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EDITORS
Laura McCullough
Leon Hsu
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Preface

The theme of the 2006 PERC, *Discipline-based education research in other STEM disciplines*, is reflected in a few of the articles, but the bulk continue to represent a very broad spectrum of directions within PER. The Editors would like to thank organizers Steve Kanim, Rebecca Lindell, Michael Loverude and Chandralekha Singh for organizing a stimulating and productive meeting.

This year marks the fourth year of publication of the PERC Proceedings by the AIP and the sixth year that a peer-reviewed volume has been produced. Feedback suggests that the Proceedings continue to play an important role. They provide a snapshot of ongoing research that can help characterize the PER community as a whole. They also provide a mechanism for authors to get feedback, for readers to find ideas, and for both to consider new collaborative efforts. For many members of the community the Proceedings also serve as valuable evidence of scholarly activity. Since the value of the Proceedings is determined as much by the referees as by the authors, it is traditional to thank them in the preface. Most referees are authors themselves. In fact, agreeing to review papers is a condition for submitting one. This system works well up to a point. Many authors, such as junior graduate students, are relative newcomers to the field. Some groups submit a large number of papers that increases the refereeing load but are not able to contribute a corresponding number of referees to the reviewing pool. In order to ensure that every paper submitted receives a fair review in a short period of time it has been the practice of recent editors to ask a few non-authors to review as a service to the community. Without the willingness of these people to devote time and energy to the Proceedings they would not be as good as they are. This year a total of 67 individuals reviewed more than 50 papers. Thanks go out to: Eugenia Etkina, Chandralekha Singh, Charles Henderson, Jennifer Blue, Valerie Otero, Kathleen Harper, Andy Elby, Scott Bonham, Jeffrey Marx, Charles De Leone, David Meltzer, Paula Engelhardt, Karen Cummings, Steven Pollock, Vincent Coletta, Melissa Dancy, Michael Wittmann, Richard Steinberg, Rebecca Lindell, John Thompson, Bob Beichner, Dean Zollman, Alice Churukian, Noah Finkelstein, Sanjay Rebello, Tom Foster, John Clement, Paul Ashcraft, Young-Jin Lee, Anna Karelina, Federica Raia, Katherine Perkins, M. L. Horner, Cathy Mariotti Ezrailson, Gyoungho Lee, Edward Price, Antti Rissanen, Jeffrey Phillips, Gary Gladding, Catherine Ishikawa, Kristin Walker, Zeynep Isvan, Daniel Haileselassie, David Rosengrant, E. Grant Williams, A. Lynn Stephens, Maria Ruibal Villasenor, Danielle Harlow, Jessica Maimis, Noah Podolefsky, C.J. Keller, Eleanor Sayre, Elizabeth Gire, Patrick Kohl, Brandon Bucy, Eugene Torigoe, Ossama Tfeily, Katrina Black, Dedra Demaree, Bijaya Aryal, Edgar Corpuz, Lili Cui, Jeff Saul, and Eric Brewe.

Two recent developments raise some important issues for the future of the Proceedings. One is the launch of *Physical Review Special Topics – PER*, which provides an additional publication venue. The Proceedings were started in the era in which many felt that growth in the community was far outpacing the ability of the *American Journal of Physics* to serve as the de facto publication venue. The advent of PRST-PER may change the way in which the PERC Proceedings are used and viewed. The other development is the establishment of the PER Topical Group in the AAPT and the election of its first
leadership committee. In the past the three editors of the PERC have invited a new member to join the team each year as the senior editor cycles off. It may be that the PER-TG may provide some input into the editorial succession in the future. In any case it seems probable that the PERC Proceedings will continue to evolve as the community does. I wish the future conference organizers and editors the best of luck.

Paula Heron
Outgoing Editor
Program
2006 Physics Education Research Conference
Syracuse, New York

Wednesday, July 26
3:30 - 5:30: Bridging Session: Invited Talks & Panel Discussion

3:30: Use of Concept Inventories to Identify Misconceptions in Thermal Sciences
Ronald L. Miller, Colorado School of Mines

4:00: Student Thinking About Rate of Change in Differential Equations
Chris Rasmussen, San Diego State University

4:30: Building the Biology Concept Inventory using Ed's Tools, an on-line response analysis system
Michael W. Klymkowsky, Rachel Gheen, Rebecca Koopman, Isidoros Doxas & R. Kathy Garvin-Doxas, University of Colorado, Boulder

5:00: Panel Discussion
Discussant: To be Announced

6:00 - 7:00: Dinner Banquet
Banquet Speaker: Jay Labov, NRC/NAS

7:00 - 9:00: Contributed Poster Session

Thursday, July 27
8:15 - 8:30: Orientation

8:15 - 9:45: Workshops, Targeted Poster Sessions & Roundtable Discussions- I
 Workshop W-B: PER and Human Subjects: The PER Community and Institutional Review Boards
Gordon Aubrecht, the Ohio State University

Targeted Poster Session TP-A: Issues and Innovations in Concept Inventory Development & Administration
Rebecca Lindell, Southern Illinois University Edwardsville

Targeted Poster Session TP-B: Physics Education Research Across Disciplinary Boundaries
Michael Loverude, California State University Fullerton
Targeted Poster Session TP-C:  Investigations of Student Learning in Upper Division Courses that Link Physics, Chemistry and Engineering  
Brad Ambrose, Grand Valley State University

Targeted Poster Session TP-D:  Bridging the Gap Between Instructors and Curriculum Developers: Facilitating Successful Communication and Promoting Customization  
Chandralekha Singh, University of Pittsburgh

9:45 - 10:00: Break

10:00 - 12:00: Invited Talks & Panel Discussion (Session II)  
Discussant: Chandralekha Singh

10:00: The Effects of Inquiry-Based Instruction on Elementary Teaching Majors’ Chemistry Content Knowledge and Their Views about Teaching Science  
Michael Sanger, Middle Tennessee State University

10:30: Rasch Analysis and the Geoscience Concept Inventory  
Julie Libarkin, Michigan State University & Steven W. Anderson, Black Hills State University

11:00: Astronomy Concept Inventories: Foundations and Frontiers  
Beth Hufnagel, Anne Arundel Community College

11:30: Panel Discussion  
Discussant: To be Announced

12:00 - 1:30: Luncheon Banquet  
Musician: Peter Haskell

1:45 - 3:15: Workshops , Targeted Poster Sessions & Roundtable Discussions - II

Workshop W-A:  Multiple Methods of Analyzing Reasoning About Quantum Tunneling  
Sam McKagan, University of Colorado & Michael Wittmann, University of Maine

Targeted Poster Session TP-A:  Issues and Innovations in Concept Inventory Development & Administration  
Rebecca Lindell, Southern Illinois University Edwardsville
Targeted Poster Session TP-B: Physics Education Research Across Disciplinary Boundaries
Michael Loverude, California State University Fullerton

Targeted Poster Session TP-D: Bridging the Gap Between Instructors and Curriculum Developers: Facilitating Successful Communication and Promoting Customization
Chandralekha Singh, University of Pittsburgh

Roundtable Discussion RT-A: Cross-Pollination in Science Education Research
Eleanor Sayre, University of Maine and Rebecca Lindell, Southern Illinois University Edwardsville

3:15 - 3:45: Break

3:45 - 5:15: Workshops, Targeted Poster Sessions & Roundtable Discussions - III

Workshop W-A: Multiple Methods of Analyzing Reasoning About Quantum Tunneling
Sam McKagan, University of Colorado & Michael Wittmann, University of Maine

Workshop W-B: PER and Human Subjects: The PER Community and Institutional Review Boards
Gordon Aubrecht, the Ohio State University

Targeted Poster Session TP-C: Investigations of Student Learning in Upper Division Courses that Link Physics, Chemistry and Engineering
Brad Ambrose, Grand Valley State University

Roundtable Discussion RT-A: Cross-Pollination in Science Education Research
Eleanor Sayre, University of Maine and Rebecca Lindell, Southern Illinois University Edwardsville
Poster Titles and Authors

Validation Studies of the Colorado Physics Problem Solving Survey
Adams, Wendy  University of Colorado, Boulder
Wieman, Carl  University of Colorado, Boulder

Use of Physical Models to Facilitate Transfer of Physics Learning to Understand Positron Emission Tomography
Aryal, Bijaya Kansas State University, Department of Physics
Zollman, Dean  Kansas State University, Department of Physics
Rebello, N. Sanjay  Kansas State University, Department of Physics

Modeling Aspects of Nature of Science to Preservice Elementary Teachers
Ashcraft, Paul  Penn State Erie, The Behrend College

Student Perceptions Of A Class’s Goals: Interclass Comparisons
Aubrecht, Gordon  Ohio State University at Marion
Lin, Yuhfen Ohio State University

Physics By Inquiry: A Model For Effective Education Reform In Mathematics And Science
Barsky, Constance Learning by Redesign, Physics Department, The Ohio State University

Students' Integration Methods For First-Order Differential Equations
Black, Katrina University of Maine
Sayre, Eleanor University of Maine
Wittmann, Michael  University of Maine

One Laboratory Course Serving Two Populations: Student Perceptions Of Their Understanding Of Physics And Their Group Roles
Blue, Jennifer  Miami University

Reliability, Compliance and Security of Web-based Pre/Post-testing
Bonham, Scott  Department of Physics and Astronomy, Western Kentucky University

From Physics To Physiology, A Spread Of Curricular Reform.
Brewe, Eric Hawaii Pacific University
Korsmeyer, Keith  Hawaii Pacific University
Student (Mis)Application Of Partial Differentiation To Material Properties
Bucy, Brandon R. Department of Physics and Astronomy, University of Maine, Orono, ME
Thompson, John R. Department of Physics and Astronomy, University of Maine, Orono, ME
Mountcastle, Donald B. Department of Physics and Astronomy, University of Maine, Orono, ME

Impact of a Classroom Interaction System on Student Learning
Bueckman, Joseph Kansas State University, Department of Physics
Rebello, N. Sanjay Kansas State University, Department of Physics
Zollman, Dean Kansas State University, Department of Physics

Comparison of Student Responses to Identical DC Circuit Questions When Presented on Different Diagnostics
Churukian, Alice D. Concordia College
Engelhardt, Paula V. Tennessee Technological University

Thinking in Physics
Coletta, Vincent Loyola Marymount University
Phillips, Jeffrey Loyola Marymount University

Refining Students’ Ideas of Microscopic Friction: A Case Study with Two Students
Corpuz, Edgar G. Kansas State University, Department of Physics
Rebello, N. Sanjay Kansas State University, Department of Physics

Using Physics Jeopardy Problems to Assess College Students’ Transfer of Learning from Calculus to Physics
Cui, Lili Kansas State University, Department of Physics
Rebello, N. Sanjay Kansas State University, Department of Physics
Bennett, Andrew G. Kansas State University, Department of Mathematics

The Effectiveness of Incorporating Context-Rich Conceptual Writing into Physics Education
Cummings, Karen Southern Connecticut State University
Murphy, Michael Southern Connecticut State University

A Post-Positivist Perspective on Physics Education Reform
Dancy, Melissa University of North Carolina at Charlotte
Henderson, Charles Western Michigan University
Adaptation And Implementation Of A Radically Reformed Introductory Physics Course For Biological Science Majors: Assessing Success And Prospects For Future Implementation
De Leone, Charles  California State University, San Marcos
Marion, Robin  California State University, San Marcos
Ishikawa, Catherine  University of California, Davis

Writing in an Introductory Physics Lab: Correlating English Quality with Physics Content
Demaree, Dedra  The Ohio State University
Gubernatis, Catherine  The Ohio State University
Hanzlik, Jessica  The Ohio State University
Franklin, Scott  Rochester Institute of Technology

Some Issues Of Test Items That Affect Students’ Performance
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Chabay, Ruth  North Carolina State University
Sherwood, Bruce  North Carolina State University

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Etkina, Eugenia  Rutgers University
Karelina, Anna  Rutgers University
Ruibal Villasenor, Maria  Rutgers University

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Sauer, Petra  Texas A&M University
McIntyre, Peter  Texas A&M University

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Gire, Elizabeth  University of California, San Diego
Price, Edward  California State University, San Marcos
Jones, Barbara  University of California, San Diego

Evaluating Web-Based Tutorials To Develop Expertise In Introductory Students
Haileselassie, Daniel  University of Pittsburgh
Singh, Chandralekha  University of Pittsburgh

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Freuler, Richard J. The Ohio State University
Demel, John T. The Ohio State University

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Beach, Andrea   Western Michigan University
Famiano, Michael Western Michigan University

Comparison of Teaching Methods for Energy Conservation
Horner, M. L. Southern Illinois University Edwardsville
Jeng, Momo   Southern Illinois University Edwardsville / Syracuse University
Lindell, Rebecca Southern Illinois University Edwardsville

Threatened Because of Gender?
Humpherys, Candice  BYU-Idaho Department of Physics
Pyper, Brian A.   BYU-Idaho Department of Physics

Tutorials on Coulomb's law and Gauss's law
Isvan, Zeynep   University of Pittsburgh
Singh, Chandralekha University of Pittsburgh

Investigating Students’ Ideas About X-rays While Developing Teaching Materials for a Medical Physics Course
Kalita, Spartak  Kansas State University, Department of Physics
Zolman, Dean   Kansas State University, Department of Physics

When And How Do Students Engage In Sense-Making In A Physics Lab?
Karelina, Anna  Graduate School of Education, Rutgers University
Etkina, Eugenia Graduate School of Education, Rutgers University

Studying the Use of Computer Simulations in Undergraduate Laboratory Environments
Keller, Christopher University of Colorado at Boulder
Finkelstein, Noah  University of Colorado at Boulder
Perkins, Katherine University of Colorado at Boulder
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Finkelstein, Noah  University of Colorado at Boulder

Addressing Students’ Difficulties in Understanding Two Different Expressions of Gravitational Potential Energy (I): mgh & -GMm/r
Lee, Gyoungho  Department of Physics Education, Seoul National University
Yi, Jinseog  Department of Physics Education, Seoul National University

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Lee, Young-Jin  MIT
Palazzo, David  MIT
Warnakulasooriya, Rasil  MIT
Pritchard, David  MIT

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Li, Pengfei  The Ohio State University
Reay, Neville  The Ohio State University
Bao, Lei  The Ohio State University

Using the Physics Modeling Method in the Chemistry Classroom
Mamais, Jessica  Olentangy Local Schools

Learning and Dynamic Transfer Using the ‘Constructing Physics Understanding’ (CPU) Curriculum: A Case Study
Mamolo, Charles B.  Kansas State University, Department of Physics
Rebello, N. Sanjay  Kansas State University, Department of Physics

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Cummings, Karen  Southern Connecticut State University

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Montenegro, Maximiliano  Department of Mathematics, Science and Technology Education, OSU
Aubrecht, Gordon J II  Department of Physics, Ohio State University, Marion
Bao, Lei  Department of Physics, The Ohio State University, Columbus
**Student Estimates of Probability and Uncertainty in Statistical Physics**
Mountcastle, Donald B. Department of Physics and Astronomy, University of Maine
Bucy, Brandon R. Department of Physics and Astronomy, University of Maine
Thompson, John R. Department of Physics and Astronomy, University of Maine

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Murthy, Sahana Massachusetts Institute of Technology (previously, Rutgers University)
Etkina, Eugenia Rutgers University

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Jalovec, Stephanie University of Colorado at Boulder
Harlow, Danielle University of Colorado at Boulder

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Lindell, Rebecca Southern Illinois University Edwardsville
Foster, Thomas Southern Illinois University Edwardsville

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Simon, Beth University of California, San Diego
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Steinberg, Richard  City College of New York and CUNY Graduate Center

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Van Heuvelen, Alan  Rutgers, The State University of New Jersey

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Clement, John J. University of Massachusetts - Amherst

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Teaching Interventions to Increase Outside Class Study Hours of Non-Science Majors Taking Physical Science Courses
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Analysis of Shifts in Students’ Reasoning Regarding Electric Field and Potential Concepts
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