MSP

MATH AND SCIENCE PARTNERSHIP

Framing Effective Teaching in STEM

NSF

NATIONAL SCIENCE FOUNDATION

MSP LEARNING NETWORK CONFERENCE PROGRAM

RENAISSANCE WASHINGTON, D.C., HOTEL

JANUARY 23-24, 2012

We express our thanks and appreciation to the Conference Planning Committees

2012 MSP LNC Planning Committee

Planning Committee

Eric Banilower, Horizon Research, Inc.
Brian Drayton, TERC
Felicia Martin, Prince Georges County Public Schools Science Office
Patrick Morandi, New Mexico State University
Melissa Reeves, Tuskegee University
Kyrsis Rodriguez, Roxbury Community College
Kwang Suk Yoon, American Institutes for Research
Todd Ullah, Washington Preparatory High School, Los Angeles Unified School District
Donald Wink, University of Illinois at Chicago

Organizing Committee

Lance C. Pérez, University of Nebraska–Lincoln
Hannah Sevian, University of Massachusetts Boston
Wendy Smith, University of Nebraska–Lincoln
Ruth Heaton, University of Nebraska–Lincoln
Katherine Morrison, University of Nebraska–Lincoln

LNC Evaluation conducted by:
James Hammerman, TERC
Jonathan Christiansen, TERC

January 23, 2012

Dear Participant:

We at the National Science Foundation welcome you to the 2012 Math and Science Partnership (MSP) Learning Network Conference. Our theme for this year is Framing Effective Teaching in STEM. This theme focuses on teachers and teaching, certainly central elements in K-12 schools and institutions of higher education as well as one of the most important leverage points for MSP projects. Three related strands were developed to organize breakout sessions at the conference.

One strand focuses on coming to common definitions around effective teaching at K-12 and postsecondary levels. Nationally, there are very active scholarly and policy-focused discussions on this definition, with significant portions of the debate judging teacher effectiveness through the lens of student outcomes. This, then, has led to value-added notions being considered for the valuation of inservice teachers as well as for the evaluation of the teacher preparation programs that develop preservice teachers. In this year's conference, we encourage you to be clear about such definitions within the context of your MSP work. After you have a definition, the conference's second strand asks you to consider the efforts of your partnership to prepare and support teachers and faculty to teach effectively. What strategies are you using at both K-12 and postsecondary levels, and what are the intellectual bases for these strategies? Finally, the conference's third strand asks MSP projects to defend their approaches towards effective STEM teaching through demonstrations of evidence. Connecting the dots between partnership-developed interventions, influences on teachers who grow in their content and pedagogical knowledge, and effective teaching is not an easy task. It is only through continual reflection on all aspects of this work – definition, intellectual bases for the work and research designs – that MSP projects will be able to contribute to the national dialogue on what is effective teaching. I urge you all to engage in this important conversation during and after this year's Learning Network Conference, including broadening the discussion to include your entire partnership through the virtual poster hall that will commence in a few weeks.

We thank the members of the 2012 Conference Planning Committee and the LNC Organizing Committee, including colleagues at the University of Nebraska–Lincoln and the University of Massachusetts Boston, who have assisted us in organizing and focusing this meeting. Our appreciation goes to the Conference speakers; MSP project team members who have graciously agreed to share their work at this meeting; and our colleagues at the U. S. Department of Education who, with their state MSP efforts, broaden our collective work. Most importantly, we thank you for your participation. Your expertise and investment of time, your leadership in your projects, and your willingness to share what you are learning continue to be critical to advancing our effort to improve STEM teaching and learning for the Nation's students.

Have a great meeting!

James E. Hamos

James E. Hamos
MSP Team Leader
Math and Science Partnership

2012 Math and Science Partnership (MSP) Learning Network Conference
Framing Effective Teaching in STEM

January 23-24, 2012
Renaissance Washington, D.C., Hotel
999 Ninth Street NW, Washington, D.C.

GOALS

1. To learn more about effective STEM teaching: What are ways of defining and theorizing it? What are ways of measuring it? What are supports that work to improve STEM teaching?
2. To network: What can we learn from each other? How can we benefit from each other's expertise and what we are learning?
3. To continue learning: What new ideas can you take from this conference and put to use in your MSP work when you return home? What ways will you continue to work with others you meet at the LNC?

Sunday, January 22, 2012

1:30 p.m. - 6:30 p.m.	**Registration and Poster Setup**	Grand Ballroom Foyer
2 p.m. - 6 p.m.	**Pre-Conference Meeting** Orientation Session for New Projects *Louis J. Everett*, Program Director, NSF *Ron Buckmire*, Program Director, NSF	Congressional A

Monday, January 23, 2012

7:30 a.m. - 8:30 a.m.	**Registration and Poster Setup**	Grand Ballroom Foyer
8:30 a.m. - 8:45 a.m.	**Welcome** James E. Hamos, MSP Program Lead, NSF Katherine J. Denniston, Acting Division Director, Division of Undergraduate Education, NSF	Grand Ballroom
8:45 a.m. - 9:45 a.m.	**Keynote Speaker** "STEM Teaching in the Age of the Common Core: Promises and Paradoxes" *Suzanne Wilson*, University Distinguished Professor and Chair, Department of Teacher Education, Michigan State University Introduction: *Ruth Heaton*, Professor of Teaching, Learning and Teacher Education, University of Nebraska–Lincoln	Grand Ballroom
9:45 a.m. - 10 a.m.	**Morning Break, Refreshments and Transition to Coffee House Activity** *Hannah M. Sevian*, Associate Professor of Chemistry, University of Massachusetts Boston	Grand Ballroom Foyer and Meeting Room Level Hallway

10 a.m. - 11 a.m.	**Coffee House Activity**	Check Your Name Badge for Room
11 a.m. - 11:10 a.m.	**Transition to Paper Session 1**	
11:10 a.m. - 12:45 p.m.	**Paper Session 1**	See Schedule for Breakout Rooms
12:45 p.m. - 2 p.m.	**Keynote Speaker and Working Lunch** "Transforming Learning for Science, Technology, Education and Mathematics: An NSF Perspective" *Cora Marrett*, Deputy Director, NSF Introduction: *James E. Hamos*, MSP Program Lead, NSF	Grand Ballroom
2 p.m. - 2:15 p.m.	**Transition to Exploring Dilemmas Activity**	
2:15 p.m. - 3:15 p.m.	**Exploring Dilemmas of Effective STEM Teaching Part I**	Check Your Name Badge for Room
3:15 p.m. - 3:30 p.m.	**Afternoon Break, Refreshments**	Grand Ballroom Foyer and Meeting Room Level Hallway
3:30 a.m. - 4:30 p.m.	**Keynote Speaker** "Taking the Subject Seriously in STEM Professional Learning Communities and Teacher Induction" *Edward (Ted) Britton*, Associate Director, Senior Researcher and Evaluator, STEM Program, WestEd Introduction: *Elizabeth VanderPutten*, Program Director, NSF	Grand Ballroom
4:30 p.m. - 5 p.m.	**Transition to Meet as Project Teams to Reflect on Learning** *Wendy M. Smith*, Research Assistant Professor, Center for Science, Mathematics & Computer Education, University of Nebraska–Lincoln	Meet in Grand Ballroom or Other Locations
5 p.m. - 6 p.m.	**Plenary Session** "Innovation and Reform Initiatives from the U.S. Department of Education" *Patricia O'Connell Johnson*, Team Leader for the Mathematics and Science Partnership program, U.S. Department of Education *James H. Shelton III*, Assistant Deputy Secretary for Innovation and Improvement, U.S. Department of Education *Ann Whalen*, Director, Program and Policy Implementation in the Implementation and Support Unit, Office of the Deputy Secretary, U.S. Department of Education Introduction: *Kathleen B. Bergin*, Program Director, NSF	Grand Ballroom
6 p.m. - 7:30 p.m.	**Exploring Dilemmas of Effective STEM Teaching Part II and Working Dinner**	South Ballroom

8 a.m. - 9 a.m.	**Special Interest Groups**	See Summary of SIGs on Pages 34-35
9 a.m. - 9:10 a.m.	**Introduction to Fishbowls and Transition to Activity** *Lance C. Pérez*, Professor of Electrical Engineering, University of Nebraska–Lincoln	Grand Ballroom
9:10 a.m. - 10:10 a.m.	**Fishbowl Activity**	Check Your Name Badge for Room
10:10 a.m. - 10:25 a.m.	**Morning Break, Refreshments and Transition to Paper Session 2**	Grand Ballroom Foyer and Meeting Room Level Hallway
10:25 a.m. - Noon	**Paper Session 2**	See Schedule for Breakout Rooms
Noon - 12:10 p.m.	**Afternoon Break and Transition to Final Reflection**	Grand Ballroom Foyer and Meeting Room Level Hallway
12:10 p.m. - 12:45 p.m.	**Final Reflection Activity with Project Teams** *Hannah M. Sevian*, Associate Professor of Chemistry, University of Massachusetts Boston	Meet in Grand Ballroom or Other Locations
12:45 p.m. - 2 p.m.	**Keynote Speaker and Working Lunch** "Future Directions in NSF's Directorate for Education and Human Resources" *Joan Ferrini-Mundy*, Assistant Director, Directorate for Education and Human Resources, NSF Introduction: *James E. Hamos*, MSP Program Lead, NSF	Grand Ballroom
2 p.m. - 2:15 p.m.	**Future Directions for MSP** *James E. Hamos*, MSP Program Lead, NSF	Grand Ballroom

The conference evaluation survey will be conducted online. To access it, please log-in at: https://surveys.terc.edu/NoviSurvey/n/LNCEvaluation.aspx

2012 Math and Science Partnership (MSP) Learning Network Conference
Framing Effective Teaching in STEM

Goals of the Conference

1. To learn more about effective STEM teaching: What are ways of defining and theorizing it? What are ways of measuring it? What are supports that work to improve STEM teaching?
2. To network: What can we learn from each other? How can we benefit from each other's expertise and what we are learning?
3. To continue learning: What new ideas can you take from this conference and put to use in your MSP work when you return home? What ways will you continue to work with others you meet at the LNC?

Conference Strands

1. How do we define effective STEM teaching in preK-12 and post-secondary education?
2. How do we prepare and support teachers and faculty to teach effectively?
3. How do we know we are making progress toward more effective STEM teaching?

In order to think about "effective teaching in STEM," we offer this description of teaching as a way to initiate some conversation and reflection:

> *Teaching is what teachers do, say, and think with learners, concerning content, in a particular organization of instruction, in environments, over time. What we often mistakenly refer to as the practice of teaching is a collection of practices, including pedagogy, learning, instructional design, and managing instructional organization. (Cohen, Raudenbush, & Ball, 2002, p. 90)*

Theme: Framing Effective Teaching in STEM

Effective STEM teaching is necessarily viewed from multiple perspectives, including those of different stakeholders (students, instructors, administrators, policymakers) as well as the different views on how to implement and interpret teaching (e.g., different learning theories, prioritizing different aspects such as pedagogical content knowledge vs. pedagogy vs. application of content knowledge). There is a need to articulate how different perspectives construe and contribute to understanding what effective teaching is in different disciplines.

Additionally, achieving effective STEM teaching, at all different levels (pre-K, elementary school, middle school, high school, undergraduate, graduate school), and in different contexts and communities, is an ongoing evolutionary journey of improvement rather than a fixed destination at which one can arrive (and remain). Thus, research examining effective STEM teaching necessarily evolves to push the boundaries of the field's knowledge.

While teaching and learning are inextricably connected, the focus of this year's LNC is on effective teaching in STEM, with the understanding that teaching cannot be effective if it is not connected to learning. STEM teaching is much broader than classroom practices, as interactions among teachers, learners, and content are situated in theories of teaching and learning, as well as multiple environments that impact effective STEM teaching.

One way to characterize the different influences on STEM teaching is to use a logic model, breaking it down into conditions, activities, and outcomes. The conditions are what make effective STEM teaching possible, and include, but are not limited to: coherence among the various components of the education system (or sub-systems); common or differing visions and values among stakeholders; theories of teaching and learning;

productivity of relationships among stakeholders in teaching and learning; student, teacher, and school account-ability and responsibility; cross-disciplinary connections; curricula and standards; school culture and leadership; and ongoing, effective professional development.

The activities of STEM teaching include: the craft of teaching; processes of teacher preparation, community building, systems thinking, flexibility; and changing the culture of teaching and learning. While the primary desired outcome of STEM teaching is student success in STEM learning, there are many other outcomes of interest as well, including: interest in and aspirations to further study and pursue careers involving STEM disciplines; value for STEM; ability to use and adapt understanding of STEM content in interpreting information and making decisions in daily life; transfer of STEM content and reasoning to other academic disciplines; understanding the origins of learners' misconceptions; assessing/diagnosing student difficulties/challenges in order to intervene strategically in fostering learning; and preparation for and success in post-secondary STEM.

Strand 1:
How do we define effective STEM teaching?

Abstracts submitted to this strand should carefully specify your MSP project's definition of effective STEM teaching, as well as how you document teaching for the purpose of determining effectiveness. Abstracts should include your MSP's theory of action, theory of leadership, and/or theory of learning/instruction related to effective STEM teaching. Abstracts may address how schools or school districts recognize effective STEM teaching, or what effective STEM teaching looks like at the post-secondary level. How has your MSP's definition of effective STEM teaching evolved since you first wrote your proposal?

Strand 2:
How do we prepare and support STEM teachers and faculty to teach effectively?

Abstracts submitted to this strand should first include your MSP project's definition of effective STEM teaching. Abstracts should address how effective STEM teaching should be supported, especially at the system level, at either preK-12 or post-secondary education levels. Abstracts should also address the strategies, resources and policies needed to support effective STEM teaching, and the implications for teacher and faculty preparation, recruitment, retention, professional development, compensation and evaluation. What has your MSP learned about preparing for and supporting effective STEM teaching that you did not know when you wrote your proposal?

Strand 3:
How do we know we are making progress toward more effective STEM teaching?

Abstracts submitted to this strand should first include your MSP project's definition of effective STEM teaching. Abstracts should describe how your MSP gathers and analyzes evidence of effective STEM teaching. What types of evidence inform progress toward more effective STEM teaching? How can and does your MSP assess progress toward more effective STEM teaching? What is the intersection between K-16 student success and effective STEM teaching? What does your MSP know now about measuring progress toward more effective STEM teaching that you did not know at the time you wrote your proposal?

Speakers' Biographies
(alphabetical order)

Edward (Ted) Britton
Associate Director, Senior Researcher and Evaluator, STEM Program, WestEd

Dr. Edward Britton is an Associate Director, Senior Researcher and Evaluator in the STEM Program at WestEd. Dr. Britton has been Principal Investigator of several major research projects, including an international study of new ways to address the subject-specific needs of beginning mathematics and science teachers. With the National Commission on Teaching and America's Future, he recently completed a knowledge synthesis about professional learning communities involving STEM teachers. His earlier research includes helping design international procedures for analyzing curriculum materials during the Third International Mathematics and Science Study (TIMSS). As Project Manager for Mary Budd Rowe of the University of Florida during the 1980s, Britton developed the first CD-ROM in science education and produced videotapes for the professional development of science teachers. During the late 1970s, he taught all the science courses for grades 7–12 at a rural junior-senior high school in Florida. Britton has authored or edited almost 20 books, reports, and curriculum products and has written more than 40 articles and papers. He received a B.S. in chemistry and education, an M.S. in analytical chemistry, and an Ed.D. in science education from the University of Florida.

Katherine J. Denniston
Acting Division Director, Division of Undergraduate Education, National Science Foundation

Dr. Katherine Denniston is acting Division Director of the Division of Undergraduate Education (DUE) at the National Science Foundation. Her early research career included positions as a post-doctoral fellow in the Department of Genetics at the University of Wisconsin–Madison, as a Senior Staff Fellow at the National Cancer Institute and as a Research Assistant Professor in the Division of Molecular Virology and Immunology of Georgetown University. In 1985, Dr. Denniston joined the faculty of Towson University, holding a variety of positions over the years. She was Professor of Biological Sciences and for many years held the position of Director of the Center for Science and Mathematics Education. In that position she ran a variety of programs including the Maryland Collaborative for Teacher Preparation II, the Maryland Educators' Summer Research Program, and the Maryland Governor's Academy for Science and Mathematics Teachers. Denniston and co-authors Robert Caret and Joseph Topping have published a chemistry text for allied health majors, beginning in 1989. This text, General, Organic, and Biochemistry, is in its seventh edition. In 1999, Denniston became the Associate Dean of the Fisher College of Science and Mathematics and in 2008 was appointed Associate Provost of the university. She spent the 2002-2004 academic years as a program officer in DUE at NSF and returned to DUE as Deputy Division Director in 2010, prior to her current role as the Acting Division Director. Dr. Denniston received a B.A. in Biology from Mansfield University and a Ph.D. in Microbiology from The Pennsylvania State University.

Joan Ferrini-Mundy
Assistant Director, Directorate for Education and Human Resources,
National Science Foundation

Dr. Joan Ferrini-Mundy is Assistant Director of the Directorate for Education and Human Resources at the National Science Foundation, a position she has held since February 2011, in which she is responsible for management of this directorate. She serves as a member of the NSF senior management team and is involved in strategic planning and leadership for the scientific and education mission of the NSF. Prior to her appointment as assistant director, she had served the Foundation in a number of management capacities since 2007. In connection with her agency-wide responsibilities, Dr. Ferrini-Mundy serves as NSF's science, technology, engineering, and mathematics (STEM) workforce development goal leader for the Office of Management and Budget's Priority Goal Initiative. From 2007 through January 2010, she was a member of the National Science and Technology Council's (NSTC) Subcommittee on Education, and currently serves on two task forces of the NSTC Committee on STEM Education. She is currently a member of the Mathematics Expert Group of the Programme for International Student Assessment (PISA) commissioned by the Organisation for Economic Cooperation and Development (OECD), and in 2007-2008, representing NSF, she served as an ex officio member of the President's National Mathematics Advisory Panel, and co-chaired its Instructional Practices Task Group. Dr. Ferrini-Mundy holds an appointment at Michigan State University (MSU) as a University Distinguished Professor of Mathematics Education in the Departments of Mathematics and Teacher Education. Her research interests include calculus teaching and learning, mathematics teacher learning, and mathematics and science education policy at the K-12 level. Dr. Ferrini-Mundy received a Ph.D. in mathematics education from the University of New Hampshire.

Patricia O'Connell Johnson
Team Leader, Mathematics and Science Partnership Program, U.S. Department of Education

Patricia Johnson is the Team Leader for the Mathematics and Science Partnership program, U.S. Department of Education. In 17 years of Federal service, she also has managed the Javits Gifted and Talented Students program, the Eisenhower Math and Science National programs, and the Fund for the Improvement of Education. Before joining the Department of Education, she served as: associate director of Project 2061, a part of the American Association for the Advancement of Science (AAAS); director of academic programs with the Center for Talented Youth at Johns Hopkins University, which serves more than 5,000 students in programs around the world; and as an education specialist with the Maine Department of Education. She received her undergraduate degree in anthropology from Beloit College, a Master of Arts in Teaching in museum education from George Washington University, and a Master of Education degree in education policy from Harvard University.

Cora Marrett
Deputy Director of the National Science Foundation

Dr. Cora B. Marrett is Deputy Director of the National Science Foundation. Since January 2009, she has served as NSF's acting Director, acting Deputy Director, and Senior Advisor, until her confirmation as Deputy Director in May 2011. Before her appointment as acting Director, Dr. Marrett was the Assistant Director for Education and Human Resources (EHR). In EHR, she led NSF's mission to achieve excellence in U.S. science, technology, engineering, and mathematics (STEM) education at all levels, in both formal and informal settings. From 1992 to 1996, she served as the first Assistant Director for the Social, Behavioral, and Economic Sciences (SBE) directorate. Dr. Marrett earned NSF's Distinguished Service Award for her groundbreaking leadership of the new directorate. From 2001 to 2007, Dr. Marrett was the University of Wisconsin System's Senior Vice President for Academic Affairs. She also served concurrently as Professor of Sociology at the University of Wisconsin–Madison. Before joining the University of Wisconsin, she was the Senior Vice Chancellor for Academic Affairs and Provost at the University of Massachusetts Amherst. Dr. Marrett holds a Bachelor of Arts from Virginia Union University, as well as a Master of Arts and a doctorate from the University of Wisconsin–Madison, all in Sociology. She received an honorary doctorate from Wake Forest University in 1996, and was elected a fellow of the American Academy of Arts and Sciences in 1998 and the American Association for the Advancement of Science in 1996. In May 2011, Virginia Union University awarded Dr. Marrett an honorary degree as a distinguished alumna.

James H. Shelton III
Assistant Deputy Secretary for Innovation and Improvement,
U.S. Department of Education

James Shelton is the Assistant Deputy Secretary for Innovation and Improvement at the United States Department of Education, managing a portfolio that includes most of the Department's competitive teacher quality, school choice and learning technology programs, housed in the Office of Innovation and Improvement. Previously, he served as a program director for the education division of the Bill & Melinda Gates Foundation, managing the foundation's national programs and work in the northeast region of the United States. Shelton has also been a partner and the East Coast lead for NewSchools Venture Fund and co-founded LearnNow, a school management company that later was acquired by Edison Schools. He spent over four years as a senior management consultant with McKinsey & Company in Atlanta, Ga., where he advised CEOs and other executives on issues related to corporate strategy, business development, organizational design, and operational effectiveness. Upon leaving McKinsey, he joined Knowledge Universe, Inc., where he launched, acquired and operated education-related businesses. Shelton holds a bachelor's degree in computer science from Atlanta's Morehouse College as well as master's degrees in business administration and education from Stanford University.

Ann Whalen
Director; Program and Policy Implementation in the Implementation and Support Unit in the Office of the Deputy Secretary, U.S. Department of Education

Ann Whalen serves as the Director of Program and Policy Implementation in the Implementation and Support Unit in the Office of the Deputy Secretary for the United States Department of Education. As Director, Ann manages a team of Program Officers to serve as the single point of contact at the Department of Education for an over $50 billion portfolio of formula and discretionary grant programs consisting of the State Fiscal Stabilization Fund, the Race to the Top State program, the Race to the Top Assessment program, and the Education Jobs Fund. Prior to her work in the Implementation and Support Unit, Ann was a Special Advisor to the Secretary of Education, working across offices within the Department to develop and implement policy, regulations, guidance and programs including: School Improvement Grants, State Fiscal Stabilization Fund, Teacher Incentive Fund, and Race to the Top Assessment. Ann came to the U.S. Department of Education with Secretary Duncan from Chicago Public Schools (CPS) where she most recently served as Deputy to the Chief Education Officer and focused on the development and implementation of curriculum and instruction strategies, as well as district level polices and guidelines since 2006. From 2003 to 2006, Whalen served as Deputy Director of Special Initiatives for the CEO of CPS, working on the development and implementation of system-wide policies, assessments and professional development. Prior to her time at CPS, Whalen worked as a Project Administrator for the Department of Planning and Development for the City of Chicago, where she coordinated with community groups, developers, City officials, and other City agencies in anticipating and meeting the development needs of neighborhoods on the City's south side. Whalen has also worked as a Research Assistant for the Consortium for Research on Information Security and Policy (CRISP) at the Center for International Security and Cooperation at Stanford University where she received her B.A. in Political Science.

Suzanne Wilson
University Distinguished Professor at Michigan State University

Dr. Suzanne M. Wilson is a University Distinguished Professor at Michigan State University (MSU), where she currently serves as Chair and Professor in the Department of Teacher Education. Prior to joining the faculty at MSU, Wilson was the first director of the Teacher Assessment Project, which developed prototype assessments for the National Board for Professional Teaching Standards. Dr. Wilson served as a Commissioner on the Carnegie Commission on Mathematics and Science Education (2007-09), chaired the teacher quality subgroup, National Research Council/National Academy of Education Ed in '08 White Paper Project (2008-09), and has also served on several National Research Council committees, including the Teacher Preparation Study (2005-2009), Review and Assessment of the Health and Productivity Benefits of Green Schools (2005-06), and the Board on Science Education (2011-present). Dr. Wilson has written on teacher knowledge, curriculum reform, educational policy, and teacher learning. Her current work concerns documenting what teachers learn in innovative induction and professional development programs housed in museums; exploring various measures of teaching and teachers' understanding that might be used for teacher education and education research; and understanding the contemporary and jurisdictional battles over who should control teacher education and licensure. She is author of California Dreaming: Reforming Mathematics Education (Yale, 2003), and editor of Lee Shulman's collection of essays, Wisdom of practice: Essays on teaching, learning, and learning to teach (Jossey-Bass, 2004). Dr. Wilson is also a committed teacher, having taught undergraduate, MA, and doctoral classes in educational policy, teacher learning, and research methods. Her undergraduate degree is in History and American Studies from Brown University; she also has a M.S. in Statistics and a Ph.D. in Education from Stanford University.

Paper Session 1

Monday, January 23, 2012
11:10 a.m. - 12:45 p.m.
Summaries on Pages 16-18, Abstracts on Flash Drives

Breakout Room 2:   **Discussant: Louis J. Everett**

Defining Effective Mathematics Teachers: How Can Professional Development Promote Evidence-Based Definitions?	*The Role of Vocabulary in "Inquiry" Science Instruction for English Language Learners*
Zenaida Aguirre-Munoz　　　　Strand: 1 WT Middle School Math Partnership	**Andrew Elby**　　　　Strand: 1 Minority Student Pipeline MSP

Breakout Room 3:   **Discussant: Melissa Reeves**

Infusing Issues in Sustainability Science Across the Curriculum to Motivate Improved Teaching and Learning in STEM	*Bridging Research and Knowledge to Application in an Effort to Improve and Refine Strategic Goals, Program Implementation, and Evaluation Methods*
Stephen Madigosky　　　　Strand: 1 ES(2)	**Nisaa Kirtman**　　　　Strand: 1 Project MAST

Breakout Room 4:   **Discussant: Richard W. Peterson**

Refining Learning Progressions in Astronomy and Plate Tectonics in the Middle Grades	*Assessing the Impact of Cross-Cutting Science Concepts on Teacher Effectiveness in the 3-8 Classroom*
Scott McDonald　　　　Strand: 1 Middle Grades Earth and Space Science Education Partnership	**Abigail Levy**　　　　Strand: 3 Boston Energy in Science Teaching (BEST)

Breakout Room 5:   **Discussant: Lance C. Pérez**

Development and Implementation of a Year-long High School Engineering Course	*Promoting Effective Elementary STEM Teaching through Engineering Design in Grades 3 through 6* **Brenda Capobianco**　　　　Strand: 2
David Allen　　　　Strand: 2 UTeachEngineering	Science Learning through Engineering Design (SLED)

Breakout Room 6:   **Discussant: Felicia Martin**

Several Models of Preparing and Supporting STEM Faculty to Teach Effectively	*How Can STEM Faculty Become Effective in the Advanced Training of Teachers?*
Joan Karp　　　　Strand: 2 Boston Science Partnership	**Erin Militzer**　　　　Strand: 2 Arizona Teacher Institute

Paper Session 1

Monday, January 23, 2012
11:10 a.m. - 12:45 p.m.
Summaries on Pages 18-20, Abstracts on Flash Drives

Breakout Room 7:   **Discussant: Wendy Smith**

Supporting Inservice K-8 Mathematics Teachers: The Vermont Mathematics Partnership's Frameworks for Strengthening Content Knowledge
Douglas Harris   Strand: 2
Vermont Mathematics Partnership

Evolution of a Partnership Engagement Project in the Appalachian Mathematics and Science Partnership:Lessons Learned
David Royster   Strand: 2
Appalachian MSP

Breakout Room 8:   **Discussant: Todd Ullah**

Teacher Motivation in Professional Development - Results from a National Sample
Stuart Karabenick   Strand: 2
Motivation Assessment Program II (MSP-MAP II) Teacher Motivation in Professional Development

MOSART: Examining SMK and PCK with Modern Psychometric Analysis

Philip Sadler   Strand: 2
MOSART-LS

Breakout Room 9:   **Discussant: Elizabeth VanderPutten**

STEM Teaching Effectiveness: A Synthesis of Perspectives

James Madden   Strand: 2
Louisiana Math and Science Teacher Institute

Using Teacher Assignments to Measure the Rigor and Relevance of Middle School Mathematics Instruction
Jamie Shkolnik   Strand: 3
Impact of MSP Professional Development on the Quality of Instruction in Middle-School Mathematics Classrooms

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Breakout Room 10:   **Discussant: Brian Drayton**

Feedback for Improving Teaching and Learning

Cathy Kinzer   Strand: 2
Mathematically Connected Communities - Leadership Institute for Teachers

Task Analysis: A Process of Documenting Task-Level PCK

Frieda Parker   Strand: 2
Math TLC

Breakout Room 11:   **Discussant: James E. Hamos**

Collaborative Development of Biology and Geology Content Courses for Future Elementary and Inservice Teachers
George Nelson   Strand: 2
NCOSP

Development and Implementation of Learning Progression-based Teaching Strategies (LPTSs) for Environmental Science
Alan Berkowitz   Strand: 2
Culturally Relevant Ecology, Learning Progressions and Environmental Literacy (LTER)

Paper Session 1

Monday, January 23, 2012
11:10 a.m. - 12:45 p.m.
Summaries on Pages 21-23, Abstracts on Flash Drives

Breakout Room 12:   **Discussant: Kathleen B. Bergin**

Supporting Inquiry-rich Teaching through Professional Development within a District-Higher Education Partnership
Joshua Caulkins   Strand: 2
RITES

"Equity Practices" for Teaching and Student Learning: How to Go Below the Surface of the Words
Thomas Philip   Strand: 2
MOBILIZE: Mobilizing for Innovative Computer Science Teaching and Learning

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Breakout Room 13:   **Discussant: Joan T. Prival**

NebraskaMATH: Getting it Right from the Start: Supporting Effective Instruction in the Primary Grades
Michelle Homp   Strand: 2
NebraskaMATH

A Decade-Long Effort to Improve the Teaching of K-12 Mathematics in Rapid City, South Dakota

Ben Sayler   Strand: 3
PRIME

Breakout Room 14:   **Discussant: Pamela Brown**

Learning Together: A User-Friendly Tool to Support Research on STEM Education Interventions Research
Joan Pasley   Strand: 3
Knowledge Management and Dissemination

Data Connections: Methodology for Developing Student Achievement Trajectories to Estimate Teaching Effectiveness
Jennifer Green   Strand: 3
Data Connections

Breakout Room 15:   **Discussant: Ron Buckmire**

Conceptually-rich Mathematics Coaching: Will Mathematics Specialists Put Into Practice What They Have Learned?
Aimee Ellington   Strand: 3
Preparing Virginia's Mathematics Specialist

Effective Teaching in Middle School Mathematics

John Mayer   Strand: 3
Greater Birmingham Mathematics Partnership

Breakout Room 16:   **Discussant: Lee L. Zia**

Qualitative Analysis of Changes in Teachers' Knowledge, Beliefs and Classroom Practices Based on Three Years of Professional Development
Carol Baldassari   Strand: 3
Focus on Mathematics

Evidence of Enhanced Teaching in Student Content Knowledge Gains: Missouri's A TIME for Physics First MSP
Keith Murray   Strand: 3
A TIME for Physics First in Missouri

Paper Session 1 – Summaries

Breakout Room 2:

Defining Effective Mathematics Teachers: How Can Professional Development Promote Evidence-Based Definitions?

Zenaida Aguirre-Munoz, WT Middle School Math Partnership, Strand: 1

SUMMARY: The theoretical model that underlies the West Texas Middle School Math Partnership addresses: (1) conceptual understanding of the math taught in middle school, (2) knowledge for teaching math; (3) teaching self-efficacy; and (4) culturally and linguistically sensitive instruction. Thus, effective teaching in mathematics from this perspective involves a focus on conceptual understanding utilizing instructional practices that address students' cultural and linguistic needs as well as interaction patterns that promote positive student self-efficacy of mathematics content learning. Evidence in support of the theory of action was found. Teachers' conceptual mathematical knowledge, content knowledge for teaching, and self-efficacy has grown consistently. Improvements in culturally and linguistically sensitive instruction have lagged behind. Implications are discussed and lessons learned are presented.

The Role of Vocabulary in "Inquiry" Science Instruction for English Language Learners

Andrew Elby, Minority Student Pipeline MSP, Strand: 1

SUMMARY: Researchers disagree about how best to introduce vocabulary to English language learners (ELLs) to facilitate inquiry discussions. Some advocate frontloading vocabulary, so that ELLs can express themselves more easily. Others advocate letting ELLs begin discussions using whatever words they have available, and introducing vocabulary responsively, when students request it to express an idea. The data underlying this debate, however, has mostly been teacher reflections and field notes, not videotaped classroom episodes subjected to fine-grained analysis. Our videotaped examples of ELLs engaging in inquiry suggest the ELLs can engage productively in inquiry without frontloaded vocabulary. In fact, frontloading vocabulary can have the unintended side effect of reinforcing students' framing of science as words to learn rather than ideas to hash out.

Breakout Room 3:

Infusing Issues in Sustainability Science Across the Curriculum to Motivate Improved Teaching and Learning in STEM

Stephen Madigosky, ES(2), Strand: 1

SUMMARY: Improving science education is essential to improving global human sustainability. Sustainability Science, which spans the interface of natural and social systems, provides creative new methods for analyzing human Earth ecosystems and engineering a 21st Century green economy. Our theory of action extends these approaches into the domains of STEM education. Our project will create a multi-school district network of professional learning communities (semi-formally organized in a multi-university matrix of course offerings, certificates, and a master's degree in Sustainability Science Education) that will design and implement new and innovative curricula that infuses project-based sustainability issues into STEM courses across the curriculum. We suggest that these infusions will cause students to learn because learning is driven by motivation to learn and sustainability is relevant, engaging, interdisciplinary, and brings a novel approach to learning in STEM.

Bridging Research and Knowledge to Application in an Effort to Improve and Refine Strategic Goals, Program Implementation, and Evaluation Methods

Nisaa Kirtman, Project MAST, Strand: 1

SUMMARY: The Mississippi Academy for Science Teaching (Project MAST) is a professional development program intended to provide high school science teachers with the content and pedagogy necessary to teach the state's physical science standards. Halfway through the project, MAST staff and evaluators revisited their original strategic plan; an activity termed the Teacher Effectiveness Action White Paper Project. The TEAWPP defines what MAST is, based on the strongest alignment between the proposed theory of action, the professional development literature, and empirical evidence of the program's implementation and outcomes. Locating the program within the larger literature base helped illustrate the critical components of MAST that lead to better teaching. The TEAWPP protocol can serve as an evaluation model and help inspire program revisions.

Paper Session 1 – Summaries

Breakout Room 4:

Refining Learning Progressions in Astronomy and Plate Tectonics in the Middle Grades

Scott McDonald, Middle Grades Earth and Space Science Education Partnership, Strand: 1

SUMMARY: The Middle Grades Earth and Space Science Partnership defines effective STEM teaching in terms of three criteria: 1) it targets big ideas in science, not topics; 2) it is organized around a coherent content storyline; and 3) it engages students to develop understandings of both science content and the practices of science. As part of the project's effort to define effective teaching we are developing learning progressions in Astronomy, Plate Tectonics, Climate and Energy. Learning progressions are "empirically grounded and testable hypotheses about how students' understanding of, and ability to use, core scientific concepts and explanations and related scientific practices grow and become more sophisticated over time, with appropriate instruction." We are in year two of our project.

Assessing the Impact of Cross-Cutting Science Concepts on Teacher Effectiveness in the 3-8 Classroom

Abigail Levy, Boston Energy in Science Teaching (BEST), Strand: 3

SUMMARY: The Boston Energy in Science Teaching (BEST) project is researching the impact that concept-based professional development (PD) has on teacher effectiveness compared to the discipline-based PD that was offered through the Boston Science Partnership (BSP). We have recruited grade 3-8 teachers who participated in BEST PD, BSP PD, and both. We will analyze data collected through teacher interviews and surveys, energy assessments for teachers and students, and classroom observations. We will compare data across groups to determine if there are differences in instruction and student achievement that correlate with the PD that teachers participated in. We therefore will be able to say if helping teachers make connections across science disciplines via concept-based PD results in more efficient and effective instruction.

Breakout Room 5:

Development and Implementation of a Year-long High School Engineering Course

David Allen, UTeachEngineering**,** Strand: 2

SUMMARY: The UTeachEngineering Program has developed a year-long high school Engineering Design and Problem Solving course that can be used to satisfy part of the science requirement for students graduating from high schools in Texas. The course is now in its second year of pilot testing in a diverse group of high schools. This session will describe the curriculum, the development and testing of the curriculum, and the professional development provided to teachers delivering the curriculum. Plans for continued modifications and dissemination of the curriculum will also be described.

Promoting Effective Elementary STEM Teaching through Engineering Design in Grades 3 through 6

Brenda Capobianco, Science Learning through Engineering Design (SLED)**,** Strand: 2

SUMMARY: The Science Learning through Engineering Design (SLED) Partnership is a new targeted project aimed at improving student learning of science and math at the elementary/intermediate school level through the integration of engineering design-based activities. The SLED project seeks to develop a framework for effective STEM teaching through engineering design to support educational change and innovation among 200 inservice and 100 preservice teachers and 5,000 students over five years. Progress to date has focused on creating the SLED community through shared information on instructional and curricular issues, development and implementation of content-rich design tasks, professional development for inservice teachers, creation of a design-based methods course for preservice teachers, and preliminary interactions within/across the community.

Paper Session 1 – Summaries

Breakout Room 6:

Several Models of Preparing and Supporting STEM Faculty to Teach Effectively

Joan Karp, Boston Science Partnership, Strand: 2

SUMMARY: The Boston Science Partnership (BSP Phase I &II) has provided a variety of forms of preparation and support for STEM faculty at institutions of higher education centered on effective teaching. Many of these forms can be considered types of Professional Learning Communities (PLCs), some for STEM faculty only, and some also involving K-12 teachers. Evaluation findings have shown that STEM faculty involved in these activities report increased understanding of teaching practice, interest in and ability to implement student-centered learning practices and greater awareness of the entire STEM educational pathway from K-12 to college. They report changes in student performance and changes to departmental culture related to issues of pedagogy.

How Can STEM Faculty Become Effective in the Advanced Training of Teachers?

Erin Militzer, Arizona Teacher Institute, Strand: 2

SUMMARY: We will report on our efforts to prepare mathematics faculty to effectively teach inservice middle and elementary school teachers. Our speakers will include mathematicians who have taught the mathematics content courses along with those who have co-taught an educational research based class on student learning, Research on the Learning of Mathematics. Our session addresses the important challenge of how one prepares the typical STEM faculty member (one who has not worked in mathematics education) for the atypical experience of teaching middle school level mathematics to experienced schoolteachers. In our session, we will first outline a series of key issues related to STEM faculty teaching courses for middle school teachers and include examples of the innovative support faculty members have received when preparing for and teaching the content courses.

Breakout Room 7:

Supporting Inservice K-8 Mathematics Teachers: The Vermont Mathematics Partnership's Frameworks for Strengthening Content Knowledge

Douglas Harris, Vermont Mathematics Partnership, Strand: 2

SUMMARY: The Vermont Mathematics Partnership (VMP) has developed a conceptual framework and set of protocols to inform planning to support teachers and leaders at the classroom, school, and system levels. The planning protocols are based on three antecedents: the Professional Development Model and accompanying materials developed by Kenneth Gross and the Vermont Mathematics Initiatives; the VMP Equity Framework based on Rachel Lotan's work related to equity and complex instruction; and the Diagnostic Classroom Observation materials and protocols developed by Nicole Saginor of The Vermont Institutes and Paul Decker and Amy Johnson of Mathematica, Incorporated. These are described and related to lessons learned through intensive work with successful and less successful school and district partners.

Evolution of a Partnership Engagement Project in the Appalachian Mathematics and Science Partnership: Lessons Learned

David Royster, Appalachian MSP, Strand: 2

SUMMARY: The AMSP's model of STEM K-12 /Higher education engaged partnership, the Partnership Engagement Project (PEP), is in its sixth administration. Using NSF's DIO Cycle of Evidence of formative evaluation, seven modifications have been incorporated into the current model. The modifications include: assistance in writing professional development plans, analyzing data, creating a toolkit for programmatic evaluations, development of a district needs survey, and locating STEM higher education faculty to collaborate in planning and implementation. Due to geographic isolation inherent in rural districts and the difficulty of making IHE connections, we propose to use the AMSP local master teacher as an intermediary between IHE faculty and school districts. The intermediary serves as a bridge between these two cultures and offers a support mechanism for the reform effort.

Paper Session 1 – Summaries

Breakout Room 8:

Teacher Motivation in Professional Development - Results from a National Sample

Stuart Karabenick, Motivation Assessment Program II (MSP-MAP II) Teacher Motivation in Professional Development, Strand: 2

SUMMARY: Teacher professional development (PD) is an essential feature of instructional interventions in general, and for the improvement of students' math and science learning and achievement in particular. The more motivated teachers are to participate and engage in PD, the more likely they will be to profit from the experience. When teachers benefit, they are more likely to enact the PD approaches, content, and skills in their classrooms. Informed by theory and research on student and teacher motivation, a national study of teachers (n = 552) examined the level of teachers' motivation for PD (PDM), teachers' experiences in PD, and perceived benefits of PD, as well as associations with features of PD programs, teacher factors, and contextual factors.

MOSART: Examining SMK and PCK with Modern Psychometric Analysis

Philip Sadler, MOSART-LS, Strand: 2

SUMMARY: MOSART assessments are unique in measuring teachers' Subject Matter Knowledge (SMK) and Pedagogical Content Knowledge (PCK). This session will focus on how both types of knowledge contribute to effective teaching and learning. Because of these assessments' objectivity and validity, instructional sensitivity can be probed. Prior research of teachers' knowledge of student misconceptions enhances students' gains in understanding the science represented in items. New analyses of our MOSART test items use Item Response Theory (IRT) to examine the relationship of students' answers to the proficiency of students ranging in performance level. These analyses further extend the power of MOSART tests to support the work of MSPs to enhance teacher SMK and PCK.

Breakout Room 9:

STEM Teaching Effectiveness: A Synthesis of Perspectives

James Madden, Louisiana Math and Science Teacher Institute, Strand: 2

SUMMARY: Our presentation includes contributions from the lead designer of the physics curriculum (Slezak), cognitive scientists studying teacher expertise (Fisher, Lane and Matthews), the external project evaluator (Meyer), a teacher who has investigated transfer to classroom practice (Alphonso) and the project director (Madden). We give several different but related perspectives on the problem of delivering and evaluating university-based academic work that impacts the effectiveness of STEM instruction. The perspectives are brought together in our conceptual framework, which identifies the expected pathways of influence from the academic program to the classroom and distinguishes these pathways from other factors that impact classroom work. Partnership activities promote consonance between the academic program and school-based classroom demands.

Using Teacher Assignments to Measure the Rigor and Relevance of Middle School Mathematics Instruction

Jamie Shkolnik, Impact of MSP Professional Development on the Quality of Instruction in Middle-School Mathematics Classrooms, Strand: 3

SUMMARY: This presentation will illustrate the use of teacher assignments for examining the quality of instruction of middle school mathematics teachers who received MSP-provided professional development and similar teachers who did not. The presentation will explain how carefully developed scoring rubrics and the Many-Facet Rasch model can be applied to measuring the quality of teacher assignments and how the scoring process can be effectively managed by using the Access-based Teacher Assignment Scoring System. This presentation will also demonstrate how measures of assignment quality can be properly analyzed using an advanced analytic method--HLM latent variable modeling, and report preliminary findings. We hope that these under-utilized measurement tools will become part of an expanding repertoire of methodological tools for STEM education researchers.

Paper Session 1 – Summaries

Breakout Room 10:

Feedback for Improving Teaching and Learning

Cathy Kinzer, Mathematically Connected Communities - Leadership Institute for Teachers**, Strand: 2

SUMMARY: Mathematicians, mathematics educators, researchers, and K-12 teachers at New Mexico State University involved in the Leadership Institute for Teachers (LIFT) collaboratively design and improve mathematics lessons and coursework in the two-year institute. Reflective feedback is a central strategy to think about what we do, how we communicate, and what we learn. Specific tools and strategies are strategically used throughout the semester to provide data /feedback to teacher leaders and instructors in the LIFT courses. The feedback is used over time in developing a learning system that values stakeholder voice and focuses on what and how we learn. The feedback strategies and tools provide evidence to take action for improving learning.

Task Analysis: A Process of Documenting Task-Level PCK

Frieda Parker, Math TLC, Strand: 2

SUMMARY: In this presentation, we describe the task analysis process, which is a tool we developed to support teachers systematically thinking about and articulating the pedagogical content knowledge (PCK) for teaching a rich math task. A complete task analysis includes: the mathematics embedded in the task, including an appropriate range of strategic approaches and correct answer(s); pedagogical moves and tools/technology that could support student thinking about the mathematics embedded in the task; mathematical difficulties and misconceptions students might face while engaging with the task; and content and process standards that could be addressed with the task. The task analysis process can be used to support lesson planning, as a coaching or mentoring tool, and as an activity in professional development.

Breakout Room 11:

Collaborative Development of Biology and Geology Content Courses for Future Elementary and Inservice Teachers

George Nelson, NCOSP, Strand: 2

SUMMARY: The North Cascades and Olympic Science Partnership (NCOSP), in partnership with California State University Chico (in biology) has developed and implemented semester-long courses in biology and geology based on the model provided by Physics and Everyday Thinking (Goldberg et.al. 2006) which incorporates the research base described in How People Learn (NRC 2000). The sequence of courses is offered for future teachers at Western Washington University and three community colleges. The biology materials have been adapted for use in high schools in two school districts. More than five years of evaluation data indicate that the courses are effective in helping future teachers learn important content through instruction that explicitly models effective teaching practices. A five-year longitudinal research study was recently funded.

Development and Implementation of Learning Progression-based Teaching Strategies (LPTSs) for Environmental Science

Alan Berkowitz, Culturally Relevant Ecology, Learning Progressions and Environmental Literacy (LTER), Strand: 2

SUMMARY: Our Targeted Partnership, Culturally Relevant Ecology, Learning Progressions and Environmental Literacy, is centered on four Long Term Ecological Research sites: Baltimore, Maryland (urban); Kellogg Biological Station, Michigan (agro-ecosystems); Ft. Collins, Colorado (short grass steppe); and Santa Barbara, California (land/marine ecosystems). Each site is working with middle and high school science teachers to enhance environmental science teaching. We describe the development and use of research-based learning progressions to explore how students and teachers learn environmental science in strands focusing on carbon cycling, evolution and biodiversity, and water systems. We then discuss the place-based, culturally-responsive models of professional development we have created and tested to support the use of learning progression-based teaching strategies in the diverse classrooms encompassed by our multi-site project.

Paper Session 1 – Summaries

Breakout Room 12:

Supporting Inquiry-rich Teaching through Professional Development within a District-Higher Education Partnership

Joshua Caulkins, RITES, Strand: 2

SUMMARY: There is a need for instructional materials to help teachers enact inquiry-rich science in their classrooms. Technology-enhanced investigations can provide students with opportunities to collect data using probeware and investigate natural systems through models and simulations. The RITES partnership is a statewide collaboration between grade 6-12 schools and higher education to develop inquiry-rich activities addressing state standards and to provide meaningful learning opportunities for Rhode Island students. A challenge faced within the partnership is how to design PD that helps teachers use RITES materials effectively. This study describes the design of 16 PD short courses attended by approximately 100 teachers. We used course evaluations, pre/post assessments, short course observations and interviews to determine how teachers benefited from the PD.

"Equity Practices" for Teaching and Student Learning: How to Go Below the Surface of the Words

Thomas Philip, MOBILIZE: Mobilizing for Innovative Computer Science Teaching and Learning, Strand: 2

SUMMARY: Our model of "effective teaching in STEM" addresses inquiry-based instruction, equity in teaching and learning, and computational thinking concepts. We will discuss what equity practices mean for teaching and learning, especially in the context of a classroom project based on technology/computational thinking. We ask how to integrate our critical perspective about the purposes of technology, schooling, and STEM education into our work with teachers. We question how to turn our theory about schools reproducing inequitable and unjust processes, and the current myths about technology as the great equalizer, into alternative practices with teachers. Within the larger context of a "culture of power," we examine our own approaches to helping teachers develop effective methods for encouraging students to see themselves as capable "doers" of STEM.

Breakout Room 13:

NebraskaMATH, Getting it Right from the Start: Supporting Effective Instruction in the Primary Grades

Michelle Homp, NebraskaMATH, Strand: 2

SUMMARY: We will share information about coursework and study groups for K-3 teachers becoming K-3 Mathematics Specialists in Nebraska. We discuss how we have refined our courses and study groups over time, and how we are focusing on helping teachers to become more intentional, planful, observant, and reflective mathematics teachers. We also share one presenter's perspective in the dual role of a K-3 district math coach and course instructor, and what she sees as necessary to support K-3 teachers to teach math more effectively. We also discuss the role of K-3 teacher leaders in a distributed leadership model to support more effective math teaching statewide.

A Decade-Long Effort to Improve the Teaching of K-12 Mathematics in Rapid City, South Dakota

Ben Sayler, PRIME, Strand: 3

SUMMARY: Now in its 10th year, Project PRIME has assembled a wide array of evidence, both direct and indirect, about improved teaching of mathematics within Rapid City Area Schools. Direct evidence exists in the form of classroom observations conducted over the life of the project by PRIME's external evaluation team, Inverness Research. Indirect evidence exists in the form of student outcomes: Achievement on state test; achievement on a more performance-oriented test; and student attitudes. A powerful story is emerging, attributable largely to a robust infrastructure that has been established to support teacher growth. The session will share how far the district has come, factors contributing to success, obstacles along the way, persistent challenges, and the path ahead.

Paper Session 1 – Summaries

Breakout Room 14:

Learning Together: A User-Friendly Tool to Support Research on STEM Education Interventions Research

Joan Pasley, Knowledge Management and Dissemination, Strand: 3

SUMMARY: The MSP KMD project is charged with situating what MSPs are learning in the broader knowledge base. MSP KMD has developed a "User-Friendly Tool" to provide a common language for project teams with varying research backgrounds to discuss their STEM education research. The tool describes key considerations in designing and reporting research on STEM education interventions, includes reflection questions for research teams to use when considering their research designs, and illustrates the use of the tool with sample research designs. The LNC session will engage participants in using this tool with a hypothetical research design for studying the impact of an MSP intervention on STEM teaching. Participants will also consider implications of this tool for their own MSP research.

Data Connections: Methodology for Developing Student Achievement Trajectories to Estimate Teaching Effectiveness

Jennifer Green, Data Connections, Strand: 3

SUMMARY: While effective teaching is conceptualized broadly, statistical modeling is one approach to identify teaching which induces growth in student achievement that exceeds expectations. In particular, one tool for measuring the impact of MSP programs on teaching effectiveness is student achievement data. Detecting the impact of a MSP project on student achievement requires more than a single snapshot of student performance. Instead, a coherent picture of student progress is needed before, during and after a project's initiation. However, the data available to projects often do not meet the technical requirements of current statistical methods. This project is investigating the use of new methods to analyze less-than-ideal data. These methods and their applicability to MSP projects will be discussed in this session.

Breakout Room 15:

Conceptually-rich Mathematics Coaching: Will Mathematics Specialists Put Into Practice What They Have Learned?

Aimee Ellington, Preparing Virginia's Mathematics Specialist, Strand: 3

SUMMARY: With respect to the education of Mathematics Specialists, effective STEM teaching involves presenting K-8 mathematics ideas in ways that help our MSP Institute participants develop a rich conceptual understanding of the content and develop a deep understanding of how children learn mathematics. In this session, we will describe how our definition of effective STEM teaching is implemented in the courses participants take in our program. We will present data from our initial visits to our participants' school buildings that address the questions: Are teachers preparing to be middle school Mathematics Specialists able to implement similar teaching strategies in their classrooms? And how will what they are learning and how they are teaching impact them when they assume roles as mathematics coaches?

Effective Teaching in Middle School Mathematics

John Mayer, Greater Birmingham Mathematics Partnership, Strand: 3

SUMMARY: The Greater Birmingham Mathematics Partnership (GBMP), through Phase I and II MSP awards, has focused its support and study on effective teaching of middle school mathematics (grades 5-8). Our approach to effective teaching in mathematics can be fit to an MSP logic model. Conditions involve partner commitments to summer courses, school-based PLCs, Community Math Nights, Administrator sessions emphasizing what inquiry-based instruction looks like, and Math Support Teams (MSTs) in the schools. Activities involve summer courses modeling inquiry-based pedagogy, support for inquiry-based teaching in the classroom, PLCs, coaching MSTs, and guidance in facilitating good PLC meetings. Outcomes include classroom observations showing increased implementation of inquiry-based instruction, and relating this to improved student achievement as measured by both aligned and unaligned instruments.

Paper Session 1 – Summaries

Breakout Room 16:

Qualitative Analysis of Changes in Teachers' Knowledge, Beliefs and Classroom Practices Based on Three Years of Professional Development

Carol Baldassari, Focus on Mathematics, Strand: 3

SUMMARY: This session presents methods researchers developed to collect and analyze data about how/ extent which FoM's 3-year masters' degree program deepens secondary mathematics teachers' MKT, beliefs about teaching and learning mathematics, and transfer of learning to their students. Methods include observations of PD sessions, review of teacher artifacts, interviews with teachers and faculty, classroom observations. The study focused on four secondary teachers; data was collected over 2-3 years; data analysis is currently being completed. Early analysis reveals the significant impact of contextual factors (school/district circumstances; teacher background/prior experiences) that bear on teacher learning and their influence on their work with students. This pilot study allowed researchers to develop and test research methodologies and to recognize the need for policy changes.

Evidence of Enhanced Teaching in Student Content Knowledge Gains: Missouri's A TIME for Physics First MSP

Keith Murray, A TIME for Physics First in Missouri, Strand: 3

SUMMARY: A TIME for Physics First, researching intervention effects on two cohorts of ninth-grade Missouri physics teachers, includes leadership building, content, pedagogy, research and evaluation components in its professional development model. Inquiry and modeling-based physics content in the classroom is emphasized. With a random-assignment, delayed-entry design, analysis of student pre/post physics content tests in the first treatment year permitted an early opportunity to confirm project assumptions that intervention would improve teaching and yield enhanced student achievement. Students of intervention teachers within one year after participation began showed statistically significant higher mean gains ($p < .000$, e.s. .53) compared to students of comparison teachers not yet participating, based on scores from the Test of Understanding Graphs-Kinematics. Teachers themselves experienced similar test results.

Paper Session 2

Tuesday, January 24, 2012
10:25 a.m. - Noon
Summaries on Pages 27-29, Abstracts on Flash Drives

Breakout Room 2:   **Discussant: Elizabeth VanderPutten**

Defining the Aims of STEM Education in an Era of Hyperpluralism

F. Joseph Merlino   **Strand: 1**
MSPGP

Inequality for All: Identifying and Addressing Curricular Policies Supporting Systemic Inequality in Mathematics
Bill Schmidt   **Strand: 1**
PROM/SE

Breakout Room 3:   **Discussant: Pamela Brown**

Defining Effective STEM Teaching Within a Middle-School/Post-Secondary Collaboration Through a Cycle of Logic Model Development
Robert Curtis   **Strand: 1**
SF Bay Integrated Middle School Science Project

Using Energy as a Cross-Cutting Concept to Teach More Effectively

Robert Chen   **Strand: 1**
Boston Energy in Science Teaching (BEST)

Breakout Room 4:   **Discussant: Maura Borrego**

Understanding Barriers to Change and Innovation in STEM Teaching and Learning: Silos and District-wide Teacher Learning Networks
Fouad Abd-El-Kalick   **Strand: 2**
EnLiST

Exploring the Effectiveness and Utilization of Teacher Leader Support and Resources Through Social Network Analysis
Gale Mentzer   **Strand: 2**
LEADERS: Leadership for Educators: Academy for Driving Economic Revitalization in Science

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Breakout Room 5:   **Discussant: Kyrsis Rodriguez**

A "Test-of-Concept" Study of a Learning Theory-based Model of Professional Development

Eric Banilower   **Strand: 2**
AIM: K-8 Science

Noyce Master Teacher Developed K-5 Science Curriculum and Professional Development

George Nelson   **Strand: 2**
NCOSP

Breakout Room 6:   **Discussant: Joan T. Prival**

Localizing Teacher Leadership Expertise in Appalachia

Kimberly Zeidler-Watters   **Strand: 2**
Appalachian MSP

Evolution of a Professional Development Program to Promote Effective Teaching

Michelle Borrero   **Strand: 2**
Puerto Rico MSP

Paper Session 2

Tuesday, January 24, 2012
10:25 a.m. - Noon
Summaries on Pages 29-31, Abstracts on Flash Drives

Breakout Room 7:   **Discussant: Kwang Suk Yoon**

Professional Learning Communities: A Vehicle for Preparing, Supporting and Sustaining Effective STEM Teaching
Blake Decker   Strand: 2
College Ready

Mathematics Studio - a Greenhouse for Growing Mathematics Leadership
Thomas Dick   Strand: 2
Oregon Mathematics Leadership Institute Partnership

Breakout Room 8:   **Discussant: Wendy Smith**

Use of Multiple Strategies and Processes to Prepare Teachers and Faculty to Teach Effectively

Dianne DeMille   Strand: 2
TASEL-M Phase 2

Building a Mathematics Coalition

Davida Fischman   Strand: 2
Mathematical ACES

Breakout Room 9:   **Discussant: Lee L. Zia**

The Poincaré Institute: Supporting Effective Teaching and Learning
Montserrat Teixidor-i-Bigas   Strand: 2
Poincaré Institute: A Partnership for Mathematics Education

Using Teacher Liaisons to Support and Promote Effective Algebra Teaching

Michelle Homp   Strand: 2
NebraskaMATH

Breakout Room 10:   **Discussant: Richard W. Peterson**

Creating Coherence: Working with University Faculty and School Administrators to Support Effective High School Science Teaching
Kristin Bass   Strand: 2
Project MAST

Supporting Freshman Physics Teachers

Deborah Hanuscin   Strand: 2
A TIME for Physics First in Missouri

Breakout Room 11:   **Discussant: Ruth Heaton**

Common Core Mathematical Practices Are Good Instructional Practices
Amy Cohen   Strand: 2
NJ Partnership for Excellence in Middle School Mathematics

Mathematical Knowledge for Teaching as a Critical Element of Preservice Teacher Preparation
DeAnn Huinker   Strand: 2
Milwaukee MSP

Paper Session 2

Tuesday, January 24, 2012
10:25 a.m. - Noon
Summaries on Pages 32-33, Abstracts on Flash Drives

Breakout Room 12:   **Discussant: Kathleen B. Bergin**

Reconceiving "Misconceptions" in Teacher Professional Development

Ayush Gupta   Strand: 2
Minority Student Pipeline MSP

The RITE Way to STEM Assessment

Dan Murray   Strand: 3
RITES

Breakout Room 13:   **Discussant: Donald Wink**

Attention to Teaching for Science Education Fellows

Pamela Pelletier   Strand: 2
Boston Science Partnership

Effective STEM Professional Learning Communities - Learning from the Field

Joan Pasley   Strand: 2
Knowledge Management and Dissemination

Breakout Room 14:   **Discussant: James E. Hamos**

Affecting and Documenting Shifts in Secondary Precalculus Teachers' Instructional Effectiveness and Students' Learning
Marilyn Carlson   Strand: 3
Project Pathways: A Math and Science Partnership Program for Arizona Targeted Project TrackEducation

Assessing Mathematical Habits of Mind for Teaching
Sarah Sword   Strand: 3
Focus on Mathematics, Phase II: Learning Cultures for High Student Achievement

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Breakout Room 15:   **Discussant: Ron Buckmire**

How Do You Know if Your Project Is Resulting in Effective STEM Teaching?
Karin Wiburg   Strand: 3
Mathematically Connected Communities - Leadership Institute for Teachers

Developing Effective Math Teaching: Assessing Content Knowledge, Pedagogical Knowledge, and Student Success
Roger Peach   Strand: 3
Math Teacher Transformation Institute

Paper Session 2 – Summaries

Breakout Room 2:

Defining the Aims of STEM Education in an Era of Hyperpluralism

F. Joseph Merlino, MSPGP, Strand: 1

SUMMARY: The factor most responsible for the elusiveness in defining effective STEM teaching is the fundamental problem in reaching clarity and consensus as to what should be the aim of STEM education. We live in an era of "hyperpluralism" where a vast number and variety of contending groups and individuals involved in K-20 education, and the larger public and policy world, each stake their claim, or harbor their private definition, as revealed by their actual practice, as to the purpose of STEM education. Based on our nine years of operating a targeted MSP, we share the first results of a research supplement to provide a historical-based taxonomy of different aims as a way to negotiate consensus about the meaning of effective STEM teaching.

Inequality for All: Identifying and Addressing Curricular Policies Supporting Systemic Inequality in Mathematics

Bill Schmidt, PROM/SE, Strand: 1

SUMMARY: The "effective teaching" concept informing the Promoting Rigorous Outcomes in Mathematics and Science Education (PROM/SE) MSP focused on what is taught together with a commitment to provide all students with a challenging and rigorous curriculum. Professional development helped teachers understand linkages between topics taught in their classrooms as well as linkages to those taught earlier and in subsequent years. The point has been to bring coherence to the curriculum both from a disciplinary viewpoint as well as from the experience of students as they move through all the grades of schooling. After more than five years of effort, PROM/SE has found some evidence that this approach has benefited students.

Breakout Room 3:

Defining Effective STEM Teaching Within a Middle-School/Post-Secondary Collaboration Through a Cycle of Logic Model Development

Robert Curtis, SF Bay Integrated Middle School Science Project, Strand: 1

SUMMARY: This proposal focuses on the first year of implementation of an NSF MSP grant. The process of developing and using logic models helped our project define effective STEM teaching and learning, and refine and evaluate project goals, outcomes and activities. These goals, outcomes and activities have continued to evolve and be clarified over the first year of the project using a logic-modeling process involving key partners, project staff, researchers and our evaluator. The logic model process helps us to reveal and negotiate core assumptions; align project components; network across groups; share learnings about effective STEM teaching; increase coherence across all partners and build capacities of all partners for inquiry-based teaching and learning.

Using Energy as a Cross-Cutting Concept to Teach More Effectively

Robert Chen, Boston Energy in Science Teaching (BEST), Strand: 1

SUMMARY: The Boston Energy in Science Teaching (BEST) project defines effective teaching as facilitating opportunities for learners to explore concepts and connections across science disciplines. Our project's strategy is to use the cross-cutting concept of energy to facilitate these opportunities for teachers by adapting our phase I professional development (PD) strategies to be cross-disciplinary instead of disciplinary specific. We believe that using concept-based PD will lead to more effective and efficient instruction compared to discipline-based PD. To test this we will be comparing data of grade 3-8 teachers who participated in our discipline-based PD through the BSP, teachers who participated in both, and teachers who have only participated in BEST.

Paper Session 2 – Summaries

Breakout Room 4:

Understanding Barriers to Change and Innovation in STEM Teaching and Learning: Silos and District-wide Teacher Learning Networks

Fouad Abd-El-Kalick, EnLiST, Strand: 2

SUMMARY: Effective precollege STEM teaching provides students with meaningfully integrated horizontal (within-grade level) and vertical (across-grade levels) innovative experiences across scientific disciplines. This approach requires a holistic transformation of STEM learning across the curriculum and school experiences. This study adopted a social network perspective on learning to understand how innovation is 'taken up' by teachers across school buildings or districts, and characterized the nature of extant science teacher learning networks within a whole school district. Results show that science teachers' learning networks were mostly siloed within buildings with hardly any cross-grade, cross-level, and cross-building relations. Additionally, teacher networks related to science teaching and learning were less elaborate when compared to other networks, such as those related to learning about classroom management.

Exploring the Effectiveness and Utilization of Teacher Leader Support and Resources Through Social Network Analysis

Gale Mentzer, LEADERS: Leadership for Educators: Academy for Driving Economic Revitalization in Science, Strand: 2

SUMMARY: Student engagement is the hallmark of effective STEM teaching. It is student-centered and includes iterative cycles of authentic scientific investigation centered on real-world issues through collaboration between students, teachers, and members of the community in a collaboration of inquiry. As such, teachers must be aware of and take advantage of the wealth of community resources that can translate relevant issues facing students to the classroom. Social network analysis (SNA) can compare teacher leader interactions with the partnership's support to determine strengths and weaknesses. Our findings revealed that support use was linked to school district dynamics, teacher preferences, and teacher awareness of supports. Results allowed the partnership to improve support offerings thereby improving STEM teaching. This presentation includes SNA graphs and interpretations.

Breakout Room 5:

A "Test-of-Concept" Study of a Learning Theory-based Model of Professional Development

Eric Banilower, AIM: K-8 Science, Strand: 2

SUMMARY: Assessing the Impact of the MSPs: K-8 Science (AIM) is working with MSPs to study the impact of different professional development strategies on teacher content knowledge and student learning. As part of this broader study, AIM is conducting a "test-of-concept" study for a learning theory-based model of professional development. We hypothesize that professional development consistent with this model will increase teacher understanding of the targeted content and provide teachers with the tools and support needed to teach science effectively (in a manner aligned with the vision of science instruction described in the framework for the Next Generation Science Standards). This session will share initial findings of the impact of this model on teacher knowledge, classroom practices, and student learning.

Noyce Master Teacher Developed K-5 Science Curriculum and Professional Development

George Nelson, NCOSP, Strand: 2

SUMMARY: Six elementary and two middle school teachers were supported by the North Cascades and Olympic Science Partnership and their school district to research and assemble a coherent K-5 science curriculum. They are also supported to design and deliver professional development and instructional support for all of their peers in the district's 14 elementary schools to promote effective science teaching as the new curriculum is implemented. As a result, in the first year the percent of fifth and second grade classrooms where science is consistently being taught increased from 18% to 68% and the school district has committed to continued funding for curriculum implementation and professional development. The support materials developed by the group are now available and being accessed and used by other districts including NCOSP partner districts, and the Noyce Master Teachers are providing advice and training to schools outside of their district.

Paper Session 2 – Summaries

Breakout Room 6:

Localizing Teacher Leadership Expertise in Appalachia

Kimberly Zeidler-Watters, Appalachian MSP, Strand: 2

SUMMARY: The Appalachian Mathematics and Science Partnership received NSF supplemental funding for the AMSP Master Teacher Project. Eighteen experienced grade 6-12 mathematics and science teachers received a three-year program of mentored professional development and support designed to develop Master Teachers in mathematics and science who demonstrate effective teaching in their own classrooms and serve as leaders in the rural Appalachian region. Findings to-date indicate: most participants have shifted their thinking about instruction, moving from a focus on teaching to a focus on learning; they still vary in their conception of teacher leadership and their views of themselves as leaders; and the teachers have developed a strong professional network, valuing and using each other as sources of information, ideas, and support.

Evolution of a Professional Development Program to Promote Effective Teaching

Michelle Borrero, Puerto Rico MSP**,** Strand: 2

SUMMARY: The Puerto Rico Math and Science Partnership defines effective teaching in STEM as the practice that generates learning with understanding. We prepare and support teachers to teach effectively through our Authentic Professional Development Program (APDP) which integrates the best teaching practices with math and science content, while performing continuous assessment to promote reflection and metacognition. Our current emphasis is on empowering teachers to train their peers and support them as leaders in their schools. Our APDP includes collaborative evaluation as a strategy that enables teachers to design, implement and evaluate APDP activities for their peers. Our preliminary results suggest that teachers are improving in content knowledge and practices; thus becoming more effective in their roles in their classroom and schools.

Breakout Room 7:

Professional Learning Communities: A Vehicle for Preparing, Supporting and Sustaining Effective STEM Teaching

Blake Decker, College Ready, Strand: 2

SUMMARY: This session describes the iterative process of implementing PLCs across the College Ready in Mathematics and Physics Partnership. PLC concepts and practices for effective implementation have been the unifying link across Partnership activities, building to the launch of PLCs during the 2011-2012 academic year. Initial findings have revealed the need for a precise definition of and expectations for PLCs in the MSP; that a knowing-doing gap exists in educational leadership; and that training for PLC facilitation is lacking. These findings have resulted in numerous changes in how the Partnership has systematized activities to support PLC implementation in partner schools. This session will include further explication of specific challenges and in-progress solutions relating to the implementation of PLCs in College Ready.

Mathematics Studio - a Greenhouse for Growing Mathematics Leadership

Thomas Dick, Oregon Mathematics Leadership Institute Partnership, Strand: 2

SUMMARY: The Mathematics Studio Classroom is a scalable and sustainable model that can transform the professional learning culture in a school. A cohort of teachers, coaches, and administrators meets to learn and rehearse "mathematically productive teaching routines" - practices that are designed to: align directly with how students learn mathematics, recur regularly in the everyday work of teaching mathematics, typically involve one or more challenging aspects of mathematics teaching, and enable mathematical access and challenge for all students. Studio work includes planning for implementation of a lesson, a "live" rehearsal of one or more of these routines, observations of the enacted plan, gathering of student data, and analysis of data as evidence about the impact of instructional decisions and lesson design.

Paper Session 2 – Summaries

Breakout Room 8:

Use of Multiple Strategies and Processes to Prepare Teachers and Faculty to Teach Effectively

Dianne DeMille, TASEL-M Phase 2, Strand: 2

SUMMARY: "Effective teaching in STEM" relies on the support of "learning" for each student by motivating and engaging them in mathematics. In order to address these varying aspects, Teachers Assisting Students to Excel in Learning Mathematics: Phase II (TASEL-M2) approach content delivery; best practices and assessment; a structure for lesson design; and strategies that support student struggles in learning mathematics. A cohesive plan that brings all teachers and faculty members together within a school or district with a common cohesive approach will increase mathematics knowledge for each student to learn at their highest potential. In addition, through the years, this process will support students in the school and district.

Building a Mathematics Coalition

Davida Fischman, Mathematical ACES, Strand: 2

SUMMARY: ACES has constructed and continues to deepen and broaden a coalition of partners who support one another in enhancing mathematics learning in grades 4-8, with the ultimate goal of having students succeed in algebra, and be well-prepared for advanced mathematics classes. The partners include teacher-teams, district administrators, county specialists, education faculty, natural science faculty, and the project evaluator. We will discuss how ACES is creating true and long-lasting partnerships which involve mutual trust and respect, and how these are influencing professional development, lesson study teams, and mathematics instruction. District and University personnel identify strengths of highly effective teachers, and ways to enhance pre and inservice teacher education. The web of collaborative relationships strengthens P-18 articulation and instruction at all levels.

Breakout Room 9:

The Poincaré Institute: Supporting Effective Teaching and Learning

Montserrat Teixidor-i-Bigas, Poincaré Institute: A Partnership for Mathematics Education, Strand: 2

SUMMARY: The Poincaré Institute provides three online courses for inservice teachers. The courses – designed and taught by mathematicians, physicists, and education researchers – focus on the real line and Cartesian plane, algebra and functions, their representation and applications. This presentation will focus on the content and structure of the lessons, on how the courses have evolved taking into account teachers' suggestions and performance, on how we evaluate the impact of the project on teacher development and student learning, and on preliminary data we have collected and analyzed so far.

Using Teacher Liaisons to Support and Promote Effective Algebra Teaching

Michelle Homp, NebraskaMATH, Strand: 2

SUMMARY: NebraskaMATH is a 5-year Targeted Math Science Partnership Project, whose goal is to improve achievement in mathematics for all students and to narrow achievement gaps of at-risk populations. Nebraska Algebra is the component of NebraskaMATH which targets Algebra 1 teachers, in order to support these teachers in becoming more effective Algebra 1 teachers. Participants take three graduate courses focused on increasing their knowledge of algebra, adolescents/motivation, and pedagogy; we believe these areas are crucial to helping teachers teach algebra more effectively. During the academic year, participants are provided with teacher liaisons, to help support them in improving their algebra instruction, and thus increase student achievement in algebra.

Paper Session 2 – Summaries

Breakout Room 10:

Creating Coherence: Working with University Faculty and School Administrators to Support Effective High School Science Teaching

Kristin Bass, Project MAST, Strand: 2

SUMMARY: Effective post-secondary STEM teaching relates the material being taught with teachers' prior knowledge and experiences, and helps them apply what they're learning to their classroom context. The Mississippi Academy for Science Teaching's (Project MAST) staff and external evaluators closely monitor the alignment of university professional development with K-12 policies and practices through observations, instructor interviews, teacher surveys and school site visits. This session describes Project MAST's efforts to support STEM instruction by improving the teaching done by STEM faculty, adjusting the content of the professional development, and educating school administrators about the ways in which they can best support their teachers. This session shares our evidence-based reflective process and the lessons learned along the way.

Supporting Freshman Physics Teachers

Deborah Hanuscin, A TIME for Physics First in Missouri, Strand: 2

SUMMARY: Our project, currently in its third year, seeks to increase both the teaching effectiveness and leadership capacity of ninth grade physics teachers. Our professional development program, which consists of three summers of content-rich academies (10 weeks) and three academic years of online leadership courses, provides opportunities for teachers to strengthen their content knowledge, develop their use of modeling pedagogy, and expand their knowledge and skills for serving as leaders and catalysts for changes within their schools and districts. Through implementation of two different models, one that utilizes coaching (face to face classroom support) and one that utilizes mentoring (online support), we hope to understand how teachers can best be supported in enhancing their teaching effectiveness and impacting student learning.

Breakout Room 11:

Common Core Mathematical Practices Are Good Instructional Practices

Amy Cohen, NJ Partnership for Excellence in Middle School Mathematics, Strand: 2

SUMMARY: This presentation describes the structure of an MSP Institute for mid-career middle school math teachers intended to deepen their understanding of the mathematics of the middle grades and of some key aspects of mathematical pedagogy. The mathematical practices called for in CCSSM are implicit in our basic definition of effective teaching and learning. We make explicit reference to these "core practices" in this presentation.

Mathematical Knowledge for Teaching as a Critical Element of Preservice Teacher Preparation

DeAnn Huinker, Milwaukee MSP, Strand: 2

SUMMARY: An important element of preservice teacher preparation is developing a deep knowledge of mathematics content that is relevant to teaching. However, not all preservice teachers elect the same math coursework which leads to variations in content knowledge upon program completion. Our MSP developed four content courses for preservice elementary (Grades 1-8) teachers electing a mathematics minor. It stands to reason that these individuals would demonstrate stronger mathematics content knowledge at the conclusion of their preparation program. To answer this question, we compare the results of preservice teachers with mathematics minors to non-mathematics minors on measures of mathematical knowledge for teaching (MKT) completed at the beginning and end of their programs.

Paper Session 2 – Summaries

Breakout Room 12:

Reconceiving "Misconceptions" in Teacher Professional Development

Ayush Gupta, Minority Student Pipeline MSP, Strand: 2

SUMMARY: When science teachers engage in inquiry as part of professional development, facilitators often nudge them away from common misconceptions as quickly as possible, in order to help the teachers engage in more productive ways of thinking about the targeted concept. We argue that confronting certain misconceptions too soon can sometimes (often?) cut off productive lines of inquiry. To make this case, we present data from an inquiry workshop where a group of elementary school science teachers started from a common misconception, viewing forces as analogous to a substance carried by an object. Building on this metaphor, however, they construct a sophisticated Galilean explanation for why objects of different masses accelerate at the same rate due to gravity.

The RITE Way to STEM Assessment

Dan Murray, RITES, Strand: 3

SUMMARY: Effective STEM teaching is manifested in gains in content knowledge, increased use of technology, and a shift towards more discovery-based teaching. Assessment of progress towards these goals employs a variety of instruments that capture gains in content and shifts towards more discovery-based modes of teaching. This assessment of effective teaching begins in summer workshops, and continues with examination of teaching practices in the classroom throughout the following academic year. Beyond the workshops, we monitor the increased involvement of teachers in other STEM initiatives, changes in their attitudes towards science and inquiry-based methodologies, and measures of student success. Results from all of these measures of progress will be presented, along with a consideration of which instruments best predict effective teaching.

Breakout Room 13:

Attention to Teaching for Science Education Fellows

Pamela Pelletier, Boston Science Partnership, Strand: 2

SUMMARY: The Boston Public Schools' Science Department defines teacher leadership as leadership in schools, the district or beyond that stems from excellent and recognized classroom practice with children and work with peers. To increase the number of teacher leaders and deepen their leadership skills, the Boston Science Partnership has supported a year-long fellowship for K-12 teachers of any science subject. This session will share the program design and components of the fellowship, such as the use of video, collaborative lesson study and personal plans which form the basis of the year-long fellowship. These components have led teachers to elevate the quality of their own classroom practices. The district has benefited by being able to focus the attention of teachers – both Fellows and their colleagues – on the importance and excitement of classroom instruction. Lessons learned provide direction for future efforts that aim to improve classroom practice for the teaching of science.

Effective STEM Professional Learning Communities - Learning from the Field

Joan Pasley, Knowledge Management and Dissemination**,** Strand: 2

SUMMARY: The Math and Science Partnership Knowledge Management and Dissemination project (MSP KMD) is charged with situating what the MSPs are learning in the broader knowledge base. One area of inquiry we have pursued involves STEM professional learning communities, an approach for improving mathematics/science teaching and learning that is included in a number of MSP projects. The MSP KMD project has collected and synthesized recent MSP research as well as the insights of experienced practitioners utilizing STEM PLCs as a key mechanism for enhancing teaching and impacting student success in mathematics and science. This session will address what we know from research and engage participants with the key practice-based insights of MSP leaders and other experienced practitioners on designing STEM PLCs.

Paper Session 2 – Summaries

Breakout Room 14:

Affecting and Documenting Shifts in Secondary Precalculus Teachers' Instructional Effectiveness and Students' Learning

Marilyn Carlson, Project Pathways: A Math and Science Partnership Program for Arizona Targeted Project Track-Education, Strand: 3

SUMMARY: The Pathways Precalculus Professional Development Model (PPDM) that includes focused workshops for teachers, in-class activities with detailed teacher notes, online videos and dynamic applets will be shared. Its design was based on lessons learned from Phase I research activities and findings. The PPDM student assessment data from over 30 Pathways precalculus classes revealed large gains in student understandings and ability to use the central ideas of precalculus. Analysis of data also revealed that improvement in teachers' content knowledge alone did not result in gains in student learning. However, when teachers were provided a research designed, conceptually oriented curriculum, with focused workshops and instructional resources to support their implementation, large gains in student learning and teacher effectiveness were achieved.

Assessing Mathematical Habits of Mind for Teaching

Sarah Sword, Focus on Mathematics, Phase II: Learning Cultures for High Student Achievement, Strand: 3

SUMMARY: Focus on Mathematics is a targeted MSP funded by the National Science Foundation since 2003. As part of this work, we are developing a research program with the goal of understanding the connections between secondary teachers' mathematical habits of mind (MHoM) and students' mathematical understanding and achievement. We are developing tools to study the question: What are the MHoM that high school teachers use in their professional lives and how can we measure them? In this session, we will share our working definition of effective teaching and describe how that definition is shaping the development of an assessment to measure MHoM.

Breakout Room 15:

How Do You Know if Your Project Is Resulting in Effective STEM Teaching?

Karin Wiburg, Mathematically Connected Communities - Leadership Institute for Teachers, Strand: 3

SUMMARY: The MC2-LIFT project has a strong research component which provides frequent feedback to the staff and participants in relation to meeting its purpose of developing mathematics teacher leaders. Researchers have been able to measure progress towards our definition of effective STEM teaching. The research team is also able to share findings with our institute development team and school support team who can use the data in developing revised content and modifying school support. This presentation will share our research design, research questions, methodology and instrumentation as well as current findings. So far findings indicate that it is possible for teachers with significant support to make positive changes in as little as one year in the quality of their mathematics teaching.

Developing Effective Math Teaching: Assessing Content Knowledge, Pedagogical Knowledge, and Student Success

Roger Peach, Math Teacher Transformation Institute, Strand: 3

SUMMARY: The Mathematics Teacher Transformation Institutes (MTTI) program attempts to develop math teacher leaders in part by providing content, inquiry and leadership courses aimed at making them more effective teachers. We assessed progress by observing their teaching practices, and encouraging them to introduce or extend inquiry-based pedagogy in their classrooms. We found there was little relationship between our measures of math content knowledge and effective teaching. But teachers who employed student-centered, inquiry-based pedagogy tended to be more effective as math teachers, at least if effectiveness is assessed by the extent to which their students were engaged in the lesson. We also found that we needed to broaden our concept of student success from the time we submitted our proposal.

Summary of Special Interest Groups

Tuesday, January 24, 2012
8 a.m. - 9 a.m.

Breakout Room 2: *STEM Education at the U.S. Department of Education*

U.S. Department of Education staff will discuss federal administration efforts through the Department of Education to stimulate and support K-12 STEM education.
Facilitator: Pat O'Connell Johnson, Team Leader, Mathematics and Science Partnership, United States Department of Education

Breakout Room 3: *Evaluation*

Evaluating MSP projects is challenging and important work that requires a wide range of resources and knowledge. This SIG offers an opportunity for MSP project evaluators to share how we approach the work, including our goals as evaluators, strategies, resources, and common challenges, and perhaps to develop a network of evaluators within the MSP community who continue to share ideas after the LNC.
Facilitator: Joan Karp, Senior Research Associate, Program Evaluation Research Group, Lesley University

Congressional A: *Common Core State Standards in Mathematics - Secondary*

This group will discuss the Common Core State Standards in Mathematics, focusing on the high school level and how to support the enactment of the standards for mathematical practice.
Facilitator: Bill Schmidt, University Distinguished Professor of Mathematics, Michigan State University

Congressional B: *Common Core State Standards in Mathematics - Elementary*

This group will discuss the Common Core State Standards in Mathematics, focusing on K-8 and how to support the enactment of the standards for mathematical practice.
Facilitators: Linda Foreman, President and Executive Director, Teachers Development Group
Amy Cohen, Professor of Mathematics, Rutgers University

Grand Ballroom: *Framework for K-12 Science Education and Next Generation Science Standards*

This SIG will include a brief review of the new Framework and the progress of the Next Generation Science Standards. The session will then focus on discussion, questions and answers related to these documents. The session will be led by the Director of the Board on Science Education at the National Research Council.
Facilitator: Martin Storksdieck, Director, Board on Science Education, National Academy of Sciences / National Research Council

Breakout Room 4: *Learning Progressions - Science*

Learning progressions in science form part of the foundation for the new Framework for K-12 Science Education and are an emerging area of research interest. This SIG will engage participants in discussion of what learning progressions in science are and how this area of research may be relevant to MSP projects.
Facilitator: Scott McDonald, Associate Professor, Science Education, Pennsylvania State University

Summary of Special Interest Groups

Tuesday, January 24, 2012
8 a.m. - 9 a.m.

Breakout Room 5: *Learning Progressions - Mathematics*

Learning trajectories in mathematics are a similar, or perhaps the same, idea as learning progressions in science. Last year's MSP Learning Network Conference keynote speaker, Jere Confrey, shared with the MSP community work she has been conducting on a learning progression for K-8 rational number reasoning. This SIG offers an opportunity to continue discussing what learning progressions in mathematics are and how this area of research in mathematics education may be relevant to MSP projects.
Facilitator: Susan Graupner, Mathematics Coordinator, Lincoln Public Schools

Breakout Room 9: *Nuts and Bolts of Project Management*

Managing MSP projects well is critically important and complex work. This SIG offers an opportunity for project directors and other project administrators to share wisdom, strategies, challenges, and opportunities in the work of managing MSP projects.
Facilitator: Julie Tilton, Project Director, West Texas Middle School Math Partnership

Breakout Room 10: *Ocean and Environmental Sciences*

Ocean and environmental sciences offer interdisciplinary and engaging science education opportunities. This SIG aims to bridge ocean and environmental efforts within the MSP Learning Network. The goal is to learn from each other, share best practices, knowledge, and networks, and further ocean and environmental science literacy nationally as well as locally. Please come to this SIG with handouts and other informational materials for distribution, and be prepared to discuss your interests informally for 2-3 minutes, as a prelude to sharing ideas, knowledge, and resources to increase connections between existing social and professional networks. This exchange is sponsored by COSEE Ocean Education Communities And social Networks (COSEE OCEAN), and as such serves as a connection to the national Network of 13 COSEE Centers.
Facilitator: Robert Chen, Professor, Earth, Environmental and Ocean Science Department, University of Massachusetts Boston

Breakout Room 11: *Engineering Education*

Collectively, recent MSPs awarded in the area of engineering education cover nearly the entire K-16 educational continuum and are involved in working with pre-service and inservice teachers to create and deliver innovative and exciting curricula that will allow their students to discover what engineering is, what engineers do, and the role that engineering plays in shaping their world. This SIG session will include brief overviews of each engineering-focused MSP, a summary of results to date, accomplishments and challenges, and a structured discussion on how to best move forward, both individually and collectively, in leveraging each others' experiences and expertise as well as how to effectively include stakeholders across the nation interested in engineering education.
Facilitator: Brenda Capobianco, Associate Professor, Engineering Education, Purdue University

Fishbowl Fish

Breakout Room 2:

Moderator: Melissa Reeves
Donna Horn
Stuart Karabenick
Libby Knott
George Nelson
Alan O'Bryan
Mary Beth Piecham

Breakout Room 3:

Moderator: Eric Banlilower
Lauren Beal
Charlene Czerniak
Kathryn Race
Ken Rath
Kacy Redd
Keith Sheppard

Breakout Room 4:

Moderator: Donald Wink
Marilyn Carlson
Blake Decker
Kaaren Fife
James Harrington
Gerry Meisels
Erin Militzer

Breakout Room 5:

Moderator: Todd Ullah
Serigne Gningue
Lynda Hayes
Harold McWilliams
Helen Meyer
Bernadette Mullins
Susan Tucker

Breakout Room 6:

Moderator: Kwang Suk Yoon
Becky Canty
Kimberly Childs
Mahesh Hosur
Scott McDonald
Christine Ong
Walt Stroup

Breakout Room 7:

Moderator: Brian Drayton
Liah Alphonso
Sean Bentley
Sarah Bonner
Douglas Kurtz
Joe Merlino
Joan Shaughnessy

Breakout Room 8:

Moderator: Kyrsis Rodriguez
Phyllis Balcerzak
Brooke Bradley
Lisa Delissio
Deborah Hecht
Susie Katt
David Pagni

Breakout Room 9:

Moderator: Pat Morandi
Meera Chandrasekhar
Nancy Cook Smith
Carol Cronk
Andrew Elby
Doris Kimbrough
Stephen Madigosky

Breakout Room 10:

Moderator: Felicia Martin
Fouad Abd-El-Khalick
Sheila Jones
Leslie Lukin
Alyssa Panitch
Geoffrey Phelps
Kathryn Rommel-Esham

Breakout Room 11:

Moderator: Kathleen Bergin
Alan Berkowitz
Michelle Borrero
Barbara Brizuela
Karen Collier
Keith Esch
William Schmidt

Breakout Room 12:

Moderator: Maura Borrego
David Burghardt
Lee Klingler
Bryon McIntyre
Jodie Novak
Joan Pasley
Susan Smith

Breakout Room 13:

Moderator: Pam Brown
June Apaza
Robert Curtis
Jennifer Dorsen
Edith Gummer
Carl Hanssen
Doug Sawyer

Breakout Room 14:

Moderator: Ron Buckmire
Amy Burns
John Coleman
AnneMarie Conley
Douglas Harris
Gary Harris
John Surendonk

Breakout Room 15:

Moderator: Lee Zia
Carol Baldassari
Tom Dick
Lisa Guerra
Patricia Roberton
Patrick Thompson
Michael Walker

Breakout Room 16:

Moderator: Dick Peterson
Aaron Cassill
Kristen Bass
Jan Hustler
Tala Khudeiri
Beth (Mary) Kubitskey
Catherine Skokan

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