Teacher Professional Development Programs Promoting Authentic Scientific Research in the Classroom II

Presiding: G Scowcroft, University of Rhode Island; S M Pompea, National Optical Astronomy Observatory; C E Walker, Constance Walker

ED22A-01 INVITED

The Cosmic Ray Observatory Project: A Statewide Outreach and Education Experiment in Nebraska

* Snow, G gsnnow1@unl.edu, University of Nebraska, Dept. of Physics and Astronomy 116 Brace Hall, Lincoln, NE 68588-0111, United States
Claes, D dclaes@unlhep.unl.edu, University of Nebraska, Dept. of Physics and Astronomy 116 Brace Hall, Lincoln, NE 68588-0111, United States

For the past 8 years, the University of Nebraska-Lincoln (UNL) Department of Physics and Astronomy has led the Cosmic Ray Observatory Project (CROP), a statewide education and research experiment involving Nebraska high school students, teachers, and university undergraduates in the study of extensive cosmic-ray air showers. With generous funding from the National Science Foundation in the first 7 years, a growing network of high school teams construct, install, and operate school-based detectors in coordination with UNL physics professors and graduate students. The detector system at each school is an array of scintillation counters recycled from the Chicago Air Shower Array in weather-proof enclosures on the school roof, with a GPS receiver providing a time stamp for cosmic-ray events. The detectors are connected to triggering electronics and a data-acquisition PC inside the building. Students share data via the Internet to search for time coincidences with other sites. The presentation will highlight the scientific and professional development achievements of the project to date, lessons learned since its inception, and plans for continued expansion to the 314 high schools in the state.

http://crop.unl.edu

ED22A-02

Teacher Research Programs: An Effective Form of Professional Development to Increase Student Achievement and Benefit the Economy

* Dubner, J jd109@columbia.edu, Columbia University, 630 W. 168 Street Room 11-444, New York, NY 10032, United States

U.S. high school students perform markedly less well in science, technology, engineering and math (STEM) than students in other economically advanced countries. This low level of STEM performance endangers our democracy and economy. The President's Council of Advisors in Science and Technology's 2004 report attributed the shortfall of students attracted to the sciences as a result of the dearth of teachers sufficiently conversant with science and scientists to enable them to communicate to their students the excitement of scientific exploration and discovery, and the opportunities science provides for highly rewarding and remunerative careers. Nonetheless, the United States has made little progress in correcting these deficiencies. Studies have shown that high-quality teaching matters more to student achievement than anything else schools do. This belief is buttressed by evidence from Columbia University's Summer Research Program for Science Teachers (SRP) that highly motivated, in-service science teachers require professional development to enable them and their students to perform up to their potential. Columbia's Summer Research Program is based on the premise that to teach science effectively requires experience in using the tools of contemporary science to answer unsolved questions. From its inception, SRP's goal has been to enhance interest and improve performance in science of students. It seeks to achieve this goal by increasing the professional competence of teachers. The reports of Elmore, Sanders and Rivers, and our own studies, show that professional development is a "key lever for improving student outcomes." While most middle and high school science teachers have taken college science courses that include cookbook laboratory exercises, the vast majority of them have never attempted to answer an unsolved question. Just as student learning depends on the expertise of teachers, the expertise of teachers depends on the quality of their professional development. Columbia University's teacher research program is a very effective form of professional development for pre-college science teachers and has a direct correlation to increased student motivation and achievement in science. The Program is premised on the belief that hands-on experience in the practice of science improves the quality and authenticity of science teaching, and that improved science teaching is correlated with increased student interest and achievement in science. The author will present the methodology of the program's evaluation citing statistically significant findings. The author will also show the economic benefits of teacher participation in a well-designed research program.

http://www.ScienceTeacherProgram.org

ED22A-03

Bringing Experience from the Field into the Classroom with the NOAA Teacher at Sea and PolarTREC Teacher Research Experience Programs

* Eubanks, E D hoocaca@yahoo.com, St. Mark Catholic School, North East 6th Ave., Boynton Beach, FL 33435, United States
Kohin, S Suzanne.Kohin@noaa.gov, National Oceanic and Atmospheric Administration, Fisheries Resources Division, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037, United States
Oberbauer, S oberbaue@fiu.edu, Florida International University, Dept. of Biology, #OE 167, University Park Campus, 11200 S.W. 8th Street, Miami, FL 33199, United States
As a participant of the National Oceanic and Atmospheric Administration (NOAA), Teacher at Sea (2007) and the Arctic Research Consortium of the U.S., PolarTREC (2008) programs, I have had the opportunity to participate in hands-on research with leading scientific researchers from the tropics to the Arctic. These Teacher Researcher Experiences (TRE's) and the resulting relationships that have developed with the scientific community have been an asset to my professional development and have greatly enhanced my students' learning. The opportunity to participate in data collection and hands-on research with a NOAA researcher, Dr. Kohin, helped me bring shark, ocean, and ship science from my expedition onboard the NOAA Ship David Starr Jordan in the Channel Island region into my classroom. The new knowledge, experiences, and resources that I brought back allowed me to create lesson plans and host Shark Month—an activity that involved all 300 students in my school. My students were able to link real data regarding the location of sharks to practical application and still meet state standards. Likewise, the scientist from my PolarTREC expedition, Dr. Oberbauer, is assisting me in a long-term plan to incorporate his data into my classroom curricula. Already, my experiences from Barrow, Alaska, have been shared through webinars with my community and as a keynote speaker to over 600 Palm Beach County science teachers. We are also working together to develop a yearlong curriculum, in which my entire school of 300 students will discover interdisciplinary polar science. Participation in TRE's has been beneficial for my students and my community, but what is the return on the investment for the scientists who invited me to participate in their research? Both scientists have transferred their knowledge out of the laboratory and made a link between their research and a different generation--our future scientists. They become instrumental science leaders in a community of young impressionable learners. Additionally, I've been invited to participate in a future research project in Costa Rica with Dr. Oberbauer--allowing his research to continue to reach a broad audience of students and community members interested in learning about fascinating science from around the world. I have found that the best way to be an effective science teacher is to be a scientist. Having the opportunity to work in the field with researchers, allowed me to become a scientist. Participating in TRE's has rejuvenated my career, allowed me to acquire new and innovative ideas for my classroom and school, and has given my students the opportunity to work with renowned oceanographers and climatologists and real data--something most kids will never get the chance to do. Teachers and researchers only stand to benefit from these unique relationships. As a Zoology major and teacher, these experiences were life changing for me during a time when I had contemplated leaving my profession due to boredom. The expeditions rekindled my love for science and desire to share and teach through the eyes of a scientist. The more we bridge the gap between teachers and researchers the more science comes alive for our future scientists. We need to our youth to continue the research that is already underway.

http://www.polarTREC.com

ED22A-04

Taking Broader Impacts to Another Level: Researcher Benefits from Teacher Researcher Experience Collaborations

* Warburton, J J warburton@arcus.org, Arctic Research Consortium of the U.S., 3535 College Rd., Suite 101, Fairbanks, AK 99709, United States
Timm, K M kristin@arcus.org, Arctic Research Consortium of the U.S., 3535 College Rd., Suite 101, Fairbanks, AK 99709, United States
Holmes, R M rholmes@whrc.org, Woods Hole Research Center, 149 Woods Hole Rd., Falmouth, MA 02540, United States
Geiger, C cgeiger@udel.edu, University of Delaware, Geography Dept., 216 Pearson Hall, Newark, DE 19716, United States
Lefer, B blefer@uh.edu, University of Houston, Dept. of Geosciences, 312 SR-1, 4800 Calhoun Rd., Houston, TX 77204, United States

Preliminary evaluation results from PolarTREC--Teachers and Researchers Exploring and Collaborating, a Teacher Research Experience (TRE) program matching teachers with polar researchers, has shown that program activities have many positive impacts on educators and their ability to teach science concepts and improve their teaching methods. Additionally, K-12 students benefit from their teacher's participation, and when polled in interest surveys, showed significant changes regarding the importance of understanding the polar regions as a person in today's world. Researchers participating in PolarTREC have also been overwhelmingly satisfied with the experience and have cited several specific strengths, including the program's crucial link between the teachers' field research experiences and their classroom and the extensive training provided to teachers prior to their expedition. Participating researchers have also reported that working closely with an educator has given them valuable perspectives on K-12 education and teaching methods that they often take back to their institutions, local schools, and communities. For many researchers, the experience is just the beginning of a long-lasting collaboration and a change in their view of education and its role in scientific research. This presentation will address how TRE's conceived and organized according to current best practices, such as pre-research training, mentoring, support for classroom transfer, and long-term access to resources, are integral to a successful collaboration before, during, and after the field research experience. Additionally, we will discuss how TRE's can greatly impact and diversify the broader impacts of scientific projects, and how TRE's have also become professional development experiences for the researchers that have hosted teachers. Teacher Research Experiences, including programs like PolarTREC, provide a tested approach and a clear route for varying levels of researcher participation in the education community, facilitating collaboration and ensuring educator, student, and community understanding of science during times of interrelated global change.

http://www.polarTREC.com

ED22A-05

Bringing Real-Life Marine Science Experience to the Classroom: Results From a Teacher in the Bering Sea

* Karavias, J A jkaravias@shufsd.org, Walt Whitman High School, 301 West Hills Rd, Huntington Station, NY 11746, United States
Kelly, R P rokelly@gso.uri.edu, University of Rhode Island, Graduate School of Oceanography, 215 South Ferry Rd, Narragansett, RI 02882, United States

Many public school science teachers are "textbook" teachers who lack basic research experience. Conversely, many scientists fail to relate their findings back to the general public in a meaningful way. The ARMADA project, funded by the National Science Foundation, is an effective program that exposes teachers to real-world oceanographic experiences. Additionally, the ARMADA project provides opportunities for teachers to pass on first hand experiences from the research community to their classrooms. After participating in a month long cruise aboard the USCGC Healy during July 2008 as part of the Bering Sea Ecosystem Study (BEST), a new appreciation for field research was developed. As part of a group from the University of Rhode Island Graduate School of Oceanography, first hand experience was gained on how marine scientists study the effects of global climate change in the Bering Sea. These experiences at sea have resulted in changes to the marine biology class curriculum to include the tools and techniques used by marine scientists to conduct their work. One lesson in particular discusses anthropogenic impacts on polar regions. In addition, students’ attitudes toward the class have changed. For example, a lesson on global climate change from a teacher who has first hand experience of climate change research is far more effective than from one who lacks it. The effect of having a teacher who has unique field experience in front of the classroom on students is immeasurable. In addition, the presence of a teacher at sea encourages the scientists to reduce their work to the most significant observations and conclusions on a daily basis during the cruise, helping to prepare the scientists for future public communications. In this manner, the gap between science research and public education is reduced.

http://armadaproject.org
Lessons Learned in Supporting Student and Teacher Research at NOAO

* Pompea, S M spompea@noao.edu, National Optical Astronomy Observatory, 950 N. Cherry Ave., Tucson, AZ 85719, United States

A professional development program for supporting student and teacher research in Astronomy has been underway at the National Optical Astronomy Observatory in Tucson for over a decade. The research has involved telescopes on Kitt Peak as well as in space, such as the NASA Spitzer Space Telescope. The program has evolved to reflect best practices in professional development as well as to provide long-term support for teachers. The program has evolved to reflect telescope availability as well as the changing needs of students and teachers. Currently we are reevaluating our methods for professional development for teachers and for their long-term support in doing research projects in the classroom. NOAO is operated by the Association of Universities for Research in Astronomy (AURA), Inc. under cooperative agreement with the National Science Foundation.

Teachers as Researchers: Using Estuarine Processes to Learn and Teach Earth System Interactions

* Johnson, J joel.johnson@unh.edu, Dept. of Earth Sciences, University of New Hampshire, Durham, NH 03824,
Varner, R K ruth.varner@unh.edu, Joan and James Leitzel Center for Mathematics, Science, and Engineering Education, UNH, Durham, NH 03824,
Varner, R K ruth.varner@unh.edu, Institute for the Study of Earth, Oceans and Space, UNH, Durham, NH 03824,
Bryce, J julie.bryce@unh.edu, Dept. of Earth Sciences, University of New Hampshire, Durham, NH 03824,
Finkel, L finkel@nwrel.org, Northwest Regional Educational Laboratory, 101 SW Main St., Suite 500, Portland, OR 97204,
Froburg, E erik.froburg@unh.edu, Joan and James Leitzel Center for Mathematics, Science, and Engineering Education, UNH, Durham, NH 03824,
Froburg, E erik.froburg@unh.edu, Institute for the Study of Earth, Oceans and Space, UNH, Durham, NH 03824,
Graham, K karen.graham@unh.edu, Joan and James Leitzel Center for Mathematics, Science, and Engineering Education, UNH, Durham, NH 03824,
Hale, S R stephen.hale@unh.edu, Joan and James Leitzel Center for Mathematics, Science, and Engineering Education, UNH, Durham, NH 03824,
Von Damm, K karen.vondamm@unh.edu, Joan and James Leitzel Center for Mathematics, Science, and Engineering Education, UNH, Durham, NH 03824,
Scientific Crew, T tesse.esst2@gmail.com, Institute for the Study of Earth, Oceans and Space, UNH, Durham, NH 03824,
Scientific Crew, T tesse.esst2@gmail.com, Dept. of Earth Sciences, University of New Hampshire, Durham, NH 03824,

One component of the University of New Hampshire's Transforming Earth System Science Education (TESSE) project provides a research immersion experience (RIE) for middle and high school science teachers. The chief goal of this component of the program is to provide teachers with authentic research experiences that will sharpen their research skills by providing guidance in designing projects and in the gathering and interpreting of data. This intensive research experience provides a springboard for approaching authentic research in the classroom. A subset of the teachers participating in the TESSE project, many of them second-year participants, enrolled in a course providing Research Techniques in the Earth System Sciences for Teachers (ESST-2). Estuaries provide an ideal teaching laboratory for emphasizing interactions between the components of the Earth system. Accordingly, the course was centered around an estuary cruise in which teacher participants took air and water samples, measured parameters in the water column, and took several sediment cores. Onshore, the teacher teams carried out follow-up work, including gas analyses in air samples, gas and trace metal content analyses in collected water samples, grain size and related sedimentological analyses of the core samples, and extractable metal contents from the cores. The research experience culminated in a poster presentation of the results. The participants will use this field trip-based model to bring authentic research into their classrooms. The ESST-2 teachers also plan to present their results at a regional Geoscience society meeting.

Developing a High School Astronomy Research Program

* Adkins, J J astronomyteacher@mac.com, Deer Valley High School, 4700 Lone Tree Way, Antioch, CA 94531, United States

Jeff Adkins from Antioch, CA will present a session about the ESPACE (Earth, Space, and Astronomy Center for Education) Academy at Deer Valley High School in Antioch, California and how research projects sponsored by NOAO's RBSE program and the Lawrence Hall of Science's Hands On Universe have been used to develop a research program and high school astronomy curriculum. Jeff is also a NASA Astrophysics Education Ambassador and will discuss how working in Education and Public Outreach programs has affected his classroom instruction.

http://www.astronomyteacher.com

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