**Teacher Professional Development Programs Promoting Authentic Scientific Research in the Classroom I**

**Presiding:** S M Pompea, Natl Optical Astronomy Obs, Tucson; G Scowcroft, University of Rhode Island, Narragansett; C E Walker, Education & Public Outreach, National Optical Astronomy Observatory, Tucson

**ED51B-01**

**Research in the Classroom with the WISE Mission (Invited)**

*Mendez, B J (bmendez@ssl.berkeley.edu), Space Sciences Laboratory, University of California, Berkeley, Berkeley, CA, USA*

NASA's Wide-field Infrared Survey Explorer (WISE) has surveyed the sky in four bands of infrared light creating a treasure trove of data. These data will not only be useful to the professional space science community, but also to teachers and students. The education and public outreach program for WISE has been working to create experiences and resources for students and teachers to use WISE data in classroom investigations. Prior to the launch of WISE, we trained a group of ambassador teachers to conduct original research using the Spitzer Space Telescope in partnership with a scientist from the Spitzer Science Center. During the survey operations of the telescope we worked with the International Astronomical Search Collaboration to engage students in confirmation studies of WISE-discovered asteroids and comets. We are now developing resources for teachers and students to access WISE data when it becomes public in 2011 to conduct both original research and laboratory-style investigations. We will describe the WISE mission, its data products, and our efforts to engage students in science by having them do science.

http://wise.ssl.berkeley.edu

**ED51B-02**

**Seismology in Schools an integrated approach to funding developing and implementing a coordinated programme for teachers and high school students**

*Blake, T A  (thb@cp.dias.ie), School of Cosmic Physics, Dublin Institute for Advanced Studies, Dublin, Ireland  
Jones, A G  (alan@cp.dias.ie), School of Cosmic Physics, Dublin Institute for Advanced Studies, Dublin, Ireland  
Campbell, G  (gcampbell@cp.dias.ie), School of Cosmic Physics, Dublin Institute for Advanced Studies, Dublin, Ireland*

Statistics in Ireland show that physics at Advanced Level in Secondary Schools is declining in popularity and is the most likely subject to be cut first from the curriculum in a curriculum readjustment by school authorities. In an attempt to attract students to study Earth science and seismology the School of Cosmic Physics, DIAS embarked on an outreach programme in 2007 to promote Earth science, particularly seismology, in schools at both Primary and Secondary Levels. Since its inception, DIAS's Seismology in Schools programme has been very well received, with seismometers installed in over fifty schools across the State. Although this number may appear small, given that the population of Ireland is 4M this number of 1 per 80,000 compares favourably with the U.K. (70 in a population of 70M, 1 per 1M) and the U.S.A. (200 in a population of 300M, 1 per 1.5M) with an penetration of 15-20 times greater. The phenomenal success of our Seismology in Schools programme has been helped significantly by the support we have received from the British Geological Survey (BGS) and IRIS (Incorporated Research Institutions for Seismology) in terms of hardware, software and advice. Similarly, the programme would be a pale reflection of what it is today if the Directors of the Educational Centres (ATECI, Association of Teacher's/Education Centres in Ireland) across Ireland had not become enthused and funded the purchase of 34 additional seismometers, and the Geological Survey of Ireland purchased a further six. Also, funding support from Discover Science and Engineering (DSE) was absolutely critical for us to roll out this hugely enlarged programme of 50 seismometers from the originally envisioned four. As this programme is an initiation into seismology for students, it is important to stress that the seismometer is not used in the schools as a professional recording instrument but helps students visualize what seismology and the recording of earthquakes comprises. Essential to the success of the programme was targeting teachers who would be committed to its implementation and promotion in the school. Strong emphasis by DIAS was placed on providing teacher training days on the set-up and operation of the seismometer, and they were also trained in various animation software programmes used to enhance the learning capacities of the students in the classroom. Regular contact is maintained with the teachers in the programme throughout the academic year to support and encourage their work in the classroom. Teachers receive an SMS alert message from DIAS when an earthquake of Mag 5 has been recorded by the Irish National Seismic network which will then form part of the next lesson plan for Geography and Maths in the curriculum. Most participating schools have become affiliated to the IRIS International Schools Seismic Network site, and students upload the waveform seismic data in SAC format for the recorded seismic events at their school to share with schools internationally. Future developments in the programme will include the investigation of twinning of schools on different continents who are actively pursuing a seismology in schools programme.

http://www.dias.ie/sis/

**ED51B-03**

**Research experience in Maine leads to teacher and student success in Texas**

*Slade-Redden, D  (dredden@newcaneyisd.org), New Caney High School, Conroe, TX, USA  
Incze, L  (lewisincze@gmail.com), University of Southern Maine, Portland, ME, USA*
As a High School science teacher it is my responsibility to present curriculum, to create enthusiasm for science, and to instill a passion and love for science in my students. Through a research experience as an ARMADA master teacher my passion and enthusiasm for the ocean was rekindled in the Gulf of Maine. Topics I had taught for years came alive in the front of my eyes, and I was able to experience science to its fullest. I brought home many photographs, valuable information, and new enthusiasm to my students. I began a program called S.A.N.D. (Students As Nature Directors). In this program my students teach 3rd graders about the oceans and its many wonders. Also, I have incorporated hands-on research based projects. The research experience has enabled my students to become more scientifically literate and capable of sharing scientific knowledge with others. This presentation will show how research/teacher partnerships benefit students as well as teachers and how my students and district have benefited from my experience as an ARMADA master teacher. Author: Debra Slade-Redden Author #2: Lew Incze

ED51B-04

Connecting Teachers and Students with Science Experts: NASA’s Expedition Earth and Beyond Program

*Graff, P V  (pgraft@nasa.gov), NASA JSC/ESCG, Houston, TX, USA
Stefanov, W L  (william.l.stefanov@nasa.gov), NASA JSC/ESCG, Houston, TX, USA
Willis, K J  (kim.willis-l@nasa.gov), NASA JSC/ESCG, Houston, TX, USA
Runce, S  (susan.k.runce@nasa.gov), NASA JSC, Houston, TX, USA
McCollum, T  (tmccollum@charleston.k12.il.us), Charleston Middle School, Charleston, IL, USA
Baker, M  (mbaker@rsu18.org), Messalonskee Middle School, Oakland, ME, USA
Mailhot, M  (michele.mailhot@maine.gov), Maine Department of Education, Augusta, ME, USA
Lindgren, C F  (cf.lindgren@comcast.net), Gates Intermediate School, Scituate, MA, USA

Classroom teachers are challenged with engaging and preparing today’s students for the future. Activities are driven by state required skills, education standards, and high stakes testing. How can educators teach required standards and motivate students to have the desire to learn more? One way is to allow students to take charge of their learning and conduct student-driven research. NASA’s Expedition Earth and Beyond program, based at the NASA Johnson Space Center, is designed to do just that. The program, developed by both educators and scientists, promotes inquiry-based investigations in classrooms (grades 5-14) by using current NASA data. By combining the expertise of teachers, who understand the everyday challenges of working with students, and scientists, who work with the process of science as they conduct their own research, the result is a realistic and useable means in which to promote authentic research in classrooms. NASA’s Expedition Earth and Beyond Program was created with the understanding that there are several important aspects that enable teachers to implement authentic research experiences in the classroom. These aspects are: 1) Standards-aligned, inquiry based curricular resources and an implementation structure to support student-driven research; 2) Professional development opportunities to learn techniques and strategies to ensure seamless implementation of resources; and 3) Ongoing support. Expedition Earth and Beyond provides all three of these aspects and adds two additional and inspiring motivators. One is the opportunity for student research teams to request new data. Data requested and approved would be acquired by astronauts orbiting Earth on the International Space Station. This aspect is part of the process of science structure and provides a powerful way to excite students. The second, and perhaps more significant motivator, is the creation of connections between science experts and classrooms. Scientists are able to connect with participating classrooms on a variety of different levels, including being a mentor. These powerful connections provide extraordinary opportunities for students to develop the rigor and relevance of their research, along with encouraging them to have a sense of pride in the work they are doing in school. Providing teachers with skills and the confidence to promote authentic research investigations in the classroom will equip them to create science literate students, and by extension, improve the public understanding of science. The opportunity to connect classrooms with science experts creates personal experiences that are engaging, motivating and impactful. These impactful experiences will help prepare today’s students to become the next generation of scientists or perhaps science educators who can help continue these powerful connections for generations to come.

ED51B-05

Teacher Research Experience Programs = Increase in Student Achievement

*Dubner, J  (jd109@columbia.edu), Columbia University, New York, NY, USA

Columbia University's Summer Research Program for Science Teachers (SRP), founded in 1990, is one of the largest, best known university-based professional development programs for science teachers in the U.S. The program’s basic premise is simple: teachers cannot effectively teach science if they have not experienced it firsthand. For eight weeks in each of two consecutive summers, teachers participate as a member of a research team, led by a member of Columbia University’s research faculty. In addition to the laboratory experience, all teachers meet as a group one day each week during the summer for a series of pedagogical activities. A unique quality of the Summer Research Program is its focus on objective assessment of its impact on attitudes and instructional practices of participating teachers, on the performance of these teachers in their mentors’ laboratories, and most importantly, on the impact of their participation in the program on student interest and performance in science. SRP uses pass rate on the New York State Regents standardized science examinations as an objective measure of student achievement. SRP's data is the first scientific evidence of a connection between a research experience for teachers program and gains in student achievement. As a result of the research, findings were published in Science Magazine. The author will present an overview of Columbia's teacher research program and the results of the published program evaluation.

http://www.ScienceTeacherProgram.org

ED51B-06

A Physics MOSAIC: Scientific Skills and Explorations for Students

*May, S  (smai@mxschool.edu), Middlesex School, Concord, MA, USA
Clements, C  (clements@haystack.mit.edu), Marlborough High School, Marlborough, MA, USA
Erickson, P J  (pje@haystack.mit.edu), MIT Haystack Observatory, Westford, MA, USA
Rogers, A  (arogers@haystack.mit.edu), MIT Haystack Observatory, Westford, MA, USA

A 21st century education needs to teach students how to manage information in an ever more digital age. High school students (like all of us) are inundated with information, and informed citizenship increasingly depends on the ability to be a critical consumer of data. In the scientific community, experimental data from remote, high quality systems are becoming increasingly available in real time. The same networks providing data also allow scientists to use the ubiquity...
of internet access to enlist citizen scientists to help with research. As a means of addressing and leveraging these trends, we describe a classroom unit developed as part of the NSF Research Experience for Teachers (RET) program at MIT Haystack Observatory in the summer of 2010. The unit uses accessible, real-time science data to teach high school physics students about the nature and process of scientific research, with the goal of teaching how to be an informed citizen, regardless of eventual vocation. The opportunity to study the atmosphere provides increased engagement in the classroom, and students have an authentic experience of asking and answering scientific questions when the answer cannot simply be found on the Web. MOSAIC (Mesospheric Ozone System for Atmospheric Investigations in the Classroom) is a relatively inexpensive tool for measuring mesospheric ozone by taking advantage of the sensitivity of commercially produced satellite TV dishes to the 11.072545 GHz rotational transition of ozone. Because the signal from ozone in the lower atmosphere is pressure-broadened, the system is able to isolate the signal from the 1% of Earth’s ozone that comes from the mesosphere. Our teaching unit takes advantage of measurements collected since 2008 from six East Coast observing sites at high schools and colleges. Data are available online within a day of their collection, and an easy to use web interface allows students to track mesospheric ozone in frequency, time of day, or day of year. The MOSAIC unit begins with a series of activities and lessons designed to take advantage of the large data sets MOSAIC is collecting all the time to teach students about measurement, uncertainty, and data analysis. The curriculum develops an intuitive approach to thinking about numbers in science, focusing on both implicit and explicit expressions of uncertainty. Our teaching unit concludes with a final research project to provide students with the opportunity to pursue an area of interest within mesospheric ozone. This project is conceived in such a way that it can be as self-directed as a teacher or student needs. Given current concern for the state of our atmosphere and ozone, MOSAIC provides a unique opportunity for student engagement in an area of scientific research that has not been extensively explored. MOSAIC data can be compared with online resources for other atmospheric, astronomical, or geophysical data, and have been analyzed for the effects of such variables as seasonal and solar flux variations, lunar phases, shuttle and rocket launches, and sudden stratospheric warming events.

**ED51B-07**

**Piles of Rocks Create Mountains of Understanding; The Fossil Finders Model for success in Earth Science Education**

*Pella-Donnelly, M A  (mdonnell@chicousd.org), Science Department, A.P. Giannini Middle School, San Francisco, CA, USA  
Daley, B  (bondaley@mac.com), Department of Education, Cornell University, Ithaca, NY, USA  
Crawford Ph.D, B  (bcrawford@cornell.edu), Science Department, Chico Junior High School, Chico, CA, USA*

Through the implementation of the Fossil Finders Resources and Tools Project; students across the country have found increased academic understanding of biological evolution. Evolution curriculum is currently covered minimally in many elementary and middle schools. Fossil Finders is a collaboration of the Cornell University Department of Education, The Paleontological Institution of Ithaca, New York and classrooms all over the United States. Essential elements of this curriculum include a scaffolded series of lessons on nature of science, making observations and inferences of fossils and development of an increased understanding of essential earth science topics including the Law of Uniformitarianism and the principle of superposition. Through these hands-on lessons, students begin to understand evolutionary theory and nature of science. The rewards of implementing this curriculum can be observed with student excitement as they engage in authentic research; they become student paleontologists as they scour bags of rocks for the fossils that may be unearthed. The rocks had been collected during a field study, by the teachers and are well known to contain a multitude of Devonian era fossils. Students become researchers as they examine, identify, measure and quantify all fossils found in these rocks. As the children contribute their own data to an online database of an actual paleontological study, they become self driven to examine that compiled data in order to construct explanations of past life in that collection area. This presentation will focus on personal experiences of two teachers, as they engaged their students in authentic research in earth science. It will focus on using inquiry-based strategies that can be transferred to a multitude of classrooms and how to use this basic format to engage, excite and develop understanding of earth science. Teachers will learn about effective inquiry-based lessons that incorporate aspects nature of science. Additionally, this presentation may inform curriculum designers and geologists of how similar geologic educational curriculum might be designed, using an authentic investigation.
Measuring and identifying a Devonian era fossil.

ED51B-08

Teacher/Researcher Projects: The Perfect Merger

*Sutton, M  (msutt@mac.com), Science Education, Carteret County Schools, Beaufort, NC, USA
Achilles, K  (kateachilles@gmail.com), University of Hawaii, Manoa, HI, USA

NSF funding for Education and Outreach has provided researchers with an excellent opportunity to transfer their knowledge from the field to the classroom and community. Various Education/Outreach programs have been established to assist scientists in locating formal and informal educators who can assist in marine and land-based research projects. This merger allows scientists to focus on their research while the educators translate the scientific concepts to their students and the community through appropriate teaching strategies and pedagogy. As more teachers venture into the field with researchers, it is becoming imperative to develop a clear understanding of the expectations between the researchers, teachers, and supporting agencies. This presentation, developed in collaboration with researchers, educators, and Education/Outreach facilitators, provides suggested guidelines for researchers and educators to consider as they venture into Teacher/Researcher projects.