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New Members

In Fall, 2008, seven faculty members became CRMSE members: Andrew Izsák, Meredith Houle, Jessica Pierson, Sara Unsworth, Tom Carey, Tom Impelluso, and Cynthia Park. CRMSE members have enjoyed getting to know our new colleagues over the past year. This article will help you learn more about Andrew, Meredith, Jessica, and Sara. We'll feature Tom, Cynthia, and Tom in the next issue of Quest.

Meredith Houle

Meredith is an assistant professor of science education in the School of Teacher Education in the College of Education. She earned her Ph.D. in Curriculum and Instruction with a concentration in Science Education from Boston College in 2008. Prior to SDSU she had several different appointments in the Lynch School of Education and the Biology Department at Boston College. She also worked as a Curriculum Consultant at the Urban Ecology Institute in Chestnut Hill, MA, as a chemist at Groundwater Analytical in Buzzards Bay, MA, and as a high school science teacher in Hyannis, MA.

Research Focus and Current Work:

Meredith's research focuses on ways to engage students in science through issues such as urban ecology, and ways to support teachers in that work. She examines ways that socioscientific issues such as climate change, biodiversity or water use can be used to leverage and engage students in science. While such topics may engage youth in science, it's difficult for teachers to help their students examine these issues. Meredith is interested in examining the ways to support teachers in doing that kind of work. She is studying professional development and curriculum materials to provide that support for teachers.

One of Meredith's recent research projects involved urban youth studying the impact of noise pollution on bird communication. A few research studies suggested that some birds in cities raise the pitch of their song because most noise pollution tends to be at lower frequencies. Students learned about the physics of sound while studying bird song; they recorded bird songs in their schoolyard and examined the frequencies of both the noise pollution and the bird songs. In addition to student learning, Meredith also studied how teachers used these curriculum materials while enacting the project.

Meredith has provided in-classroom support for teachers. She found it was helpful but difficult to sustain and expand to serve more teachers. She became interested in educative curriculum materials: materials that help teachers anticipate student needs and misconceptions. These materials often include a range of what some students might come up with and pedagogical choices teachers could make to support those students.

Meredith's work morphed into a year-long course in urban ecology for high school students that was taught in five cities across the nation this past year. The goal is for these course materials to be published as a high school curriculum, after it undergoes further revision. Meredith has been working with a group of teachers in Boston, Rhode Island, Phoenix and Chicago to study how these teachers are implementing the urban ecology course. She has interviewed these teachers and videotaped them planning and teaching the course.

Meredith is interested in learning about how science teachers use curriculum materials, including what they read, how they process what is there, and how different teachers make sense of the process of planning with curriculum. What educative features are useful for what kinds of teachers? Could we develop digital versions of curricula where teachers could self-select resources based on some sort of criteria? These possibilities will provide more support for teachers with different needs. Meredith is working on identifying what sorts of support teachers need.

Meredith also is working on another project with CRMSE member Dr. Alberto Rodriguez in the Department of Policy Studies in Language and Cross Cultural Education. They are studying the design of science methods courses for prospective elementary teachers to better prepare them to teach English language learners. Their primary focus has been on redesigning the course itself with a team of methods faculty from San Diego State, San Francisco State, and San Jose State. They are discussing how to incorporate research-based strategies into the course. Meredith is enjoying this opportunity to meet with a group of other math and science faculty to discuss aspects of this course from different theoretical angles and different experiences.

Currently they are surveying pre-service teachers about their beliefs about science teaching and learning, and then they will conduct observations in their pre-service year and in their first year of teaching to determine if they are actually implementing in their classrooms the practices they believe are characteristic of good
Meredith, “That was the first time I ever realized that science wasn’t just these things that we already know in a textbook. There was actually stuff to discover and it was fun; and so I decided I wanted to be an ecologist.”

She started graduate school in ecology but then developed an interest in teaching. She decided to go back to the classroom and teach high school for a year—but then missed doing research. Meredith found that in science education you can do research AND education—and decided that was the perfect balance for her.

**Outside-of-Work Interests:**

Meredith likes to take her puppy Rooney to the beach and dog park with her fiancé Marty, and enjoys the San Diego weather.

**Andrew Izsák**

Andrew Izsák (pronounced “ee-jacques”) is an associate professor of mathematics education in the Department of Mathematics and Statistics in the College of Sciences. He earned his Ph.D. in Science and Mathematics Education from UC Berkeley in 1999. Prior to SDSU he was an assistant and associate professor at the University of Georgia and a post-doctoral researcher at Northwestern University.

**Research Focus and Current Work:**

When he started graduate school, Andrew was interested in students’ interpretations of graphs. He began examining students’ misconceptions and difficulties they had with graphs. His doctoral dissertation examined the knowledge that students use to build their own algebraic representations of a physical device. Andrew was intrigued by students who did things in novel ways and invented algebraic notations, and he examined the sort of knowledge they had for doing that. More recently he became interested in teachers’ capacities to reason with drawn models for fractions and arithmetic with fractions.

Andrew is interested in the knowledge that people use to reason with inscriptions. Inscriptions refer to things that people write on paper to help themselves as they reason about a problem, including a conventional graph or equation, a diagram, and other idiosyncratic notations that people generate. Inscriptions include various models for fractions, such as area models and number line models.

Andrew has more recently become interested in psychometrics, which are statistical models that measure understanding, i.e., statistical models for testing. During his early National Science Foundation-funded work at the University of Georgia, Andrew considered how to conduct classroom-based instruction to get data on both students’ and teachers’ understandings of lessons in which they participated together. The idea was to build methods for understanding how kids made sense of lessons and how teachers made sense of the same lessons to see where the points of contact were and where there were very different understandings. He did a set of case studies at a school in Georgia that followed students from grade six through grade eight. The grade six students turned out to be the most interesting for him because there
was lots of discussion about number line models and area models; and he could see teachers and students grappling with using these models to make sense of the content, including fraction addition, multiplication, and division. He saw this as a case of using inscriptions and how learners think about partitioning and units.

In a subsequent National Science Foundation-funded project, Andrew wanted to examine teacher learning in professional development that emphasized the use of drawn models for fraction arithmetic. He looked for existing instruments to measure mathematical knowledge for teachers, but there was inadequate alignment between the content of existing instruments and the content of the professional development. They constructed a new instrument that was a hybrid of items that were developed at the University of Georgia and items that were borrowed with Deborah Ball’s permission from instruments developed at the University of Michigan.

Andrew is currently working with others on a National Science Foundation-funded project called Diagnosing Teachers Multiplicative Reasoning. They are developing a new assessment of teachers’ knowledge of fractions, decimals, and proportional reasoning, focusing on both common content knowledge and specialized content knowledge, such as items involving area models, number line models, and other kinds of models that a teacher would use in instruction with students but which would probably not be used in everyday activities in solving a problem. They are currently interviewing teachers in the San Diego area and some in Georgia and analyzing how well the test items are working. Last summer a group of undergraduate students helped with the interviewing and analyzed the data in a hands-on apprentice model. Two of these students are planning to be middle grades mathematics teachers, and Andrew is hoping some of them may consider graduate school at some future point.

Andrew hopes that this kind of instrument will be more useful for people who do professional development because it will be narrowly focused content and more sensitive to the kinds of growth and change that one might see in teachers’ understanding over a longer period of time, such as one year. This might produce data on increasingly sophisticated understanding of fractions to actually start thinking about multiple relationships between the parts and the whole. These are the kinds of understandings that Andrew is trying to tap into with this instrument.

**Why Andrew Became a Math Educator:**

Andrew originally planned to become a professional mathematician, graduating with a bachelor’s degree in math, and then on to a doctoral program in math, where he discovered the difference between really liking math and loving math. The job market was so terrible that you had to really love pure mathematics to pursue a career as a researcher. He decided to find another field in which to do research. Andrew had spent a year working as a tutor in junior high school in Berkeley between college and graduate school. He worked with small groups of students from many different classrooms, where he saw a range of teachers and kids. This experience introduced Andrew to manipulative materials for the first time, and also showed him that students in the advanced math track were not always as creative at solving problems as many of the students in the regular track. This led him to be interested in math cognition versus achievement. When Andrew decided to end his doctoral work in mathematics, he looked into math education. He worked with Judah Schwartz at Harvard, where he saw Judah teach algebra using software that he had developed. This was a pivotal experience; Andrew worked for Judah for a year at Harvard and then went to Berkeley’s doctoral program in math education. After graduate school, Andrew worked for two years as a post-doctoral student with Karen Fuson at Northwestern, where he began doing research in classrooms. He wrote multi-digit multiplication and division units for grades four and five, worked with teachers who were piloting the lessons, and conducted interviews with the kids to see what sense they were making out of the lessons. He became very interested in what the teachers thought of the drawings of area models, which was a springboard to his current work.

**Outside-of-Work Interests:**

Andrew loves hiking and backpacking and is very interested in photography. He especially likes to photograph people in their environments, such as at street fairs, county fairs, carnivals, rodeos, and car races, observing the great characters there. He also enjoys music. Andrew studied classical piano for years and has a big interest in jazz.
Jessica Pierson

Jessica is an assistant professor of mathematics education in the School of Teacher Education in the College of Education. She earned her Ph.D. in Math Education from the University of Texas in 2008. Prior to beginning her graduate studies, she taught high school math in Coppell, TX.

Research Focus and Current Work:
Jessica’s research focus is on the social space of classrooms. She examines aspects such as classroom discourse, student identities, and interactional routines to better understand how teachers and students together, co-construct mathematical meaning. Thus far she has primarily studied classroom discourse, examining how discourse creates and sustains the more global and organizing structures, norms, expectations, and activities of a classroom. Jessica also examines the impact of moment-to-moment discursive patterns on student learning and mathematical identities and dispositions. Jessica noted that one of the most fascinating things to her is that classroom discourses are never the same so there is always something new and interesting to study.

For example, she has investigated the idea of mathematical identity, including how it develops and is reinforced in the classroom and ways it can impact students’ learning. Interestingly, Jessica did not set out to study identity, instead intending to focus on the ways in which two seventh-grade girls interacted with novel technology and other tools while learning about rate and proportionality. But what emerged in this study was the fact that the pair’s mathematical learning was inhibited by the identities they were enacting. Jessica carefully examined how the pair enacted their math identities in their small group, what influenced the identities these girls took up, and how their identities impacted their learning of mathematics. For example, one of the girls, Bonnie, commented that her partner, Teri, “has always been the smart one, I’ve always been the dumb one”. In exploring why she would say this, Jessica found that Bonnie’s identity of the “dumb” one was reinforced in the ways that the girls interacted: she was consistently positioned as mathematically incompetent with little to contribute to group discussions and problem-solving strategies. She also observed that the girls’ discourse showed that Bonnie had significantly fewer turns to talk, rarely initiated a mathematical conversation, and spent most of her conversational turns agreeing with Teri’s comments or responding to Teri’s requests to perform basic mathematical tasks, such as reading points off of graphs. Ironically, when Bonnie did propose ideas, they were usually mathematically sound and often novel, indicative that she wasn’t the “dumb” one after all… that she actually had some really good ideas. Jessica ultimately found that these two students’ mathematics identities impacted who had access to doing what type of mathematics, whose ideas were privileged and taken up, and how the students successfully (or unsuccessfully) co-constructed mathematical meaning.

Future Plans:
Jessica is co-PI, working with Lisa Lamb and Randy Philipp, on a new grant from the National Science Foundation that will examine students’ conception of integers and operations on integers, and will map the developmental trajectories related to these concepts. This work is similar to and can be thought of as an extension of the Cognitively Guided Instruction (CGI) framework for problem types and solution strategies for addition, subtraction, multiplication and division.

She also plans on expanding the work she began with her dissertation, in which she combined discourse analysis and hierarchical linear modeling to study effective discourse practices and their relationship to student learning in seventh-grade SimCalc classes. She wants to further explore a subtle but often-overlooked characteristic of teaching: the moment-by-moment ways teachers talk and respond to their students. For instance, consider a group of students solving the following problem: “I have three jelly beans, and my brother gave me five more. How many do I have now?” If a child responds 8, the teacher might say something like “Yes, that’s great, wonderful.” But another kind of response would be, “Who agrees or disagrees?” One might imagine the different kinds of classroom environments and expec-
Why Jessica Became a Math Educator:
In order to understand why Jessica became a mathematics educator, we first need to learn about why she became a math major. As with many other math majors, Jessica majored in math almost by default. She was always quite good at mathematics in school but the transition to college-level mathematics courses was a very rude awakening to her—she could no longer breeze through her classes. It was at first alarming but then became a pleasant surprise to be challenged in that way. She really enjoyed the challenge—and then decided to get certified and become a math teacher in order to share that same excitement and challenge with students.

While thoroughly enjoying being a high school teacher, Jessica always felt the tension of being unable to cover the content in a way that was appropriate in the available time frame. While she was teaching high school math, she worked closely with another teacher, jointly planning, using the same textbook, class activities, homework, and assessments—but their classrooms were very different places; in fact, on the end-of-year exams the other teacher’s students typically outperformed Jessica’s. Jessica wondered what she needed to do to be a more effective math teacher. She said, “I always thought if I could just pick the right problem set, or if I could give just the right explanation—it was always about me and not the students. That question, I think, drove me into math education”. She enrolled in graduate school full-time after four years of teaching. Jessica decided to focus her graduate work on mathematics first, earning her masters degree in mathematics, and then turning to math education. She describes her decision as follows, “I love mathematics . . . I have a love for mathematics . . . I like the challenge of it . . . I like the beauty of it . . . but I also love the social space of the classrooms and the unpredictability that they bring as well.”

Outside-of-Work Interests:
Jessica enjoys hiking—everywhere from Mission Trails Park to Iron Mountain, the Cuyamaca’s, the Lagunas. She also enjoys hiking back home in Texas, with her fiancé Buddy. She is a big Texas football fan although her first love is basketball (she played collegiately). She is enthusiastically looking forward to watching the Texas Longhorns win the national championship this January!

Sara Unsworth
Sara is an assistant professor in the Department of Psychology in the College of Sciences. She earned her Ph.D. in cognitive psychology from Northwestern University in 2008. Sara hails from Canada, receiving her bachelors and masters degrees in psychology from the University of Calgary.

Research Focus and Current Work:
In her research, Sara examines conceptions of the natural world, examining how those conceptions change across development from early childhood through adulthood and also how they may vary across cultural communities. Her work over the last several years has been primarily with Native Americans and non-Native communities, both in rural and urban locations, and more recently with Buddhist communities.

Sara examines the relationship between cultural practices and beliefs, and the implications of this work for science and environmental education. She’s particularly interested in considering the implications for science education for Native American populations because of the under-representation of Native Americans in science and engineering. For example, it’s puzzling that in San Diego County, the drop in science performance from fifth to tenth grade for Native American students is greater than for students from all other ethnicities (though Hispanic and African American are close seconds) and is greater than for other subjects. In science, the percentage of Native American students performing at basic levels or higher in science drops from 80% to 58% from grade 5 to grade 10! In addition, only .007% of all bachelor’s degrees are going to Native Americans (which currently make up approximately 1.5% of the total US population), and only 9% of those degrees are in science and engineering. There has been quite a bit of research conducted within the past 10 years showing that, for example, in a lot of cases and in a lot of communities, Native American children often
have very sophisticated understandings of their local natural environment. They are more likely than non-Native children to engage in ecological reasoning, and they often express an affinity toward the natural world. So what is happening in science classrooms between fifth and tenth grade?

Recent research conducted by Sara and others in her research team has shown that one likely cause is a mismatch between the cultural frameworks that are privileged in science classrooms. These frameworks tend to be based on European-American perspectives. Her most recent research shows that Native American children often are aware of these multiple frameworks, because they are often bicultural and often attend a western-style school system. The low achievement likely has something to do with the extent to which they feel like their traditional cultural knowledge is valued in the classrooms.

Lately Sara has been looking at self-efficacy in science among Native Americans and non-native middle-school and high-school students. She has found that the extent to which Native American youth feel like they want to be or could be a scientist is associated with perceiving their tribe as using science and with a stronger sense of their cultural identity.

Sara is also examining how cultural ideas are learned within Native American communities, which could lead to implications for instruction and educational practice. She has been looking at discourse practices among Menominee Native Americans and European Americans in rural Wisconsin and has found that Native Americans are more likely to think of themselves as a part of nature (rather than apart from nature), which is supported by a greater likelihood to tell descriptively-rich stories about personal experiences in nature and to use gestures that reflect first-person perspective-taking of non-human animals (e.g., using arms to mimic flying like an eagle). She has recently found that engaging and mimicking those kinds of gesture practices is cognitively related to greater perspective-taking of non-human animals, which is related to greater perceived similarity between oneself and other animals. She notes that using these discourse practices in the classroom may help to bridge multiple ways of thinking about humans and nature for Native American children, and potentially for all children. Ann Rosebery and colleagues at the Cheche Konen Center in Boston have found that increasing opportunities for supporting diversity in the classroom benefits not just students with particular cultural backgrounds, but all students in the classroom. It is important not to just think about education for Native American students but really for giving all students lots of different opportunities to think about concepts in different ways.

Sara is also examining the implications of her findings for environmentally-related behavior. Her preliminary findings show that thinking of oneself as a part of nature, as is the case for many Native Americans and for Buddhists, is related to greater likelihood to engage in conservation behaviors. She is currently exploring this more deeply.

Sara currently is working in an American Indian college recruitment (AIR) program, which is a non-profit American Indian organization directed by a Hopi man named Dwight Lomayesva. The program involves middle-school and high-school Native American students living in San Diego and on reservations in San Diego County, and the goals are to promote higher education while strengthening Native American cultural identity. This program takes place at SDSU, USD, and CSU San Marcos, and Sara has partnered up with this program to conduct research and evaluate the effectiveness of the program.

She has found that this program is working well to support American Indian students. The level of student participation is related to the likelihood that students state they will go to college as an adult, to students’ sense of efficacy in science, and to the strength of their cultural identity. This work was the basis for a recent grant proposal that she wrote. She plans to continue investigating these questions in order to use that data to inform the design of culturally-based educational instruction.

**Future Plans:**

Sara plans to continue conducting research looking at discourse practices that support cultural variations in perspectives of the natural world and cultural world views. She will work more closely with the Buddhist community and also with Native-American communities to examine the role of storytelling, metaphor use, and gestures in cognition.

She will also continue to examine developmental trajectories for cultural learning and cognitive develop-
ment. She recently examined cultural variation in concepts of nature among Native American and European American children and found cultural differences in children as young as 5 years of age. She will build on these findings to continue exploring the interaction between more intuitive (or core) conceptions of nature and culturally-learned conceptions of nature. She has recently been awarded an NSF grant for enhancing diversity in the geosciences (working with Eric Riggs at Purdue University and Eleanor Robbins at SDSU) and will be examining cultural concepts of the earth and earth sciences in Native American youth between the ages of 5 and 18.

Sara is interested in examining ways to develop stronger links between her research and education in order to support the education of students from diverse cultural backgrounds. Her participation in CRMSE provides opportunities for her to develop those kinds of goals. Her future goals are to continue strengthening relationships with communities, collaborating with faculty across disciplines, and to continue building on the foundation of research that she’s been developing over the last year.

**Why Sara Became a Science Educator:**

As an undergraduate student in Canada, Sara realized that most of what was known in psychology was based on research conducted with middle-class European-American subjects, most of whom were undergraduate students—and there was little research done on cultural variations. This prompted her to focus on cultural research on different communities. She worked with Doug Medin at Northwestern University, who invited her to go with him on a trip to the Menominee Native American reservation. She began participating regularly in Native American communities in Chicago and Wisconsin. She made friends in the communities and gained a new perspective while working on educational projects within those communities. Sara has had ongoing discussions with the chairperson of the Menominee tribe, Lisa Waukau, who also served on her dissertation committee. Chairperson Waukau discussed with Sara the concept of a moral compass; she said everybody really needs to develop a moral compass that will help them carry through life. Sara noted that her work with Native Americans has helped develop her moral compass for the kinds of contributions she wants to make in this world. She ultimately dedicated herself to work that would help to increase support for cultural diversity in the sciences.

**Outside-of-Work Interests:**

Sara enjoys many aspects of San Diego. She works with a community group to plant native plants to support the development of the ecosystem. She also enjoys hiking and sitting peacefully with nature. If she can find more time, she would like to resume swing dance lessons with her husband Jason.

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**Learning Progressions for Scientific Inquiry**

Fred Goldberg and Sharon Bendall
San Diego State University

David Hammer and Janet Coffey
University of Maryland

April Maskiewicz
Point Loma Nazarene University

Fred Goldberg and Sharon Bendall are currently recruiting teachers for participation in a science education project funded by the National Science Foundation. This project was funded in a highly competitive solicitation in which only two awards were made, one in mathematics education and one in science education. The goals of this project are (1) to identify learning progressions for students and teachers in scientific inquiry and its facilitation, and (2) to develop model materials and strategies for grades three through six in curriculum and teacher professional development. The outcomes of this project are of national interest.

Regarding the first goal, despite years of awareness of its importance, science education has yet to achieve a systematic focus on inquiry. Often, it is not an objective in itself but is seen as merely a means to achieving the objective of students’ correct understanding of facts and concepts. When
Professional Accomplishments

Note: CRMSE members in **bold** text. Faculty Emeritus are in *red*. Current and former graduate students in *orange* text.

**Nadine Bezuk** is a member of the Teaching Mathematics Advisory Panel, California Commission on Teacher Credentialing, a member of the Program Committee for the National Council of Supervisors of Mathematics’ 2010 Annual Conference, and a member of the Nominations Committee of the National Council of Teachers of Mathematics. She also serves as the Executive Director of the Association of Mathematics Teacher Educators (AMTE), and in December, 2009 will complete her term as Immediate Past President of the California Association of Mathematics Teacher Educators. Also, the fifth edition of her elementary mathematics methods textbook, *Learning mathematics in elementary and middle schools: A Learner-centered approach* will be published in January, 2010, by Pearson.

The SemanticaEdu software developed by **Kathleen Fisher**’s research groups is now being offered FREE to anyone who may be interested. It allows users to create semantic networks (extended concept maps). It can be used as a learning tool or to organize research papers and their interconnections or social networks, etc. If interested, write to: kfisher@sciences.sdsu.edu for download instructions. In addition, Kathleen organized the third meeting of the Conceptual Assessment in Biology group in San Diego in May, 2009, in conjunction with AMSCUE, the American Microbiology Association Conference for Undergraduate Educators.

**Vicki Jacobs** and **Randy Philipp** hosted the Fifth Biennial National Conference for Cognitively Guided Instruction (CGI) from July 30–August 1, 2009. More than 300 teachers and researchers from across the U.S. spent time exploring children’s mathematical thinking, and attendees were treated to a panel discussion by the co-founders of CGI, Thomas Carpenter and Elizabeth Fennema. Also, **Vicki Jacobs** began a term on the JRME Editorial Panel in May, 2009.

**Tom Impelluso** will serve as a panelist at the NAEP Science Standard Setting meeting in January, 2010. This panel will establish achievement-level cut-scores on the 2009 National Assessment of Educational Progress (NAEP) in science, which is part of the Nation’s Report Card in science.

**Joanne Lobato** is currently serving on the following advisory boards:

- Advisory Board Member, *Diagnostic e-learning trajectories approach* (DELA); directed by Jere Confrey, Mark Wilson and Lawrence Berger and funded by the National Science Foundation REESE program, 2007-2009.
- Advisory Board Member, *Framing learning contexts to promote transfer-of-learning*, an NSF CAREER award to Randi Engle, UC-Berkeley, 2009-2014.
- Advisory Board Member, *Transfer of perceptually grounded principles*; directed by Robert Goldstone, Indiana University, and funded by the NSF REESE program, 2009-2012.
- Advisory Board Member, *Justification in algebra: Growing understanding of algebraic reasoning* (JAGUAR); directed by Sean Larsen, Eva Thanheiser, Terry Wood, and Megan Staples, funded by the NSF REESE program, 2008-2011

Joanne continues to serve as the Editor for the Transfer Strand of the *Journal of the Learning Sciences* and is also on the Editorial Board for Mathematical Thinking and Learning. She was selected in 2008 for President Weber’s Top 25 award, a recognition program that honors 25 individuals who accomplished transformational work at SDSU, and was recognized by SDSU Provost Nancy Marlin in January, 2009.

**Cheryl Mason** served as an Editorial Review Board Member for the *International Journal of Environmental & Science Education* (IJESE) during 2008-2009, and as a 2009 Distinguished Executive Board Member, STEM (Science, Technology, Engineering and Mathematics) Challenge Grants (part of President Obama’s stimulus package), National Institutes of Health. Cheryl also chaired proposal review panels for education for the Human Resources Directorate, Division of Elementary, Secondary and Informal Science Education, National Science Foundation in 2008-2009.

**Jessica Pierson** received the Recognition of Merit from Phi Delta Kappa for their 2008-09 Outstanding Doctoral Dissertation Award. Jessica was one of four finalists internationally. Jessica also is serving as section co-chair for American Educational Research Association’s Division C (Learning), Mathematics, for their 2010 Annual Meeting in Denver, CO.

Publications: 2008–Present

Note: CRMSE members in **bold** text. CRMSE associate members are in *red* text. Current and former graduate students in *orange* text.


**Carey, T.T.** (in press). Best practices in teaching (Introduction to Section Four) and Three perspectives on teaching knowledge: Craft, professional and scientific (Chapter 12). In Mighty, J. and Christenson-Hughes, J. (Ed.), *Taking stock: Research on teaching and learning in higher education*. London: Queen’s University Press.


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Learning Progressions for Scientific Inquiry
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it is included in curricula, it is generally in the form of “inquiry activities” tacked onto an otherwise traditional approach. This project takes inquiry as a central objective, defining it as the pursuit of mechanistic accounts of natural phenomena. Scientists are experts at this pursuit; learning science means learning to engage in it. This project aims to identify learning progressions in service of learning science by engaging in it with the same kind of pursuit and thought processes practiced by professional scientists.

Regarding the second goal, instruction developed in this project is centered on educators recognizing and responding to resources children bring to learning science, resources that are likely to vary with students’ experiences and upbringings. Modules and instructional strategies developed in the project will help teachers become more effective at identifying and promoting student thinking regarding scientific inquiry in their classrooms. Teachers will use inquiry strategies with District-adopted materials and with a grade-appropriate, fifteen to twenty hour module developed by the project.

Teachers will work with project staff to videotape and transcribe snippets of learning from their classes and discuss them at professional development meetings. Staff will also work with teachers to collect student work samples for analysis of understanding and reasoning. Classroom videotapes, videotapes of all professional development meetings, transcripts, student work samples, and written observations from staff will be the basis for the project outcomes.

The research team consists of a group at San Diego State University and Point Loma Nazarene University with extensive experience in innovative curriculum development, and a group at the University of Maryland, College Park, that has been developing new perspectives on the learning and teaching of scientific inquiry. The project is working with 14 elementary and middle school teachers from the San Diego Unified School District.

Professional Accomplishments
(continued from page 9)

Nickerson, will be published in January, 2010, by Freeman.

Sara Unsworth and Joanne Lobato are participating in the SDSURF Professors helping Professors (PhP) program. This program pairs successfully funded senior principal investigators with talented junior faculty members to develop senior principal investigators with talented junior faculty members to develop grant proposals. The goal is to enhance research capabilities by increasing grant and contract activity and providing outreach to faculty new to extramural funding. Sara submitted a grant proposal to the NSF CAREER program in July, 2009.

Kathy Williams was selected in 2009 for President Weber’s Top 25 award, a recognition program that honors 25 individuals who accomplished transformational work at San Diego State University. She was honored for her ongoing efforts to enhance science education for undergraduates.


Bowers, J., Bezuk, N.S., & Aguilar, K. How can didactic objects be designed to support online learning of mathematics? Annual Conference of the Society for Information Technology and Teacher Education. San Diego, CA, March, 2010.


Carey, T.T., & Lopes, V. An engagement levels framework to foster interactions across SOTL collaboratories. Poster presentation at International Society for the Scholarship of Teaching and Learning, Bloomington, IN, October, 2009.

Carey, T.T., & Pierre, E. Emerging technologies to support SOTL collaborations across institutions. Panel presentation at International Society for the Scholarship of Teaching and Learning, Bloomington, IN, October, 2009.


Carey, T.T. Knowledge EDG*ES: Collaborative faculty teams to accelerate innovations in teaching. Presentation at Improving University Teaching (IUT) 34th International Conference, Simon Fraser University, Burnaby, B.C., July, 2009.

Carey, T.T. Using digital case stories to share innovations in teaching. Workshop at Improving University Teaching (IUT) 34th International Conference, Simon Fraser University, Burnaby, B.C., July, 2009.


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Philipp, R.A. Motivating prospective elementary school teachers to learn mathematics. Presentation to faculty and instructors at Portland State University, Portland, Oregon, February, 2009.


Philipp, R.A. Defining and developing mathematical content knowledge for teaching elementary school mathematics. Presentation as part of a symposium at the annual meeting of the Association of Mathematics Teacher Educators, Orlando, Florida, February, 2009.


Philipp, R.A., Jacobs, V.R., Lamb L., Siegfried, J., & Schappelle, B. Using video and student work focused on children’s thinking to help professional developers support elementary school teachers in transforming their teaching. Pre-conference session to be presented at the annual meeting of the Association of Mathematics Teacher Educators, Irvine, CA, January, 2010.


Williams, K.S., Fisher, K.M., & Lineback, J. Learning how students think about science: Developing diagnostic questions. Invited poster presented at Transforming Undergraduate Biology Education: Mobilizing the Community for Change Meeting. Special meeting convened by the American Association for the Advancement of Science with support from the Directorates for Continued on page 19
Center for Research in Mathematics and Science Education – Grant Updates

Note: CRMSE members in bold text.

Bezuk, N.S., & Bowers, J., Improving Student Achievement in Mathematics (ISAM), Qualcomm, Inc.

ISAM’s work this year focuses on moving their mathematics specialist certificate program of professional development for elementary teachers to an online delivery format, in order to serve teachers from a wider geographic area.

Bowers, J., Universal Design for Teaching and Learning Proportionality: Digital Pre-Algebra Curriculum as a Supportive Pre-service Resource, National Science Foundation.

Janet Bowers serves as co-PI with J. Roschelle of SRI. Her subcontract focuses on the development of and research on online applets to support mathematical visualization.

Bressourd, D., Rasmussen, C., Pearson, M. & Carlson, M., Characteristics of Successful Programs in College Calculus, National Science Foundation Research and Evaluation in Education in Science and Engineering.

This large empirical study proposes to undertake a national investigation of mainstream Calculus I to identify the factors that contribute to success, to understand how these factors are leveraged within highly successful programs, and to use the publications, committees, and public fora of the Mathematical Association of America (MAA) to disseminate this information and help departments of mathematics build on its insights. Calculus I is the critical course on the road to virtually all STEM majors. Even students who do well in it often find the experience so discouraging that it leads to a change of career plans. We have very little data on the preparation and aspirations of the students who enroll in this course or of the factors that contribute to success in calculus. This proposal will fill this gap through two related studies. Phase 1 will entail large-scale surveys of a stratified random sample of college Calculus I classes across the United States, leading to construction of a statistical model to predict the effect of factors that affect success in calculus. Phase 2 will undertake exploratory case study research into programs that are successful in leveraging the factors identified in Phase 1. This second phase will lead to the development of a theoretical framework for understanding how to build a successful program in calculus and in illustrative case studies for widespread dissemination.

Carey, T.T., & Nemirovsky, R., Faculty Collaborations for Course Transformations for Developmental Math, William and Flora Hewlett Foundation.

Faculty at California community colleges are invited to participate in a program of FACCTS to support implementation of effective instructional practices for the Basic Skills Initiative in Developmental Math courses. Teams of college faculty will work together to adapt and apply innovative teaching and learning methods in course redesign. By sharing knowledge and resources, faculty teams increase the impact of their individual course designs for student success. In addition, the project will continue to develop more effective ways for faculty to share exemplary practices and educational resources for enhanced student success across the college curriculum.

Chizhik, A.W., & Beck, L., Cooperative Learning Methods for Java-Based CS1 Courses, National Science Foundation.

In association with the grant, Chizhik and Beck conducted a three-hour workshop at the Association for Computing Machinery Special Interest Group on Computer Science Education Conference, in Chattanooga, TN, and presented a paper at AERA.

Fisher, K.M., Chizhik, A.W., Houle, M.E., & Williams, K.S., Springboard to Success, National Science Foundation.

This NSF-funded Robert Noyce Scholarship program provides support for prospective math and science teachers. They received additional funding this year to support four additional scholars and to provide workshops and travel for Noyce Scholars to professional conferences.


Math for America San Diego (MfA-SD) is a five-year program committed to recruiting, training and retaining extraordinary high school mathematics teachers to significantly improve local secondary school students’ understanding of mathematics. MfA-SD Fellows receive full tuition and fees for a teaching credential and master’s degree at one of our partner universities (SDSU, UCSD, or CSU San Marcos), a $15,000 stipend per year for five years, individualized support of a mentor teacher, and extensive professional development throughout the term of the fellowship. Additionally, MfA-SD Fellows receive job placement assistance from San Diego County school districts and begin their teaching career in local high-need high schools.

Continued on next page
Izsák, A., Lobato, J., Cohen, A., Templin, J., & Orrill, C., Diagnosing Teachers’ Multiplicative Reasoning, National Science Foundation.

Diagnosing Teachers’ Multiplicative Reasoning (DTMR) is a project conducted by researchers at San Diego State University and the University of Georgia at Athens, which will develop and evaluate a test form that diagnoses middle school teachers’ capacities in reasoning with rational numbers and proportions. The assessment instrument will use a new class of psychometric models called cognitive diagnosis models (CDMs). A main goal of the project is to address content and construct validity of the demonstration form in sufficient depth so that larger scale work and predictive validity studies may follow. A strong research base exists regarding CDMs, but researchers have yet to develop instruments for these models from the ground up within the CDM framework. As a result, the project promises to interest both psychometricians and mathematics educators.

Lamb, L.C., Pierson, J., & Philipp, R.A., Mapping Developmental Trajectories of Students’ Conceptions of Integers, National Science Foundation Discovery Research K-12.

Making sense of integers is particularly challenging for children and yet is foundational for success with first-year algebra coursework. This research and development project will map developmental trajectories of students’ conceptions of integers. We will analyze interviews of K-12 students and specialized adults (those who have revisited their notions of integers by drawing from one of four perspectives: a formal mathematics perspective, a historical mathematical perspective, a children’s mathematical thinking perspective, and a mathematics teacher perspective). Collectively, the conceptions identified across these interviews will help the team to map the terrain from informal to expert conceptions of integers.

The research team will use findings from the interviews to create a framework to identify problem types as well as problem-solving strategies as related to student thinking about integers and integer operations. This work will identify increasingly sophisticated conceptions that will generate developmental trajectories that teachers and researchers can use to understand students’ thinking about integers and to plan next steps to support students’ reasoning. To broaden the applicability of these findings, the research team will use the results from the interviews and subsequent framework to develop a paper-pencil assessment that can be used by teachers and researchers.

Mason, C.L., Undergraduate science course reform serving pre-service teachers: Evaluation of a faculty professional development model, National Science Foundation.


The purpose of this project is to conduct research that will take advantage of technical advances in multi-model and spatial analysis to develop new theories of embodied mathematical cognition and learning. Three university groups will conduct a coordinated series of empirical and design studies that focus on learning the mathematics of space and motion, which is a domain that has wide-ranging relevance for what children need to learn in school, and that presents particularly interesting challenges for a theory of embodied cognition. Studies will be conducted in professional workplaces and formal, academic settings where people learn and teach these subject matter areas; they will include professional mathematicians, graduate students in mathematics, professionals working with mapping and spatial analysis, pre-service high school mathematics teachers, high school students, pre-engineering vocational students, and talented middle and high school youth.

Nemirovsky, R., Math Core for Museums, National Science Foundation Informal Science Education program.

A collaboration with four science museums: Science Museum of Minnesota (St. Paul, MN), Museum of Science (Boston, MA), Explora (Albuquerque, NM) and the North Carolina Museum of Life and Science (Durham, NC), for the research and development of math-oriented exhibits focused on ratio and proportion. The purpose of the project is to conduct a two-year research study that focuses on the design and analysis of interactions among a small group of upper elementary school children who volunteer to participate in four after-school sessions conducted at a school in the San Diego area. Research will focus on six exhibit prototypes, drawn as much as possible from prototype produced and shipped by the Math Core partners. Activities will be designed to stimulate: 1) conversations on how to prove relations of similarity and proportion and 2) bodily activity in the process of using tools and generating representations.

Pierson, J. Scaling Up SimCalc, National Science Foundation, Research and Evaluation on Education in Science and Engineering.
Grant Updates
(continued from page 18)

Jessica serves as a research consultant with J. Roschelle of SRI.


Unsworth, S.J., Riggs, E., & Robbins, N., Sharing the Land, National Science Foundation, Opportunities for Enhancing Diversity in the Geosciences.

Recent and Upcoming Conference Presentations: 2009–2010
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Williams, K.S. Using diagnostic questions (DQCs) to help students learn concepts related to photosynthesis. 94th Ecological Society of America Annual Meeting, Albuquerque, NM, August 2-7, 2009.


CRMSE Faculty Visit China

In June, 2008, a delegation of four researchers from the Department of Mathematics and Statistics visited China and South Korea, in an effort to promote mathematics education research conducted at SDSU, to initiate new research collaborations with East Asian researchers, and to explore opportunities for faculty and student exchanges. The 12-day trip was funded by the President’s Leadership Fund and the Office of International Programs. The delegation was led by department chair, Sam Shen, and included mathematics education researchers Chris Rasmussen, Joanne Lobato, and Susan Nickerson. The activities included research symposia at East China Normal University in Shanghai, Beijing Normal University, East Capital Normal University in Beijing, and Seoul National University. The delegation also met with officials from the Ministry of Education in China, the China National Research Institute of Educational Sciences, the Korean Research Foundation, and the Korea Institute for Curriculum and Evaluation. The delegation received support from government and university officials and identified concrete steps to pursue collaborative research as well as faculty and student exchanges.

About CRMSE...

The Center for Research in Mathematics & Science Education (CRMSE) is an interdisciplinary community of scholars who seek to advance mathematics and science education at local, state, and national levels by providing leadership in research, materials and program development, and evaluation. Its members include faculty from the departments of mathematics and statistics, biology, physics and psychology in the College of Sciences, the School of Teacher Education and the Department of Policy Studies in the College of Education, and one member from the department of mechanical engineering in the College of Engineering. For more information, please visit our web site at: http://crmse.sdsu.edu.
CRMSE News

Distinguished Lecturer Series:
April 30–May 1, 2009, Supporting Science Teachers in Utilizing Model-Based Inquiry. Our lecturers were Joseph Krajcik, professor of science education and associate dean of research in the School of Education at the University of Michigan, and Valerie Otero, associate professor of science education at the University of Colorado in Boulder and alumna of CRMSE’s MSED program. The two professors began with a joint presentation of the importance of model building in science and in science teaching. They then each gave a lecture on their respective areas of research. The lectures were followed by a question and discussion period and preceded by an afternoon reception. Additionally, an informal discussion with San Diego science leaders, co-sponsored by the San Diego County Office of Education, was held with Otero and Krajcik at the Alvarado Road Complex.

Bruce Alberts’ Visit:
On May 8th, 2009, Bruce Alberts, former president of the National Academy of Sciences and current editor in Chief of Science, visited CRMSE. Dr. Alberts has a strong commitment to science and mathematics education. He spoke with graduate students and faculty to learn about the innovative research contributions of CRMSE to improving student learning and how these insights are being implemented in the K–12 education community.

First San Diego Science Festival—Science Expo:
The first San Diego Science Festival was held in March and concluded with an Expo Day in Balboa Park on April 4, 2009. Ricardo Nemirovsky led the CRMSE booth entitled Prime Time With Spirographs: Gearing up to Prime Numbers. Donna Ross hosted the booth, Messy and Noisy! where Health Sciences High and Middle College students shared their favorite science activities. Dean Stanley Maloy was both an advisory member and one of the “Nifty Fifty” scientists that visited some of the local high schools.

Third Annual Springer Forum:
In conjunction with the 2009 AERA Annual Conference in San Diego, the Third Springer Forum on Cultural Studies in Science Education was held at CRMSE in April. The purpose of the 2009 Forum was to establish a broader context for rethinking the role of traditional local knowledge systems in science education, a context that takes into account more recent developments in thinking about knowledge, such as cultural studies, cultural sociology, social studies of science, socio-cultural studies, and actor-network theory. CRMSE’s Alberto Rodriguez was a presenter.

CRMSE Advisory Board
The Third Annual Meeting of the CRMSE Local Advisory Board was held on Friday, October 30, 2009. Members of the Advisory Board include:

Mike Chapin
Chairman, President and CEO, Geocon

Chris Deckard
Sr. Scientist, K-12 Outreach, SPAWAR

Barbara Edwards
Executive Director, Math for America—San Diego

Robert Graeff
Superintendent, Ramona Unified School District

Bernard Greenspan
Registered Patent Agent, Greenspan IP Management

Nigella Hillgarth
Executive Director, Birch Aquarium at Scripps

Tara Hutchinson
Department of Structural Engineering, UCSD
CRMSE members attending included Ricardo Nemirovsky, CRMSE Director, Nadine Bezuk, CRMSE Associate Director, Meredith Houle, Joanne Lobato, Michelle Nolasco (MSED student), Rafaela Santa Cruz, Judith Sowder, Karen Foehl, CRMSE Office Manager.

At the meeting Ricardo Nemirovsky, CRMSE Director, and Nadine Bezuk, CRMSE Associate Director, presented a report of CRMSE’s activities and initiatives in 2008–09, and a preview of 2009–10 activities. Ricardo discussed the impact of the California budget crisis on CRMSE’s work.

Three CRMSE projects were highlighted:

- Rafaela Santa Cruz presented the SDSU Math Science Teacher Initiative (MSTI)
- Ricardo discussed Math Core for Museums
- MSED student Michelle Nolasco presented an overview of her dissertation proposal, Tangible Objects as Tools for the Exploration of Biochemical Molecules.

Several CRMSE projects and initiatives were discussed, and Advisory Board members made suggestions.

- Joanne Lobato, SDSU director of the SDSU-UCSD Joint Doctoral Program in Mathematics and Science Education (MSED) provided an update on the MSED program and discussed potential partnerships and grants/programs for sponsoring MSED students.
- Ricardo discussed work to-date on an after-school program at a possible CRMSE Learning Center, including a potential site in Imperial Beach, and additional ideas for programs and sites were discussed, including ASES and ASSETS.
- Nadine highlighted current CRMSE professional development work and challenges of funding in the current economic climate. The Advisory Board discussed strategies to provide professional development for teachers and to obtain the resources needed, including Title II funding, the Point Loma Lecture Series, and SDCOE online courses.
- Ricardo discussed possibilities for a five-year series of symposia on economy and educational policy, perhaps creating a “think tank” or a non-partisan space and voice for the public to become informed of larger STEM issues and to elevate the level of discussions that take place. Barbara Edwards submitted a list of individuals who would be very interested and looking for these opportunities. A meeting of a smaller group of individuals has been scheduled to more clearly articulate the mission, focus, and limits of the work.