ED51B-1200 0830h POSTER

New Advances in Deep Submergence Technology Using Remotely Operated Vehicles, High-Bandwidth Ship-to-Shore Satellite Technology, and Internet 2

Robert D Ballard[1] (ballard@gso.uri.edu)

Dwight F Coleman[1] (dcoleman@gso.uri.edu)

[1]University of Rhode Island, Graduate School of Oceanography South Ferry Road, Narragansett, RI 02882, United States

In August of 2003, the authors carried out a major oceanographic research cruise to the Black Sea and Central Mediterranean Sea aboard the R/V Knorr using undersea vehicles linked in real time to scientists, engineers, and students ashore. Two vehicle systems, including an ROV and a towed vehicle, worked in tandem using multiple high-definition video cameras and sonar systems to investigate and sample a number of geological and archaeological sites. Scientists and engineers controlled the vehicles on a continuous basis in a shipboard command/control center. From a menu of more than twenty video feeds and computer generated displays within the control center, twelve video signals from the vehicles below, including two high-definition camera feeds, and six audio channels were transmitted via a shipboard satellite-tracking antenna to a receiving site in the United States. From there the signals were sent to a processing center and then placed on Internet 2 and distributed to a number of participating universities across the country. Scientists and engineers at these universities were able to participate in real time in shore-based control centers similar to the one at sea. Two-way audio communications made it possible for these researchers to have full access to the data streams aboard ship and gave them the ability to discuss what they were seeing as well as request additional information and displays on demand. When new discoveries were made, experts ashore could be networked into the decision-making process. This advanced telecommunication system not only provided scientists and engineers ashore the ability to participate in the cruise in real time but also students, teachers, and the general public could participate via both Internet 2 and the conventional internet. These participants were situated at home, in schools, or at other educational venues across the country and had the ability to ask the project scientists and engineers questions while they carried out their research.

ED51C MCC: Level 2 Friday 0830h

The Benefits and Challenges of Education and Public Outreach Efforts Associated With Scientific Research Programs III Posters *(joint with OS, P, SA, SH, SM, C)*

Presiding: **F Ireton,** Science Systems and Applications, Inc.**; J Thieman,** NASA Goddard Space Flight Center

ED51C-1201 0830h POSTER

Extreme Space: Engaging and Educating the Public by Showcasing the Extremes of our Solar System

Rosaly M.C. Lopes[1] (818 393-4584; Rosaly.M.Lopes@jpl.nasa.gov)

Phil W. Davis[1] (Phillips.W.Davis@jpl.nasa.gov)

Leslie L Lowes[1] (Leslie.L.Lowes@jpl.nasa.gov)

[1]Jet Propulsion Laboratory, California Institute of Technology, MS 183-601, 4800 Oak Grove Drive, Pasadena, CA 91107, United States

The period of 2003 to 2006 is an exciting time in solar system exploration, with a fleet of more than a dozen spacecraft exploring the extremes of our solar neighborhood. NASA's Solar System Exploration Education and Public Outreach Forum plans to mine the richness of this intense mission activity and related natural astronomical events to develop a cohesive story of exploration. This is a unique opportunity to raise awareness of our solar system and provide inspiration for student career choices. The concentration of events includes mission launches and endings, spacecraft flybys, encounters, and landings, and sample returns to Earth. The missions target an exciting variety of extreme destinations in the solar system including the Sun, comets, Mercury, Venus, Mars, Jupiter, Saturn, and Pluto. To weave the variety of activities together into a simple concept, the SSE E/PO community has selected Extreme Space as the basis of our unifying theme. Also referenced in the SSE Roadmap, this thread emphasizes the harsh environments of the planets and bodies, and the challenges of designing and executing robotic missions to explore them. The theme encompasses planetary missions, research, and astrobiology, and is logically extensible to the Sun, the Earth and comparisons to other planets, including extrasolar worlds. We plan audience-focused activities around this theme, aimed at the informal and K-12 formal education communities. We are providing one-stop access to SSE mission content and E/PO resources, and professional development opportunities for scientists, teachers and informal education professionals. Content and resource needs include a calendar of events, news alerts, a summary PowerPoint presentation, image and video collections, and thematic education package.

URL: http://solarsystem.nasa.gov

ED51C-1202 0830h POSTER

The Hundred Year Hunt for the Red Sprite

Walter A. Lyons[1] (970-568-7664; walyons@frii.com)

Mickey Schmidt[2] (719-333-2779; Mickey.Schmidt@usafa.af.mil)

[1]FMA Research, Inc., 46050 Weld County Road 13, Fort Collins, CO 80524, United States

[2]USAF Academy Planetarium, Center for Educational Multimedia, USAF Academy, CO 80840, United States

This presentation reviews an NSF Informal Science Education project directed by the PO of an ongoing NSF Physical Meteorology/Aeronomy-sponsored research program on red sprites. For over 100 years, anecdotal reports and citations in the literature have persisted of strange luminous apparitions occurring high above thunderstorms. They were long discounted by the scientific community - until 1989, when by pure chance, a video revealed two giant pillars of light extending tens of kilometers above a thunderstorm. Since then, thousands of events, now called sprites, have been imaged, many by the PI. Mesospheric sprites, at 40 to 90 km altitude, are induced by lightning discharges having highly unusual characteristics. Science is now gradually unraveling the nature of the giant lightning discharges which spawn sprites. In the process we have found even more unusual electrical discharges above thunderstorms, suggesting that many new discoveries await to be made. We produced and are distributing a planetarium DVD/video program (42 minutes length) entitled, "The Hundred Year Hunt for the Red Sprite." It documents the application of the scientific method to unraveling this century old mystery surrounding strange lights in the night sky. We also contrasted this story of discovery to the pseudo-science prevalent today in topics such as UFOs. With distribution to numerous planetaria and science centers, we believe over 200,000 persons will eventually view this program (which has won three major video production awards). Our long term goal is to inspire planetarium visitors to undertake their own self-directed learning programs. A companion educational web site (www.Sky-Fire.TV) allows students and adults sufficiently motivated by the planetarium experience to further investigate sprites and related basic science topics. The highly interactive web site challenges visitors to test their knowledge of sprites and lightning by participating in an on-line 20 question quiz game, which provides instant feed back and scoring. Visitors, encouraged to actively search the sky for these fleeting phenomena, have already reported a number of highly unusual events of potential scientific value.

URL: http://www.Sky-Fire.TV

ED51C-1203 0830h POSTER

Partnering With Scientists To Increase the Visibility and Use of Published Global Climate Change Data

Mark S. McCaffrey[1] (303.497.6939; mark.mccaffrey@noaa.gov)

David M Anderson[2] (David.M.Anderson@noaa.gov)

C. Mark Eakin[2] (Mark.Eakin@noaa.gov)

[1]CIRES, 216 UCB, Boulder, CO 80309, United States

[2]NOAA Paleoclimatology, 325 Broadway, Boulder, CO 80305, United States

Scientific journal articles are notoriously difficult for non-scientists or scientists outside a specialty to comprehend. Yet in societally relevant fields such as global climate change, there is an urgent need to make the published results of scientific research more accessible and useable to a broad audience. NOAA's World Data for Paleoclimatology attempts to meet this need using the Internet to distribute raw data and information products from scientific publications. The Data Center creates "What's New" pages highlighting data from recent publications, along with descriptions and ancillary information such as photographs. The Data Center also authors a "Climate TimeLine", online slide sets and photo gallery, and "Paleo Perspectives" web pages that describe the broader significance of scientific research, and how the data are used to improve our understanding of global warming, drought, and climate change. With the goal to inform and engage, the Climate Time Line provides interactive activities, and information that can be integrated into the classroom. The approach benefits a diverse audience by demystifying climate science and making it more accessible, and benefits scientists by increasing the visibility and use of scientists' published data. The success of the approach can be seen in web site user statistics and comments, and numerous awards for providing valuable information via the Internet. To solve the challenge of simplifying complex scientific problems while maintaining the accuracy and integrity of the scientific information, the World Data Center works closely with scientists who contribute the data. Underlying the effort are the hundreds of scientists who have contributed their data to the World Data Center, and reviewed and edited the online extensions of their research.

URL: http://www.ncdc.noaa.gov/paleo

ED51C-1204 0830h POSTER

NASA's DAAC Alliance Annual and Electronic Publishing: Communicating Research Uses of Earth-Observing Data to a Broad Audience

Laurie J Schmidt[1] (303-735-1055; lschmidt@nsidc.org)

Michon Scott[1] (303-492-1846; michon@nsidc.org)

Nancy Geiger-Wooten[1] (303-735-3674; ngwooten@nsidc.org)

[1]National Snow and Ice Data Center DAAC, University of Colorado Campus Box 449, Boulder, CO 80309-0449, United States

The NASA Distributed Active Archive Centers (DAACs) are the data management and user services branches of NASA's Earth Observing System Data and Information System (EOSDIS). The DAACs process, archive, document, and distribute data from NASA's past and current Earth-observing satellites and field measurement programs. The DAACs were established in the early 1990s, and each DAAC serves a specific science discipline. The DAAC Alliance Annual is a multidisciplinary publication designed to highlight applications and research uses of satellite data archived at the NASA DAACs. Feature articles included in the publication describe research projects that use NASA satellite data. To facilitate understanding by a broad audience, which includes scientists, policymakers, and the general public, the articles are written at a lay audience level and include detailed explanations of scientific processes. Articles from the DAAC Alliance Annual are also published electronically on NASA's Earth Observatory and DAAC Alliance Web sites. The 9th edition of the NASA DAAC Alliance Annual publication, titled "Distributed Active Archive Centers Alliance: Supporting Earth Observing Science 2003," highlights the use of NASA satellite data in a variety of research disciplines, including oceanography, meteorology, seismology, land processes, cryospheric processes, and human influences on native habitats. For the first time, the 2003 edition also includes a glossy, center section featuring color data images that enhance the readers' understanding of the 11 feature articles.

ED51C-1205 0830h POSTER

Aqua Satellite Mission Educational Outreach

Claire L. Parkinson[1] (301-614-5715; Claire.L.Parkinson@nasa.gov)

Steven M. Graham[2] (301-614-5561; graham@pop900.gsfc.nasa.gov)

[1]NASA Goddard Space Flight Center, Code 971, Greenbelt, MD 20771, United States

[2]Science Systems and Applications, Inc., Code 900 NASA GSFC, Greenbelt, MD 20771, United States

An important component of the Aqua mission, launched into space on May 4, 2002 with a suite of six instruments from the U.S., Japan, and Brazil, is the effort to educate the public about the mission and the science topics that it addresses. This educational outreach includes printed products, web casts, other web-based materials, animations, presentations, and a student contest. The printed products include brochures for the mission as a whole and for the instruments, NASA Fact Sheets on the mission, the water cycle, and weather forecasting, an Aqua Science Writers' Guide, an Aqua lithograph, posters, and trading cards. Animations include animations of the launch, the orbit, instrument deployments, instrument sensing, and several

of the data products. Each of these materials is available on the Aqua web site at http://aqua.nasa.gov, as are archived versions of the eight Aqua web casts. The web casts were done live on the internet and focused on the spacecraft, the science, the launch, and the validation efforts. All web casts had key Aqua personnel as live guests and had a web-based chat session allowing viewers to ask questions. Other web-based materials include a "Cool Science" section of the aqua.nasa.gov website, with videos of Aqua scientists and engineers speaking about Aqua and the science and engineering behind it, arranged in a framework organized for the convenience of teachers dealing with core curriculum requirements. The web casts and "Cool Science" site were produced by the Special Project Initiatives Office at NASA's Goddard Space Flight Center. Outreach presentations about Aqua have been given at schools, universities, and public forums at many locations around the world, especially in the U.S. A competition was held for high school students during the 2002-03 school year, culminating in April 2003, with five finalist teams competing for the top slots, followed by an awards ceremony. The competition had all the student teams analyzing an anomalous situation encountered by Aqua shortly after launch and the five finalist teams determining how best to handle a hypothetical degradation of the solid state recorder.

ED51C-1206 0830h POSTER

Exploring Sun-Earth Connections: A Physical Science Program for (K-8)Teachers

Donald J Michels[1,2] (202 767 2737; michels@louis14.nrl.navy.mil)

Sarah M Pickert[1] (202 319 6694; pickert@cua.edu)

Joan L Thompson[1] (202 319 6471; thompsjl@cua.edu)

Charles J Montrose[1] (202 319 5347; montrose@cua.edu)

[1]The Catholic University of America, 620 Michigan Avenue, NE, Washington, DC 20064, United States

[2]Naval Research Laboratory, Code 7660 M, Washington, DC 20375, United States

An experimental, inquiry-based physical science curriculum for undergraduate, pre-service K-8 teachers is under development at the Catholic University of America in collaboration with the Solar Physics Branch of the Naval Research Laboratory and NASA's Sun-Earth Connection missions. This is a progress report. The current, stunningly successful exploratory phase in Sun-Earth Connection (SEC) physics, sparked by SOHO, Yohkoh, TRACE, and other International Solar Terrestrial Physics (ISTP) and Living With a Star (LWS) programs, has provided dynamic, visually intuitive data that can be used for teaching basic physical concepts such as the properties of gravitational and electromagnetic fields which are manifest in beautiful imagery of the astrophysical plasmas of the solar atmosphere and Earth's auroras. Through a team approach capitalizing on the combined expertise of the Catholic University's departments of Education and Physics and of NRL solar researchers deeply involved in SEC missions we have laid out a program that will teach non-science-major undergraduates a very limited number of physical science concepts but in such a way as to develop for each one both a formal understanding and an intuitive grasp that will instill confidence, spark interest and scientific curiosity and, ideally, inspire a habit of lifetime inquiry and professional growth. A three-semester sequence is planned. The first semester will be required of incoming Education freshmen. The second and third semesters will be of such a level as to satisfy the one-year science requirement for non-science majors in the College of Arts and Sciences. The approach as adopted will integrate physics content and educational methods, with each concept introduced through inquiry-based, hands-on investigation using methods and materials directly applicable to K-8 teaching situations (Exploration Phase). The topic is further developed through discussion, demonstration and lecture, introducing such mathematical formulations as are necessary to express the concept clearly (Invention Phase). To further clarify the concept, exercises will be carried out using Web-accessible SEC mission data to develop facility in use of the mathematical formulations, stimulate a sense of participation in ongoing research, and expand on ways to introduce future pupils to the excitement of real-world exploration (Expansion Phase).

ED51C-1207 0830h POSTER

Using backward design in NASA educational resources

Laura M. Peticolas[1] (laura@ssl.berkeley.edu)

Bryan Mendez[1] (bmendez@ssl.berkeley.edu)

Greg Schultz[1] (schultz@ssl.berkeley.edu)

Janet G. Luhmann[1] (jgluhman@ssl.berkeley.edu)

Nahide Craig[1] (ncraig@ssl.berkeley.edu)

[1]Space Sciences Laboratory, University of California at Berkeley 7 Gauss Way, Berkeley, CA 94720-7450, United States

It is important to create NASA educational resources that are effective in imparting deep understanding of space physics concepts, which link to main ideas outlined in the National Science Education Standards (NSES). One way of ensuring success in such a task is to use the backward design philosophy described in the book, "Understanding by Design" by Wiggins and McTighe. Using this design philosophy together with inquiry-based activities, we have developed a teacher's magnetism guide with three main lessons. The goal of this teacher's guide is to help middle school kids learn about motions and forces, magnetism, including electromagnetism, science as inquiry, and science as a human endeavor. We reach these goals in part by using the story of the NASA STEREO Mission together with the design process of the STEREO-IMPACT magnetic boom. We found that using a backward design guarantees that our activities teach the ideas we want the students to learn and also that the lessons include a variety of assessment and evaluation tools along the way. However, we also found that it is difficult to implement the backward design without a long lesson using several assessment tools. This could be a problem for teachers who may not be able to use such time-consuming NASA activities and tools in their classroom. In this presentation, we will further discuss the ideas of backward design in the context of the three activities we created, and the benefits and difficulties we encountered using this philosophy.

URL: http://cse.ssl.berkeley.edu/impact

ED51C-1208 0830h POSTER

Solar Astronomy: Science in Service to Education

Deborah Scherrer[1] (650-723-1495; dscherrer@solar.stanford.edu)

Kelly Beck[2] (650-723-8749; kbeck@stanford.edu)

Cherilynn Morrow[3] (720-974-5828; camorrow@colorado.edu)

[1]Stanford University, HEPL-4085 455 Via Palou, B128, Stanford, CA 94305-4085, United States

[2]Hass Center for Public Service, Stanford University, MC:8620 562 Salvatierra Walk, Stanford, CA 94305, United States

[3]Space Science Institute, 4750 Walnut Street, Suit3e 205, Boulder, CO 80301, United States

The Haas Center for Public Service, the Stanford Solar Center, the Space Sciences Institute, and NASA have joined in a pioneering collaboration to develop a Science Service Learning Program, being prototyped at Stanford. Our plan is to train and prepare undergraduates from many fields to engage in public service projects that communicate science and the excitement of scientific discovery to K-14 students and people of all ages. Ultimately, we hope to motivate and cultivate advocacy of science and good science education among future professionals and leaders in multiple disciplines. The program includes a 1-quarter undergraduate course where students are taught effective techniques for communicating science. Using solar astronomy as the theme, students will learn basic concepts directly from solar science researchers, and be mentored on how to apply this knowledge to outreach efforts. Selected graduates of the course will become Public Service Science Fellows and participate directly in educational outreach efforts to the community under plans that they have designed themselves. Not only will our program provide a leveraged outreach effort to underserved communities, but we hope to develop a cadre of professionals who feel that science education and public service are part of a lifetime commitment.

ED51C-1209 0830h POSTER

Solar Week: Learning from Experience

David Alexander[1] (713 348-3633; dalex@rice.edu)

Karin Hauck[2] (510 642-2343; karin@ssl.berkeley.edu)

[1]Rice University, PO Box 1892, Houston, TX 77251, United States

[2]UC Berkeley, Grizzly Peak @ Centennial Rd., Berkeley, CA 94720, United States

Solar Week is a week-long set of games and activities allowing students to interact directly with solar science and solar scientists. Solar Week was developed as a spin-off of the highly successful Yohkoh Public Outreach Project (YPOP). While YPOP provided access to solar images, movies and activities, the main goal of Solar Week was to enhance the participation of women, who are under-represented in the physical sciences. Solar Week achieves this by providing young women, primarily in grades 6-8, with access to role models in the sciences. The scientists participating in Solar Week are women from a variety of backgrounds and with a variety of scientific expertise. In this paper, our aim is to provide some insight into developing activity-based space science for the web and to discuss the lessons-learned from tailoring to a specific group of participants.

URL: http://www.lmsal.com/YPOP/solarweek

ED51C-1210 0830h POSTER

A Presentation Bank for AGU-SPA Scientists Presenting to the Public

Paul J. Mortfield[1] (408-253-1833; Paul@BackyardAstronomer.com)

Deborah Scherrer[1] (650-723-1495; dscherrer@solar.stanford.edu)

[1]Stanford SOLAR Center, HEPL Annex B-208, Stanford University, Stanford, CA 94305-4085, United States

The Stanford SOLAR Center in a coordinated effort with the AGU-SPA Education Committee is developing a Presentation Bank to provide AGU Space Physics and Aeronomy scientists with collected materials & imagery to present Sun-Earth related science in their field of expertise to the general public. The presentations can also be used for other audiences such as school groups, science museums, planetariums and the press. Working closely with the Education Committee and SPA scientists we are enhancing the existing SPA "slideset" into a prototype demonstration of the Presentation Bank. Our focus is to use up to date "best of" imagery and video to excite an audience about current research topics. By following a peer review process, the best and most useful collection of imagery will be produced to meet the needs of AGU scientists. We will share samples of slideset imagery and discuss details and infrastructure of the presentation bank and how scientists can best use this resource.

URL: http://solar-center.stanford.edu

ED51C-1211 0830h POSTER

SOFIA Education and Public Outreach (EPO): Scientist/Educator Partnerships at 41,000 Feet

Dana Backman[1] (650-604-2128; dbackman@mail.arc.nasa.gov)

Edna DeVore[2] (650-960-4538; edevore@seti.org)

Michael Bennett[3] (415-337-1100; mbennett@astrosociety.org)

[1]USRA/SOFIA, MS 144-2, NASA-Ames, Moffett Field, CA 94035-1000, United States

[2]SETI Institute, 2035 Landings Drive, Mountain View, CA 94043, United States

[3]Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco, CA 94112, United States

NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) represents a unique opportunity for education and public outreach (EPO). SOFIA is the first research observatory – airborne or ground-based – in which close participation by educators and journalists is being designed into both the physical facility and the administrative structure of the observatory. With the overall goal of contributing to the public's awareness and understanding of science in general and astronomy in particular, the SOFIA EPO program will include formal K-12 and undergraduate educational activities, informal education, public outreach, and media relations. One of the most exciting and unique aspects of the SOFIA EPO program is the observatory's ability to carry up to 10 educators on science flights, enabling those educators to partner with scientists and participate in real research. Some 200 formal and informal educators per year are expected to participate in the SOFIA Airborne Astronomy Ambassadors program once full-scale operation is achieved. Educators who have participated in the Airborne Astronomy Ambassadors program will be encouraged to continue their scientific partnerships and will be supported in their efforts to carry new-found knowledge and enthusiasm to their students, other educators in their communities and the general public. The Airborne Astronomy Ambassadors will be supported as a national network via continued communications and material support from the SOFIA EPO program office, and will constitute a wide-spread outreach cadre for NASA and space sciences based on their experiences with airborne astronomy. Scientists, engineers, and other members of the SOFIA team will be encouraged to partner with local teachers and visit their classrooms as a part of the SOFIA Education Partners Program. Training for scientist-educators will be offered via the Astronomical Society of the Pacific's Project ASTRO network of astronomy education sites around the USA. This program will enable students to interact with scientists

and other professionals on a one-to-one basis. Participating educators may fly onboard SOFIA with their scientist partners. Scientists who participate in this program will be able to work with educators and students in their local communities to forge long-lasting science education partnerships. The SOFIA EPO staff is interested in forming collaborations with interested organizations, other NASA missions, and individual astronomers. SOFIA is being developed and will be operated for NASA by USRA. The EPO program is being developed and will be operated jointly by the SETI Institute and the Astronomical Society of the Pacific.

URL: http://sofia.arc.nasa.gov

ED51C-1212 0830h POSTER

NASA High Energy Space Science E/PO at SSU: Program Overview and Lessons Learned

Philip Plait[1] (707-664-2190; phil@universe.sonoma.edu)

Lynn Cominsky[1] (707-664-2655; lynnc@charmian.sonoma.edu)

[1]NASA E/PO at Sonoma State University, 1801 E. Cotati Ave., Rohnert Park, CA 94928, United States

The NASA Education and Public Outreach (E/PO) Group at Sonoma State University is the lead institution for the E/PO of three high-energy space science missions: Swift, GLAST, and XMM-Newton. We have developed award-winning standards-based formal and informal educational activities (classroom exercises, inquiry-driven games, posters, etc.) for these missions, with many more coming soon. Our primary goal is to teach students about the high-energy end of the electromagnetic spectrum, and the astrophysical objects which emit in that energy range. We will present an overview of our group and our work. This includes our collaborations with other groups, getting mission scientists' input on the projects, and the lessons learned in making effective E/PO products that actually get used by teachers. We will also include a brief overview of the NASA Educator Ambassador program, a new highly-effective effort we have initiated to train top-notch educators from across the country to help us develop, test, and disseminate our products.

URL: http://epo.sonoma.edu

ED51C-1213 0830h POSTER

NASA Education and Public Outreach Initiatives at the MIT Center for Space Research

Irene L. Porro (617-258-7481; iporro@space.mit.edu)

MIT Center for Space Research, 77 Massachusetts Avenue, NE80-6095, Cambridge, MA 02139, United States

Since its inception in 1999, the EPO office of the MIT Center for Space Research (CSR) has fostered direct participation of local scientists in educational initiatives such as teachers workshops and public tours of the Chandra Operations and Control Center. The role played by the CSR EPO office has grown significantly, thanks to the award of a number of EPO grants associated with the Chandra and HETE missions. In the past year about one-third of the CSR research staff was involved in the office's EPO initiatives: more than 500 K-12 students, about half from underrepresented groups, were included in formal education programs and informal education events attracted an estimated 900 people. Today the mission of the CSR EPO office is focused in two areas: professional development for K-12 science teachers, and educational programs in out-of-school time. To be associated with major NASA research missions is beneficial to our mission in several respects, but provides also specific challenges. We present here some of the strategies and intiatives that we have undertaken to overcome those challenges.

ED51C-1214 0830h POSTER

Observing Occultations of Stars by Asteroids and by the Moon Teaches Astronomy and Discipline While Contributing to Astronomical Research

David W Dunham[1] (240-228-5609; david.dunham@jhuapl.edu)

Harry Bates[2] (410-704-2441; hbates@towson.edu)

Wayne H Warren[2] (410-704-3219; wwarren@towson.edu)

[1]Johns Hopkins University Applied Physics Laboratory, Group SRM, MP3-W106 11100 Johns Hopkins Rd., Laurel, MD 20723-6099, United States

[2]Towson University, Dept. of Physics, Astronomy, & Geosciences 8000 York Rd., Baltimore, MD 21252-0001, United States

Occultations of stars by asteroids and by the Moon are exciting dynamical phenomena with each event visible from a restricted region of the Earth. Much about astronomy can be taught by observing them while their time-critical nature teaches discipline. The successful observation of these events is a rewarding experience resulting in new knowledge about the cosmos. The sizes and shapes of asteroids can be determined from observations of asteroidal occultations, and satellites of these objects can be discovered. Similarly, the profile of the polar regions of the Moon can be determined from observation of lunar grazing occultations visible from narrow strips of land a few kilometers wide at the edges of the regions of visibility of lunar occultations. In addition, both types of observation can discover and resolve very close double stars difficult or impossible to resolve by other current means, and even stellar diameters can be measured from observations of some asteroidal occultations. Accurate observations can now be made with small sensitive video cameras attached to small portable telescopes. The same equipment can also be used to monitor the dark side of the crescent Moon to record lunar meteor impacts. All of these observations are coordinated mainly among amateur astronomers by the International Occultation Timing Association (IOTA). This activity is also a good subject for college, university, and some high school astronomy and physics classes that can be coordinated with (and helped by) local amateur astronomers. Since many of the observations are made during expeditions, and sometimes very bright stars are involved, they also provide an opportunity to interact with, and educate, the general public.

URL: http://iota.jhuapl.edu/ed903.htm

ED51C-1215 0830h POSTER

Synergy of Research and EPO Programs at NSO

K S Balasubramaniam[1] (505-434-7134; bala@nso.edu); Stephen L Keil[1,2] (505-434-7039; keil@nso.edu); Matthew J Penn[2] (520-318-8510); David Dooling[1] (505-434-7015; ddooling@nso.edu); Priscilla Piano[2] (520-318-8294; ppiano@nso.edu); Jackie Diehl[1] (505-434-7003; diehlj@nso.edu); Rex Hunter[1] (505-434-7075; hunter@nso.edu)

[1]National Solar Observatory, Sacramento Peak, Sunspot, NM 88349, United States

[2]National Solar Observatory, 950 N. Cherry Avenue, Tucson, AZ 85719, United States

The National Solar Observatory with its facilities at Sunspot, NM and Tucson, AZ runs an extensive education and public outreach effort. Much of these efforts are coupled research and education efforts aimed across a spectrum that spans through school teachers, school students, undergraduate and graduate researchers, and the public. In this paper, we will describe the benefits and challenges the NSO program faces, and future prospects of these programs.

URL: http://eo.nso.edu/

ED51C-1216 0830h POSTER

Supporting Research at NASA's Goddard Space Flight Center Through Focused Education and Outreach Programs

Frank Ireton[1] (301-867-2034; frank_ireton@sesda.com)

Jim Closs[1] (301-67-2119; jim_closs@sesda.com)

[1]Science Systems and Applications, Inc., 10210 Greenbelt Road Suite 500, Lanham, MD 20706, United States

NASA research scientists work closely with Science Systems and Applications, Inc. (SSAI) personnel at Goddard Space Flight Center (GSFC) on a large variety of education and public outreach (E/PO) initiatives. This work includes assistance in conceptualizing E/PO plans, then carrying through in the development of materials, publication, cataloging, warehousing, and product distribution. For instance, outreach efforts on the Terra, Aqua, and Aurastill in developmentEOS missions, as well as planetary and visualization programs, have been coordinated by SSAI employees. E/PO support includes convening and taking part in sessions at professional meetings and workshops. Also included is the coordination of exhibits at professional meetings such as the AGU, AAAS, AMS and educational meetings such as the National Science Teachers Association. Other E/PO efforts include the development and staffing of booths; arranges for booth space and furnishings; shipping of exhibition materials and products; assembling, stocking, and disassembling of booths. E/PO personnel work with organizations external to NASA such as the Smithsonian museum, Library of Congress, U.S. Geological Survey, and associations or societies such as the AGU, American Chemical Society, and National Science Teachers Association to develop products and programs that enhance NASA mission E/PO efforts or to provide NASA information for use in their programs. At GSFC, E/PO personnel coordinate the efforts of the education and public outreach sub-committees in support of the Space and Earth Sciences Data Analysis (SESDA) contract within the GSFC Earth Sciences Directorate. The committee acts as a forum for improving communication and coordination among related Earth science education projects, and strives to unify the representation of these programs among the science and education communities. To facilitate these goals a Goddard Earth Sciences Directorate Education and Outreach Portal has been developed to provide a repository and clearinghouse for upcoming education events, and a speaker's bureau. The committees are planning a series of workshops in the near future to expand participation, and further leverage respective Earth science education and outreach efforts through cooperative work with other NASA centers. Founded in 1977 as a minority, women-owned business, SSAI's staff includes a large and varied pool of scientists, E/PO employees covering a broad range of training and talents. SSAI provides support on a number of NASA related projects at Goddard Space Flight Center (GSFC) in Greenbelt, Maryland ranging from science research to data acquisition, storage, and distribution.

URL: http://webserv.gsfc.nasa.gov/ESD/portal/

ED51C-1217 0830h POSTER

Building Successful Partnerships Between Scientists and Educators to Bridge Scientific Research to Education and Outreach Audiences at a National Research Laboratory

Susan Q. Foster[1] (susanf@ucar.edu); Roberta M. Johnson[1]; Sandra Henderson[1]; Linda Carbone[1]; Teri Eastburn[1]; Randy Russell[1]; Lisa Gardiner[1]; Caspar Ammann[2]; David Carlson[2]; Cecelia DeLuca[2]; Allan Fried[2]; Tim Killeen[2]; Krista Laursen[2]; Ramon Lopez[2]; Gang Lu[2]; Dan Marsh[2]; Linda Mearns[2]; Bette Otto-Bleisner[2]; Art Richmond[2]; Dirk Richter[2]; Jeff Hughes[3]; Claudia Alexander[4]; Tamas Gombosi[5]; Geoff Haines-Stiles[6]

[1]Office of Education and Outreach, University Corporation for Atmospheric Research, PO Box 3000, Boulder, CO 80307

[2]National Center for Atmospheric Research, PO Box 3000, Boulder, CO 80307, United States

[3]Department of Astronomy and Center for Space Physics, Boston University, 725 Commonwealth Avenue, Boston, MA 02215, United States

[4]NASA Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

[5]The University of Michigan, 1416 Space Research Building, Ann Arbor, MI 48109-2143, United States

[6]Passport to Knowledge/Geoff Haines-Stiles Productions, Inc, 27 Washington Valley Road, Morristown, NJ 07960, United States

The scientific missions of National Center for Atmospheric Research (NCAR) and the University Corporation for Atmospheric Research (UCAR) community offer numerous opportunities to integrate content on atmospheric, climate, and related sciences into formal and informal public education and outreach programs. The UCAR Office of Education and Outreach currently coordinates a variety of partnerships with science PI's catalyzing activities that include work-study experiences for teachers and students in the laboratory; creation of EO resources for scientists to utilize when visiting K-12 classrooms; extension of exhibit content in K-12 teacher guides; topic-specific web site content for the public, K-12, and undergraduates; professional development for K-12 educators; and public broadcast quality documentation of emerging technology. This presentation will review how these partnerships are developed, what works best, and plans for the future drawing from examples of collaborations with scientists. The scientists represent the NSF-funded Analytical Photonics and Optoelectronics Laboratory (APOL), the Boston University Center for Integrated Space Weather Modeling, and the High Altitude Instrumented Platform for Environmental Research Program (HIAPER); the NASA-funded Earth System Modeling Framework; collaborations with the Windows to the Universe project sponsored by multiple agencies; the NCAR Climate Assessment Initiative; and several NASA-funded Sun-Earth Connection Research Programs.

ED51C-1218 0830h POSTER

The Young Engineers and Scientists Mentorship Program

Daniel C. Boice[1] (210-522-3782; dboice@swri.edu)

Jorg-Micha Jahn[1] (210-522-2491; jjahn@swri.edu)

Pamela Hummel[2] (oconn146@nisd.net)

[1]Southwest Research Institute, Space Science & Engineering Div. 6220 Culebra Road P.O. Drawer 28510, San Antonio, TX 78228-0510, United States

[2]Sandra Day O'Connor High School, 12221 Leslie Road, Helotes, TX 78023, United States

The Young Engineers and Scientists (YES) Program is a ommunity partnership between Southwest Research Institute (SwRI), and local high schools in San Antonio, Texas (USA). It provides talented high school juniors and seniors a bridge between classroom instruction and real-world, research experiences in physical sciences (including space science and astronomy) and engineering. YES consists of two parts: 1) an intensive three-week summer workshop held at SwRI where students experience the research environment first-hand; develop skills and acquire tools for solving scientific problems, attend mini-courses and seminars on electronics, computers and the Internet, careers, science ethics, and other topics; and select individual research projects to be completed during the academic year; and 2) a collegial mentorship where students complete individual research projects under the guidance of their mentors during the academic year and earn honors credit. At the end of the school year, students publicly present and display their work, acknowledging their accomplishments and spreading career awareness to other students and teachers. YES has been highly successful during the past 10 years. All YES graduates have entered college, several have worked for SwRI, and three scientific publications have resulted. Student evaluations indicate the effectiveness of YES on their academic preparation and choice of college majors. We gratefully acknowledge partial funding for the YES Program from a NASA EPO grant.

URL: http://yesserver.space.swri.edu/

ED51C-1219 0830h POSTER

Communicating Complex Concepts: A Guide For Scientists

H. Marijke Unger (303-492-1497; marijke@nsidc.org)

National Snow and Ice Data Center, 449 UCB, Boulder, CO 80309, United States

This essay argues the importance of identifying gaps in communication between the "information producers" and "information consumers." These two contingents are defined as the scientific community on the one hand, and policy makers, the media, educators, and the general public on the other. Lack of communication between these two sides makes policy and resource management decisions challenging. We will identify communication gaps, examine ways of addressing and resolving them, and discuss the importance of ensuring adequate information flow. Possible solutions involve dedicating resources to encourage the development of professional programs and integrative initiatives for both contingents to find a common language of communication, or to accept third-party negotiation as a means of improving communication. This discussion is set in the context of a research institution seeking to establish an outreach program that successfully disseminates scientific information to a broader audience.

ED51C-1220 0830h POSTER

The Benefits and Challenges of Scientist-Educator Partnerships

Cherilynn Ann Morrow (720 974 5828; camorrow@colorado.edu)

Space Science Institute, 4750 Walnut St, Suite 205, Boulder, CO 80301, United States

Space and Earth scientists who are involved in NSF Science and Technology Centers, NASA missions, and individual research awards have increasing opportunities to plan and implement significant education and public outreach (EPO) programs. This paper will begin by acknowledging the cultural differences between scientists and educators that can inhibit the success of their partnerships, but it will quickly turn an eye to the common ground between scientific research and science education. Scientists and educators have an opportunity to discover common ground in the way scientists practice science and the way science education reform is calling upon educators to teach science. Discovering this common ground can be a useful way of focusing the talents and knowledge of scientists in support of science education.

URL: http://www.spacescience.org

ED51C-1221 0830h POSTER

Opportunities and Challenges of Associating Education and Public Outreach with Individual Research Programs

Bernhard Beck-Winchatz[1] (bbeckwin@depaul.edu)

Noreen Grice[2] (ngrice@mos.org)

[1]DePaul University NASA Center, 990 W Fullerton, Suite 4400, Chicago, IL 60614, United States

[2]Boston Museum of Science, Science Park, Boston, MA 02114, United States

OSS provides individual researchers with a variety of funding opportunities to develop education and public outreach (EPO) programs. These include grants programs associated with observatory calls for proposals (e.g., Hubble Space Telescope and Chandra Cycle EPO), NASA's Research Opportunities in Space Science (ROSS) research announcement, and the Initiative to Develop Education though Astronomy and Space Science (IDEAS) grants program. OSS's unique way of funding E/PO presents a number of interesting opportunities and challenges for both scientists and educators. We will discuss some of these issues using our experience with the development of "Touch the Universe - A NASA Braille Book of Astronomy" and our work as OSS broker/facilitators in assisting other scientists and educators in the development of their programs.

ED51C-1222 0830h POSTER

Exploring Earth's Ionosphere with CINDI: Bringing an Upper Atmosphere Mission into Pre-College Classrooms

Mary L. Urquhart[1,2] (972-883-2499; urquhart@utdallas.edu)

Marc R Hairston[1] (hairston@utdallas.edu)

James M. Richardson[3] (martial@utdallas.edu)

Charlene Olson[4] (colson@mckinneyisd.net)

[1]William B. Hanson Center for Space Sciences, University of Texas at Dallas, Mail Station FO22 P.O. Box 730688, Richardson, TX 75083-0688

[2]Department of Science/Mathematics Education, University of Texas at Dallas, Mail Station FO22 P.O. Box 730688, Richardson, TX 75083-0688

[3]Department of Physics, University of Texas at Dallas, Mail Station FO32 P.O. Box 730688, Richardson, TX 75083-0688

[4]McKinney Independent School District, Scott Johnson Middle School 3400 Community Drive, McKinney, TX 75071

We will present the Education and Public Outreach work in progress for the joint Air Force/NASA project CINDI (Coupled Ion Neutral Dynamic Investigation), which will launch in early 2004 on a US Air Force C/NOFS (Communications/Navigations Outage Forecast System) Satellite. CINDI, in conjunction with the other instruments on C/NOFS, will study how radio signals sent through the ionosphere are affected by variability with this layer of the atmosphere. The Educational outreach for CINDI is focused on helping students, educators, and the general public better understand the link between the ionosphere and our technological civilization. The ionosphere is typically neglected in pre-college science classes despite its impact on modern society and the substantial resources invested by funding agencies on furthering our understanding of this atmospheric layer. Our approach is to increase student understanding of the terrestrial ionosphere and Sun-Earth connections through strong connections to existing pre-college curricula and standards. We have created a partnership between the William B. Hanson Center for Space Sciences and the Science Education Program within the University of Texas at Dallas (UTD) to produce a quality Educator Guide and a Summer Educator Workshop. A senior graduate student in physics and an experienced middle school educator in UTD's Science Education Master of Science Teaching Program have been partnered to ensure that our the Educator Guide and Workshop will contain both science and pedagogy, and be easily integrated into secondary science classes. The summer 2004 workshop will be offered in the Dallas area, which has a significant population of minority and economically disadvantaged students. We will recruit teachers from districts that serve a large number of underserved/underrepresented students. The Educator Guide and workshop materials will be made available on the CINDI Web site for distribution to a national audience.

URL: http://cindispace.utdallas.edu/

ED51C-1223 0830h POSTER

Students, Teachers, and Scientists Partner to Explore Mars

Catherine D. Bowman[1] (650-269-2787; cbowman@mail.arc.nasa.gov); Marilou Bebak[2]; Kristen Curtis[2]; Craig Daniel[3]; Brian Grigsby[4]; Tim Herman[5]; Emily Haynes[6]; D. Howard Lineberger[3]; Stephanie Pieruccini[7]; Selena Ransom[8]; Katie Reedy[2]; Cherise Spencer[5]; Adam Steege[3]

[1]Raytheon ITSS, NASA Ames Research Center M/S 269-3, Moffett Field, CA 94035-1000, United States

[2]Nardin Academy High School, 135 Cleveland Ave, Buffalo, NY 14222, United States

[3]Durham Academy Upper School, 3601 Ridge Rd, Durham, NC 27705, United States

[4]Shasta County Office of Education, 1644 Magnolia Ave, Redding, CA 96001, United States

[5]West Valley High School, 3805 Happy Valley Rd, Cottonwood, CA 96022, United States

[6]Centaurus High School, 10300 South Boulder Rd., Lafayette, CO 80026, United States

[7]Milton Hershey School, 820 Spartan Lane, Hershey, PA 17033, United States

[8]University High School, 11800 Texas Avenue, Los Angeles, CA 90025, United States

The Mars Exploration Rovers began their journey to the red planet in the summer of 2003 and, in early 2004, will begin an unprecedented level of scientific exploration on Mars, attracting the attention of scientists and the public worldwide. In an effort to engage students and teachers in this exciting endeavor, NASA's Mars Public Engagement Office, partnering with the Athena Science Investigation, coordinates a student-scientist research partnership program called the Athena Student Interns Program. The Athena Student Interns Program *ASIP* began in early 1999 as the LAPIS program, a pilot hands-on educational effort associated with the FIDO prototype Mars rover field tests *Arvidson*, 2000. In ASIP, small groups of students and teachers selected through a national application process are paired with mentors from the mission's Athena Science Team to carry out an aspect of the mission. To prepare for actual operations during the landed rover mission, the students and teachers participate in one of the Science Team's Operational Readiness Tests *ORTs* at JPL using a prototype rover in a simulated Mars environment *Crisp, etal., inpress.Seealsohttp : //mars.jpl.nasa.gov/mer/fido/*. Once the rovers have landed, each ASIP group will spend one week at JPL in mission operations, working as part of their mentor's own team to help manage and interpret data coming from Mars. To reach other teachers and students, each group gives school and community presentations, contributes to publications such as web articles and conference abstracts, and participates in NASA webcasts and webchats. Partnering with other groups and organizations, such as NASA's Solar System Ambassadors and the Housing and Urban Development Neighborhood Networks helps reach an even broader audience. ASIP is evaluated through the use of empowerment evaluation, a technique that actively involves participants in program assessment *FettermanandBowman*, 2002. With the knowledge they gain through the ASIP program and their participation in the empowerment evaluation, ASIP members will help refine the current program and provide a model for student-scientist research partnerships associated with future space missions to Mars and beyond. Arvidson, R.E., et al. 2000 Students participate in Mars Sample Return Rover field tests. Eos, 81(11). Crisp, J.A., et al. *inpress* The Mars Exploration Rover Mission. J. Geophys. Research-Planets. Fetterman, D. and C.D. Bowman. 2002 Experiential Education and Empowerment Evaluation: Mars Rover Educational Program Case Example. J. Experiential Education, 25(2).

URL: http://mars.jpl.nasa.gov/classroom/students/asip.html

ED51C-1224 0830h POSTER

Water Under Fire: A Seven Part Video Series on Canada's Water

Richard Mrazek[1] (403 329 2452; mrazek@uleth.ca)

James Byrne[1] (403 329 2002; byrne@uleth.ca)

Nicole Rabe[1] (403 394 3906; nicole.rabe@uleth.ca)

George Gallant[2] (403 380 4439; george@gallantproductions.com)

[1]University of Lethbridge, 4401 University Drive West, Lethbridge, AB T1K 3M4, Canada

[2]Gallant Productions, 202 - 12th Street 'C' North, Lethbridge, AB T1H 2M7, Canada

Canada's water is under escalating pressure from a host of threats. Increasingly, our water is being tainted, misused and over allocated. Experts have identified a multitude of threats to water quantity and quality. Among them, climate change impacts on water supply, and the effects of pesticides, pathogens, industrial waste, urban runoff, and rising demands. These and other threats are the roots to a serious shortage of high quality, safe water sources. In the 1990s, waterborne diseases have re-emerged as one of the primary health issues on a national and global scale. This seven-part video series brings science voices together and provides a nationwide context. The first six programs in the series explore regional concerns: Rocky Mountains, Prairie Waters, Northern Waters, Great Lakes Basin, St. Lawrence and Atlantic Canada. The final program covers the national and international perspectives.

ED51C-1225 0830h POSTER

Cosmic Origins: A Traveling Science Exhibit and Education Program

Paul B. Dusenbery[1] (720-974-5822; dusenbery@colorado.edu)

Cherilynn A. Morrow[1] (720-974-5828; camorrow@colorado.edu)

James Harold[1] (720-974-5858; harold@colorado.edu)

[1]Space Science Institute, 4750 Walnut Street, Suite 205, Boulder, CO 80301, United States

The Space Science Institute of Boulder, Colorado, is developing a 3,000 square-foot traveling exhibition, called Cosmic Origins, which will bring origins-related research and discoveries to students and the American public. Cosmic Origins will have three interrelated exhibit areas: Star Formation, Planet Quest, and Search for Life. Exhibit visitors will explore the awesome events surrounding the birth of stars and planets; they will join scientists in the hunt for planets outside our solar system including those that may be in "habitable zones" around other stars; and finally they will be able to learn about the wide range of conditions for life on Earth and how scientists are looking for signs of life beyond Earth. Visitors will also learn about the tools scientists' use, such as space-based and ground-based telescopes, to improve our understanding of the cosmos. Exhibit content will address age-old questions that form the basis of NASA's Origins and Astrobiology programs: Where did we come from? Are we alone? In addition to the exhibit, our project will include workshops for educators and docents at host sites, as well as a public Web site that will use a virtual rendering of exhibit content. The exhibit's size will permit it to visit medium sized museums in underserved regions of the country. It will begin its 3-year tour to 9 host museums and science centers in early 2005. A second 3-year tour is also planned for 2008. The Association of Science-Technology Centers (ASTC) will manage the exhibit's national tour. Current partners in the Cosmic Origins project include ASTC, the Denver Museum of Nature and Science, Lawrence Hall of Science, NASA Astrobiology Institute, NASA missions (e.g. PlanetQuest, SIRTF, and Kepler), New York Hall of Science, the SETI Institute, and the Space Telescope Science Institute. The exhibition is supported by grants from NSF and NASA. This report will focus on the Planet Quest part of the exhibition.

ED51C-1226 0830h POSTER

Involving Students, Educators and Amateur Astronomers in the Search for Extrasolar Planets

Edna DeVore[1]

Ron Bissinger[2] (925.462.0355; rbissinger@aol.com)

[1]SETI, 2035 Landings Drive, Mountain View, CA 94043, United States

[2]Raccoon Run Observatory, 1142 Mataro Court, Pleasanton, CA 94566, United States

Due to advances in telescope and digital imaging technology, the search for extrasolar planets can now be performed by dedicated students, educators and amateur astronomers. The applicability of off-the-shelf telescopes, hardware and software to the detection of extrasolar planets using the transit method is described. Data reduction techniques are discussed that can theoretically reveal the presence of an extrasolar planet slightly larger than earth using such equipment. Finally, educational outreach efforts conducted by an amateur astronomer involved in the search for extrasolar planets are described, including a pilot partnership with a local community college.

ED51D MCC: 3012 Friday 1020h

Teacher Professional Development Programs Promoting Authentic Scientific Research in the Classroom II *(joint with OS, P, C)*

Presiding: **I Hawkins,** Space Sciences Laboratory, University of California, Berkeley**; C E Walker,** National Optical Astronomy Observatory

ED51D-01 1020h INVITED

Teacher Professional Development Programs Promoting Authentic Scientific Research in the Classroom

Wayne W. Sukow ((703)292-5122; wsukow@nsf.gov)

Research Experiences for Teachers (RET) are a fundamentally different kind of professional development (PD) than the more typical teacher PD workshop format. In the past decade RET has evolved from "a great summer research experience with slides to show students" to an equal emphasis on transfer to the classroom so students "learn science by doing science" as they engage in authentic scientific research. Different models for RET have evolved as well as methods to increase the transfer to the classroom of thelearning-science-by-doing-science pedagogical paradigm. In the Elementary, Secondary, And Informal Education (ESIE) division at NSF, different RET models have been developed through program emphases such as Teacher Leadership, Research Experiences for Teachers and Students programs and most recently through Teacher Retention and Renewal programs. Some of them include the Research Based Science Education I project at NOAO, Research Experiences In Industry at Mississippi State, QuarkNet at Fermilab, The Cosmic Ray Observatory Project at University of Nebraska-Lincoln, the Teacher Experiencing Antarctica/the Arctic program, oceanographic research in The Teacher ARMADA project at the University of Rhode Island, and the Science Research in High School project at SUNY-Albany. Regardless of the RET model, one of the critical results is the development of a professional learning community that outlives the research experience and the RET program. RET programs exemplify the integration of science disciplinary research and education, which is a critical component of NSF's strategic plan.

URL: http://www.nsf.gov

ED51D-02 1035h

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

Gregory R. Snow[1] (1-402-472-6279; gsnow@unlhep.unl.edu)

Daniel R Claes[1] (1-402-472-2783; dclaes@unlhep.unl.edu)

[1]University of Nebraska, Dept. of Physics and Astronomy 116 Brace Hall, Lincoln, NE 68588-0111, United States

The Cosmic Ray Observatory Project (CROP) is a statewide education and research experiment involving Nebraska high school students, teachers, and college undergraduates in the study of extensive cosmic-ray air showers. A network of high school teams construct, install, and operate school-based detectors in coordination with University of Nebraska 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. Funded by the National Science Foundation, CROP has enlisted 21 schools in its first four years of operation with the aim of expanding to the 314 high schools in the state over the next several years. Similar school-based cosmic ray efforts (WALTA, ALTA, CHICOS, etc.) and the continent-wide consortium, NALTA, will also be described.

URL: http://www.physics.unl.edu/research/crop/crop.html

ED51D-03 1050h

Teachers in Industry: Connecting the Workplace to the Classroom

Sandra H Harpole (662-325-2922; Sharpole@research.msstate.edu)

Mississippi State University, P.O. Box 6347, Mississippi State, MS 39762, United States

The National Science Foundation has funded Mississippi State University to conduct professional development projects involving research/industry experiences for teachers and students providing them with real world applications of academic knowledge. Transition to the Workplace Through Manufacturing Experiences: Learn To Work (NSF ESI-9555646, 1996-2002) and Research Experiences in Industry (REI) (NSF ESI-9911885, 2000-2003) have enabled science, mathematics and technology teachers to learn the role of research and development in the workplace, develop skills to make the connection between the workplace and the classroom, enhance their content knowledge, and learn skills and competencies required by a highly skilled and technology-oriented workforce. Industry partners include Peavey Electronics, Northrop Grumman, Tennessee Valley Authority, Mississippi Lignite Company's Red Hills Mine, and Pickering Engineering. Student-Teacher Research Institute - the Delta Experience (STRIDE) (NSF ESI- 9731286, 1998 - 2002) and Career & Research Exploration for Students and Teachers (CREST) (NSF GEO-0224540, 2003-2004) are models for middle school teacher-student teams participating in research/industry experiences. STRIDE teams worked with over 50 research scientists from fourteen government agencies to learn how to conduct research and to become aware of scientific career preparation and opportunities. Through a partnership with Red Hills Mine, teachers and students learn academic content and research methods relative to the development and utilization of a lignite coal resource by working with scientists and participating in on-going research projects at the mine and in the local area.

ED51D-04 1105h

Implementing Authentic Astronomy Research in the Classroom: The TLRBSE Experience

Stephen M. Pompea[1] (520.318.8285; spompea@noao.edu); Steven K. Croft[1] (520.318.8495; scroft@noao.edu); Constance E. Walker[1] (520.318.8535; cwalker@noao.edu); Jeff Lockwood[1] (jeff_lockwood@terc.edu); Don McCarthy[2] (dmmcarthy@as.arizona.edu); Travis Rector[3] (aftar@uaa.alaska.edu); Steve Howell[1] (showell@noao.edu)

[1]National Optical Astronomy Observatory, 950 N. Cherry Ave., Tucson, AZ 85719, United States

[2]University of Arizona, Steward Observatory 933 N. Cherry Ave., Tucson, AZ 85721, United States

[3]University of Alaska, Department of Physics and Astronomy 3211 Providence Drive, Anchorage, AK 99508, United States

The Teacher Leaders in Research Based Science Education (TLRBSE) is an NSF-funded program which has as one of its primary goals the implementation of authentic research in the classroom. To achieve this goal, TLRBSE provides an in-depth professional development experience for teachers which includes a semester-long on-line course on research pedagogy, research tools (such as image processing), and astronomy content knowledge. Participants come to the National Optical Astronomy Observatory (NOAO) in Tucson in the summer for two weeks in order to hone their skills and interact with scientists. They also pursue research projects led by a TLRBSE leader in one of several astronomy areas including novae, active galactic nuclei, solar magnetic fields, and spectroscopy of variable stars using research telescopes at Kitt Peak National Observatory. The teachers have access to the data they have taken at the telescope as well as to extensive archival data sets taken by previous TLRBSE teachers. These ongoing research projects are then brought back to the classroom where teachers and students can continue their research in these areas. The student research results are then submitted for review and publication in NOAO's Research Based Science Education Journal. The TLRBSE model is being extended by providing a variety of additional research experiences for teachers and students during the school year, using the same telescopes at Kitt Peak National Observatory used in the summer program. Teachers and students from the program apply for additional research time during the school year and can come to the observatory to make observations for new or continuing projects. As remote telescopes become more widely available, the teachers and students will be able to observe from their home locations and access their observations directly over the internet. Some of the key issues in our program are teacher selection, organization and logistics of the distance learning course, workshop length, choice and organization of the research projects and team, and the transfer of research to a variety of classroom conditions.