective on teaching and learning that this adventure into the unknown provided me.

Invited Talk
Are you really teaching if no one is learning?  Research on how interactive-lecturing can be used to improve student learning
Acknowledging that traditional lecture-based teaching methods are insufficient at promoting significant conceptual gains for students is only the first step toward being able to implement instructional strategies that will actually increase students’ understanding.  Researchers at the Center for Astronomy Education (CAE) at the University of Arizona have been developing and evaluating the effectiveness of learner-centered instructional materials that put students in an active role in the classroom.  We have designed and field-tested a suite of innovative instructional strategies intended for use with collaborative student learning groups that are designed specifically for easy integration into existing conventional lectures-based courses.  As such, these instructional materials directly address the needs of heavily loaded teachers in that they offer effective, learner-centered, classroom-ready activities that do not require any outside equipment/staffing or a drastic course revision for implementation.  Each activity uses a set of carefully sequence Socratic-dialogue questions or hierarchical tasks that are coupled with graphs, illustrations and data tables to force students to reason critically about conceptually challenging and commonly taught topics in physical science.  The materials are based on research into student beliefs and reasoning difficulties and make use of a conceptual change instructional framework that promotes the intellectual engagement of students. Our research into the effectiveness of these instructional strategies shows that traditional lectures alone produces unsatisfactory gains on student understanding; however, supplementing traditional instruction with the research-validated, learner-centered activities helps students make impressive conceptual gains over traditional instruction. A review of research, and an overview of instructional strategies, will be provided.

Interactive Workshop

Methods for Maximizing the Effectiveness of Interactive Lecturing
The NASA and NSF supported University of Arizona Center for Astronomy Education (CAE), provide workshops for both novice and experienced teachers which focus on how to best implement effective teaching strategies shown to improve student learning on fundamental topics in astronomy and space science.  While most instructors believe that lecture is not the best instructional approach for all their students, they are often unable to effectively implement pedagogically sound alternative instructional strategies that actually intellectually engage students and increase their learning.

The use of engaging questioning techniques in the classroom can produce a greater level of collaboration among your students and with you.  The interactions that occur when we challenge our students with appropriate, high-level, questions can significantly increase their learning beyond what is gained from lecture alone.  Participants in this workshop will gain first hand experience with designing questions and implementation of different questioning techniques (most notably think-pair-share).  In addition, we will focus on classroom teaching and learning scenarios critical to successful implementation of the directed inquiry, small-group collaborative teaching strategies known as Lecture-Tutorials, and Ranking-Tasks.

The NASA Center for Astronomy Education is funded by the NSF CCLI Phase III CATS Program, and the JPL Navigator Public Engagement Program

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Alice Putti, Chemistry Teacher
Jenison High School , Jenison, Michigan
Sarah Toman, Chemistry Teacher
Western Michigan Christian High School , Muskegon, Michigan

Invited Talk

How Learning Through Inquiry Changed Our Teaching Philosophy

Two teachers who completed the Target Inquiry Program at Grand Valley State University , Michigan will describe the program’s impact on their teaching philosophy.  The talk will focus on how playing the role of researcher, student, and teacher forced them to reevaluate how they approached teaching and learning. Evidence to support the change in their teaching philosophy will also be presented.

Interactive Workshop
How to Give Your Activities/Labs an Inquiry Make Over
Learn simple strategies that will turn your students into active learners.  These strategies can be used to convert any verification lab or activity into a more concept-rich, inquiry-based module.  Participants will have an opportunity to revise their own experiments as well as provided activities.  Participants should bring 1-2 experiments or activities they currently use in instruction.

Bill Zoellick, Program Development Director

Yvonne Davis, Education Program Coordinator
Acadia Partners for Science and Learning and Sarah Nelson, Senator George J. Mitchell Center for Environmental and Watershed Research

Interactive Workshop
Mercury in Maine watersheds, biota, and people: The Acadia Learning Project
Over the past two years Acadia Partners for Science and Learning, working in partnership with the University of Maine ’s Senator George J. Mitchell Center for Environmental and Watershed Research, has engaged more than a dozen schools, twenty teachers, and approximately 500 students in a project that uses a citizen science investigation as the basis for guided inquiry in science classes.  The project marries the need to collect data about accumulation of mercury, a potent neurotoxin, in living systems around Maine with the need to engage students in generating scientific questions and gathering empirical evidence that can be used to help answer those questions.  The project has begun to provide a new understanding of mercury levels in different organisms and locations around the state and a new understanding of how to couple “science as a service project” with higher level learning through inquiry.  Just as important, these first two years of work have established a foundation for continued study and implementation of useful educational practices.  This workshop will include a review of work to date, of lessons learned, suggestions for teachers interested in implementing authentic scientific inquiry, and future directions.