

ISEE Exchange

Institute for Scientist & Engineer Educators

ISSUE 01 WINTER 2012



FROM OUR FILES

ISEE Receives New NSF Grant

ISEE received a new grant from the National Science Foundation, “Transforming Undergraduate STEM Experiences Through the Next Generation of Scientist and Engineer Educators.” The award (NSF#1226140) is aimed at improving the efficiency and sustainability of the PDP. The project will include developing online resources and units for PDP participants, testing dissemination models, and developing an apprenticeship program to train future PDP instructors. The award provides support for four new partners to begin developing their own PDP:

- University of California, Santa Barbara, through the Center for Science and Engineering Partnerships
- University of California, Los Angeles, through the Department of Physics and Astronomy
- University of Houston, through the College of Optometry
- Carnegie Observatories

Team members on this project include: Lisa Hunter, Anne Metevier, Scott Seagroves, Barry Kluger-Bell, Beth Walker, Jason Porter, M. Ofelia Aguirre, Michael Fitzgerald, and Jason Melbourne.

Advancing Effective, Inclusive Scientist & Engineer Educators

this issue

From Our Files	P.1
PDP Focus Areas in Practice	P.2
Reports & Literature	P.2
Collaboration & Innovation	P.3
PDP Community	P.4
Advancements & Awards	P.4
Partners	P.5
Events	P.5
Updates	P.6

To Our Readers

Welcome to our first newsletter issue. Providing information about ISEE and its concerns, as well as current events in & around our community.

PDP FOCUS AREAS IN PRACTICE



Inquiry as a Means to Teach Problem-Solving Skills

Educators, employers, and policy makers widely agree on the importance of “problem-solving” and “critical thinking” skills. However, how to teach these skills (or “practices”) is challenging and a point of debate. Within the PDP community, an inquiry learning experience is one in which learners gain an understanding of scientific concepts by applying cognitive science & engineering (S&E) practices. Cognitive S&E practices are essentially the reasoning and problem-solving processes that are used to do research and/or engineering design. For example, “generating explanations” is a highly valued practice that scientists use to make sense of findings, articulate findings to others, and engage in argumentation to defend an explanation. How does one teach students how to generate explanations? Two recent PDP activities focused on the practice of generating explanations, and illustrate the strategies used within the PDP community to teach cognitive S&E practices. First the challenging or nuanced aspects of the practice are identified, and then used to articulate a specific learning goal. Then PDP participants identify the evidence of success (what learners would do if they “got it”). And finally an activity is designed in which learners use the practice and improve their abilities in using it in other contexts. The two activities are described briefly here:

Shining Light on the Sun

Using models to explain experimental results is challenging for students at all levels, including undergraduates and even graduate students. For example, students struggle with understanding and articulating the limitations of a model, and knowing when other models are needed. In “Shining Light on the Sun,” students investigate solar phenomena with lab equipment and actual satellite data. They learn about selectively applying theoretical models of radiation processes (specifically black body, emission, absorption lines) to the solar spectrum in order to infer physical properties of the sun, and generate explanations of observed phenomena. This activity was taught as one of ISEE’s PREPs (Preparation for Research Experiences Program) for the **University of Colorado (CU) Laboratory for Atmospheric and Space Physics** REU program. The PDP team included: Katherine Kretke (Lead, Southwest Research Institute), Christopher Moore (CU), Devin Silvia (CU).

Central Dogma of Molecular Biology

Students also struggle with generating an explanation that integrates findings from multiple experiments, and relating their own results to published data. In “Central Dogma of Molecular Biology,” students use worms as an experimental model organism and design investigations to learn about how physical attributes are influenced by the integrity of genetic information. In this activity, students interpret empirical evidence by coordinating results from multiple experiments with results from published scientific literature and online research databases. The activity focuses on the scientific practice of data interpretation, and more specifically, the thorough scrutiny of one’s own data by taking into account published findings yet guarding against over-interpretation. This activity was taught as an ISEE PREP for the **MARC/IMSD Summer Research Institute which is part of the STEM Research Diversity programs at UCSC**. The PDP team included Jenn Betancourt (Lead, UCSC), Andrew Knutson (UCSC), and Cory Monteith (UCSC).



REPORTS & LITERATURE

Teaching Inquiry Improves Graduate Students’ Own Research Skills

PDP developers and instructors have always felt that the PDP helps graduate students improve their own research skills. The deep learning that comes from teaching a particular topic is something many of us have experienced, so it’s not a big leap to expect that that when PDP participants teach through inquiry (in essence teaching their own students how to do research) they also learn about doing research. A recent study found that graduate students who both taught STEM through inquiry and conducted research improved their abilities to generate testable hypotheses and design valid experiments. This paper provides evidence for what the PDP community has seen and heard from participants over the years. See: Feldon, D. F. (2011) Graduate Students’ Teaching Experiences Improve Their Methodological Research Skills, *Science* 333, 1037.

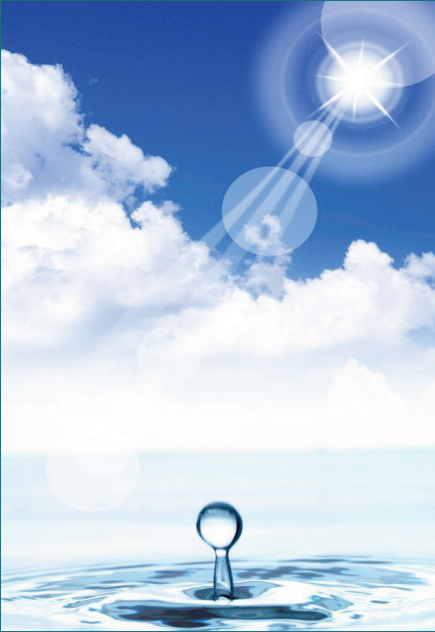
Retention in Higher Education STEM

The President’s Council of Advisors on Science and Technology (PCAST) published a report earlier this year that states “retaining more students in STEM majors is the lowest-cost, fastest policy option to providing the STEM professionals that the nation needs.” The report has compelling numbers in support of retention: “Fewer than 40% of students who enter college intending to major in a STEM field complete a STEM degree. Merely increasing the retention of STEM majors from 40% to 50% would generate three quarters of the targeted 1 million additional STEM degrees over the next decade.” One of the major recommendations of this report is to revise lab courses to be more discovery-based, which provides support for the PDP’s emphasis on designing and teaching inquiry lab activities.

See: “Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics” report at <http://www.whitehouse.gov/administration/eop/ostp/pcast/docsreports>

COLLABORATION & INNOVATION

New Frontiers for the PDP: Sustainability, global competency, and complex systems



An exciting new collaboration for ISEE is with the Center for Sustainable Energy and Power Systems (CenSEPS) and the Program in Sustainable Engineering and Ecological Design (SEED) at UC Santa Cruz. CenSEPS has just received a new NSF grant (NSF#1243536; PI: Mike Isaacson) from the PIRE program (Program in International Research and Education) that will support participants in the PDP. The grant is focused on community scale renewable energy, and emphasizes training of globally-engaged scientists and engineers. The PIRE grant, also involves two Danish universities whose work is focused on renewable energy microgrids. Both ISEE and SEED are very interested in PDP work that can address the interests of this grant, or designs in any disciplinary area that can incorporate some of the project's

unique aspects, including:

- Integrating social, environmental, and economic considerations into defining problems or proposing solutions
- Global competency, such as working in cross-cultural teams, appreciating different cultures, considering local to global scales
- Complex systems, emergent behavior (behavior that isn't explicitly described by the behavior of the components of a system, but emerges due to interactions among the components)

2103 PDP participants are encouraged to integrate these aspects into their designs, and to contribute to our understanding of what such elements look like in practice (i.e. in a PDP design). Alumni that are interested and want to engage in any way are also welcome. This is new and innovative work for the PDP, and you'll be on the frontier of learning and design with us!

ALUMNI Needed to Help Promote PDP

ISEE is seeking PDP alumni who are interested in helping recruit new graduate students to UCSC or the University of Hawaii and sharing perspectives on their PDP experience. The PDP is a unique program, and could be a significant draw for prospective grad students. By attracting more graduate students to campus the value of the PDP is enhanced, and in turn contributes to its sustainability (and continuity!). If you are willing to assist by connecting with prospective grads and/or giving a short presentation to visiting prospectives, please get in touch with Lisa Hunter. We're open to any ideas that you have and need help communicating with departments and coordinating activities.



<http://sustainability.ucsc.edu/ideass>

Improving the PDP's Use of Technology

ISEE received a new award from the NSF (see page 1), and as part of that award will be developing more web-supported activities, including:

- Improving our wiki and how we use it
- Creating ways to support our growing and dispersed community through online forums, calendars, meeting spaces, etc.
- Developing pre- and post-workshop online activities to improve our efficiency and effectiveness

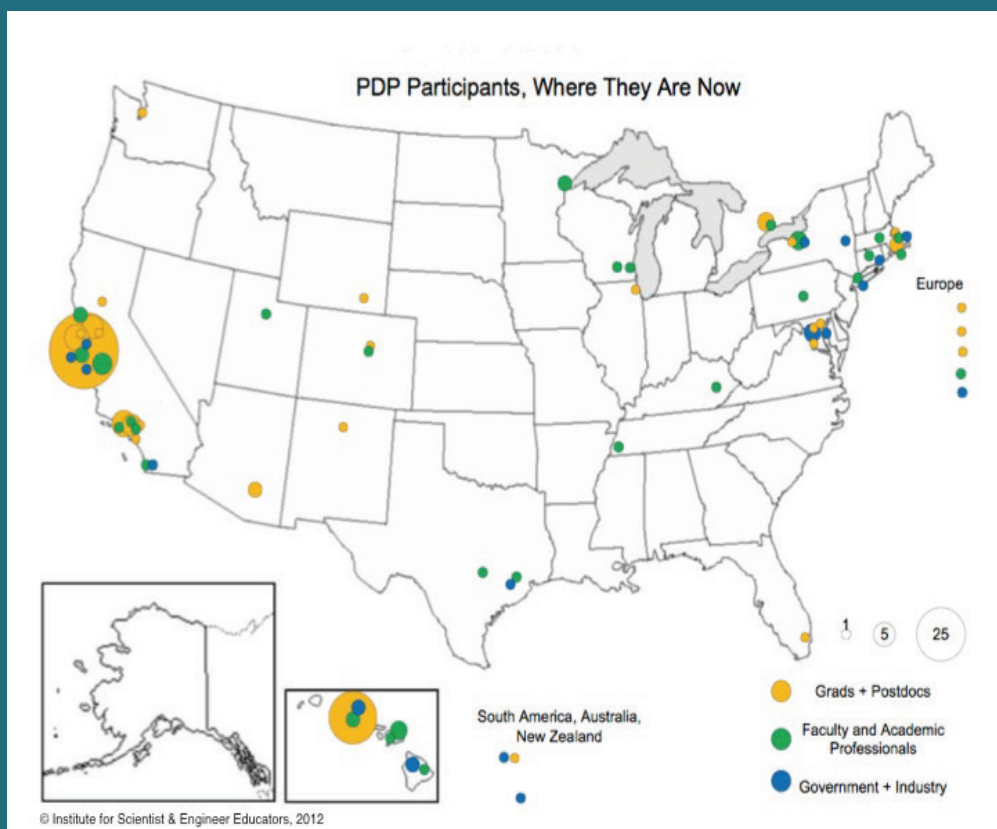
If you are interested in contributing to this work, please let us know. We will establish working groups soon, and anticipate a wide range of roles, including simply providing feedback.



PDP COMMUNITY

Alumni Geography: By the Numbers

ISEE conducted an analysis of the status of PDP alumni to determine where they are in their careers. Since 2001, 99% of PDP participants who started as either a graduate student or a postdoc are still on a STEM career track, with 18% in STEM faculty positions. The diagram below shows the distribution of our alumni across the globe as of Fall 2011.



2012 PDP ACTIVITY

Teams just wrapped up another great year of teaching at the following venues:

MAY

PREP Toronto
PREP IfA
UCSC Biomech Lab

JUNE

Big Island HS Bridge 1
Big Island HS Bridge 2
PREP Boulder
PREP UCSB

Akamai Short Course 1
Akamai Short Course 2
PREP UCSC 1
PREP UCSC 2

JULY

PREP UCSC 3
UCSC Physics Lab

SEPTEMBER

WEST 1
WEST 2
WEST 3

NOVEMBER

NSO/Akamai Technical Short Course
UH Maui College Project Management Course
UH Maui College Electronics Lab

ADVANCEMENTS & AWARDS

In 2012 PDP alumni made many advancements, including:

Eliza Kempton
*Hired, Assistant Professor of Physics
Grinnell College, Iowa*

Lauren Lui
Google Anita Borg Memorial Scholarship

Nicholas McConnell
*Beatrice Watson Parrent
Postdoctoral Fellowship
University of Hawaii*

Elizabeth McGrath
*Hired, Assistant Professor of Physics
Colby College, Maine
STSci Grant*

Anne Medling
Achievement Rewards for College Scientists

Lisa Petrella
*Hired, Assistant Professor of Biological
Sciences
Marquette University, Wisconsin*

Jason Porter
*Promoted, Associate Professor (with tenure)
University of Houston*

Alex Racelis
*Hired, Assistant Professor of Biology
University of Texas*

Calla Schmidt
*Hired, Assistant Professor
University of San Francisco*

Andy Sheinis
*Hired, Head of Instrumentation,
Australian Astronomical Observatory
Appointed, Adjunct Associate Professor,
Sydney Institute for Astronomy (SIFA),
University of Sydney*

"During my interview I had to give a teaching demonstration and discuss inquiry and learner centered models of education. I felt confident doing this as a direct result of my participation in the PDP program."

Calla Schmidt, former PDP participant and current Assistant Professor

In the future we hope to contact PDP alumni to get updates on their careers and lives. In the meantime, please feel free to share with us news about your most current advancements and awards.

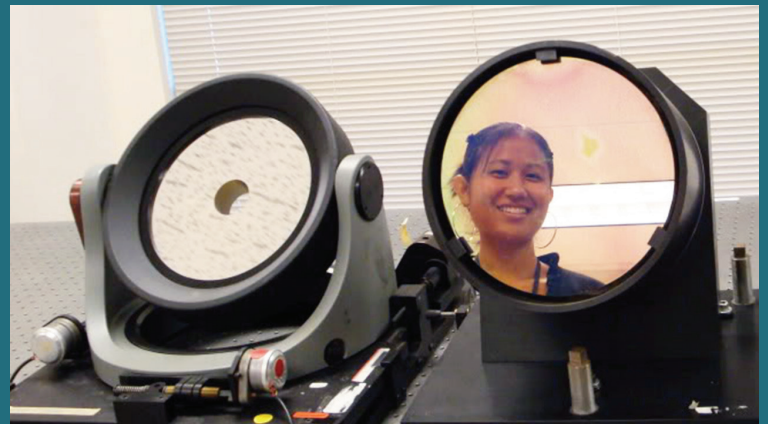
PARTNERS

University of Hawaii (UH): ISEE is a major partner in the [Akamai Workforce Initiative \(AWI\)](#) at the UH Manoa Institute for Astronomy. With funding from the National Science Foundation (AST-0836053), the Air Force Office of Scientific Research (#FA9550-10-1-0044), University of Hawaii, Thirty Meter Telescope, National Solar Observatory, Air Force Research Laboratory, and Kamehameha Schools, AWI is focused on developing a diverse technical workforce for astronomy, remote sensing, and other technical facilities in the state of Hawaii. The PDP is central to AWI, and there are many well-established teaching venues on the island of Maui, where AWI is headquartered, as well as on the Big Island and Oahu. Participants from UH campuses, observatories, and tech companies are invited to participate in the UH PDP.

Participants from the following institutions have opportunities to participate in either the UCSC or UH PDP: University of Toronto; University of California, Santa Barbara; University of Colorado Boulder; University of California, Los Angeles; University of Houston; Carnegie Observatories.

Developing Workforce Skills that Prepare Problem-Solvers: Akamai Workforce Initiative

ISEE has deep roots in workforce development, and supports the advancement of diverse students into scientific and technical careers through a partnership with the Akamai Workforce Initiative (AWI). Both AWI and ISEE were spun out of a decade of work by the NSF Center for Adaptive Optics, and have the PDP as cornerstones. The Hawaii-based PDP focuses on workforce development related to astronomy, remote sensing and other technical facilities in Hawaii. Central to AWI are the findings from a workforce needs study conducted by AWI indicating the importance of problem-solving, critical thinking, and professional skills (e.g. communication, teamwork, and project management skills) that enable employees to adapt to rapid changes in technology. AWI has developed units, workshops and entire courses that integrate inquiry, problem-based and case-based learning to build these skills. Two unique courses were developed for the new UH Maui College Engineering Technology program and were taught by IfA faculty and staff on Maui: Remote Sensing (David Harrington) and Advanced Instrumentation (Jeff Kuhn), both of which included use of the Maui IfA facilities.



Recent Events

Akamai Advisory Committee Meeting

November 16, 2013, at the Advanced Technology Research Center in Kahului, Maui. Presentations were given by the AWI leadership team: Lisa Hunter, Jeff Kuhn, Mark Hoffman, and Jerome Shaw. Pamela Castori from Inverness Research Institute attended to launch AWI's new research and evaluation project. Committee members include: Damien Cei, UH Maui College; Sandra Dawson, Thirty Meter Telescope; Georgeanne Friend, Kauai Community College; Matt Granger, Akimeka; Joshua Ka'akua, UH Manoa; Steve Keil, National Solar Observatory; Daron Nishimoto, Pacific Defense Solutions; Doug Simons, Canada France Hawaii Telescope; Donald Straney, UH Hilo; Francis Takahashi, Kauai Community College; Stacie Williams, Air Force Research Laboratory.

COMING EVENTS

Advisory Committee meeting for ISEE's NSF Transforming Undergraduate Education in STEM (TUES) project, February 1, 2013, at the Center for Adaptive Optics. Committee members include: Bruce Alberts, UC San Francisco; Brandon Allgood, Numerate, Inc.; Michael Bolte, UC Santa Cruz; Adam Burgasser, UC San Diego; Brent Haddad, UC Santa Cruz; Ellen Moir, New Teacher Center; Yvonne Rodriguez, Society for Advancement of Chicanos and Native Americans in Science; Scott Severson, Sonoma State University.



ISEE UPDATES

PDP 2013

We are pleased to announce the 2013 Professional Development Program, which includes workshops followed by a practical teaching experience, and focuses on inquiry, diversity & equity and assessment.

Participants in the program gain:

- teaching skills
- teaching experience, usually at the undergrad level
- enhanced academic job qualifications (we now have more than 30 past participants in faculty positions)
- enhanced funding capabilities for fellowships, postdocs, grants
- a certificate of teaching innovative laboratory experiences
- professional skills that enhance industry, government or academic qualifications
- enhanced research skills
- a community of dynamic and innovative scientists and engineers who value education

Please see our [2013 brochure](#) for detailed information.

Apply Online at <http://isee.ucsc.edu/programs/pdp/index.html>

Priority applications due by December 17, 2012

ISEE Teaching Certificate - Updated Requirements

New information for Professional Development Program (PDP) participants and ISEE friends! As many of you know, ISEE offers a Certificate of Completion in Teaching Laboratory Experiences. We have just updated the requirements for the certificate. If you have recently participated in the PDP, you have already fulfilled most of the requirements. See the [certificate webpage](#) for more details!

Congratulations to our most recent Certificate Recipients:
Carley Corrado, Michael Jacox, Sora Kim, and Brooks Thomas.



UC Santa Cruz
1156 High Street – CfAO
Santa Cruz, CA 95064

<http://www.isee.ucsc.edu/>

ISEE Director: Lisa Hunter

ISEE Executive Committee:
Pascale Garaud, Claire Max,
Rodney Ogawa, and Jerome Shaw



ISEE Exchange
ISSUE 01 WINTER 2012

Published Quarterly
Co-Editors: Lisa Hunter, Beth Walker
Graphics: Beth Walker