testing,we have made improvements to both the educational product and our evaluation protocol. This fall, we will conduct further testing with ∼100 additional students, half receiving auditory data and half receiving visual data, and we will conduct interviews with individual students as they interface with the auditory display. Through this process, we hope to further assess both learning and engagement gains associated with alternative and multi-modal representations of scientific data that extend beyond traditional visualization approaches. This work has been supported by the GRS Education and Public Outreach Program and the NASA Spacegrant Graduate Fellowship Program.

ED21C-1223 0830h POSTER

Assessing the IRIS Professional Development Model: Impact Beyond the Workshops

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The IRIS Education and Outreach (E&O) Program has developed a highly effective, one-day professional development experience for formal educators. Leveraging the expertise of its consortium, IRIS delivers content including: plate tectonics, propagation of seismic waves, seismographs, Earth's interior structure. At the core of the IRIS professional development model is the philosophy that changes in teacher behavior can be affected by increasing teacher comfort in the classroom. Science and research organizations such as IRIS are able to increase teachers' comfort in the classroom by providing professional development which: increases an educator's knowledge of scientific content, provides educators with a variety of high-quality, scientifically accurate activities to deliver content to students, and provides educators with experiences involving both the content and the educational activities as the primary means of knowledge transfer. As reflected in a 2002-2003 academic year assessment program, this model has proven to be effective at reaching beyond participants and extending into the educators' classrooms. 76% of respondents report increasing the amount of time they spend teaching seismology or related topics in their classroom as a result of participating in IRIS professional development experience. This increase can be directly attributed to the workshop as 90% of participants report using at least one activity modeled during the workshop upon returning to their classrooms. The reported mean activity usage by teachers upon was 4.5 activities per teacher. Since the inception of the professional development model in 1999, IRIS E&O has been committed to evaluation. Data derived from assessment is utilized as a key decision making tool, driving a continuous improvement process. As a result, both the model and the assessment methods have become increasingly refined and sophisticated. The alignment of the professional development model within the IRIS E&O Program framework has resulted in a clarified a definition of success and an increased demand for the collection of new data. Currently, the assessment program is testing tools to examine participant learning, measure the transfer of knowledge and resources from professional development into in classrooms, and measure the use of individual activities.

ED21C-1224 0830h POSTER

Classroom Assessment Techniques

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Provost David L. Potter of George Mason University chaired a joint task force and presented a report entitled "Powerful Partnerships : A Shared Responsibility for Learnin" in June 1998. The main goal is to make a difference in the quality of student learning. Further, it is important to assess this difference and document it. Clifford O. Young, Sr., & Laura Howzell Young of California State University, San Bernardino argue that a new paradigm for assessment, a learning paradigm, must be constructed to measure the success of new kinds of educational practices. Using two survey instruments, the Instruction Model Learning Model Questionnaire (IMLMQ) and the Student Evaluation of Teaching Effectiveness (SETE), they compared students' responses to the course when taught with traditional methods and with interactive methods. The results suggest that neither instrument effectively measures the kinds of learning promoted under the new paradigm. Linn, Baker, & Dunbar recommend that these newer assessment practices should be more authentic, that is, to involve students in the actual or simulated performance of a task or the documentation of the desired competency in a portfolio. Cerbin says that one of the most unfortunate consequences of a summative emphasis is that it inhibits open and productive discussions about teaching; in essence, it marginalizes the types of activity that could lead to better teaching (Cerbin, 1992). William Cerbin, who is the Director of the Center for Effective Teaching and learning, University Assessment Coordinator, and Professor of Psychology at the University of Wisconsin-LaCrosse is a recognized expert in the areas of cognition, language, and development. Edgerton, Hutchings, & Quinlan indicate that Teaching Portfolios may contain evidence of students' learning, but such information is optional, and when included, it may be only one of many pieces of material. Seldin, also supports this and stresses that the interplay between the instructor and the learner should be carefully observed and monitored. Forrest says that Student Portfolios, which document learning in more detail, seldom reveal how teaching contributes to students' progress. Cerbin further indicates that a course portfolio is essentially, a like a manuscript of scholarly work in progress. In this example, it is a work that explains what, how, and why students learn or do not learn in a course. In this paper, the author reports on a dozen techniques that could perhaps be used to document assessment of student learning. References : Cerbin, W. (1993). Fostering a culture of teaching as scholarship. The Teaching Professor, 7(3), 1-2. Edgerton, R., Hutchings, P., & Quinlan, P. (1991). The teaching portfolio: Capturing the scholarship in teaching. Washington, DC: American Association for Higher Education. Forrest, A. (1990). Time will tell: Portfolio-assisted assessment of general education. Washington, DC: American Association for Higher Education. Linn, R., Baker, E., & Dunbar, S. (1991). Complex, Performance-based Assessment: Expectations and Validation Criteria. Educational Researcher, 20 (8), 15-21. Narayanan, M. (2003). Assessment in Higher Education: Partnerships in Learning. Paper presented at the 23rd Annual Lilly Conference on College Teaching, Miami University, Oxford, OH. Seldin, P. (1991). The teaching portfolio. Bolton, MA: Anker. Young, C. O., Sr., & Young, L. H. (1999). Assessing Learning in Interactive Courses. Journal on Excellence in College Teaching, 10 (1), 63-76.

ED21D MCC: 3012 Tuesday 1020h

The GLOBE Program: What Has and Has Not Worked Well in the Past and Where Should It Go in the Future I

(joint with OS, C, PA)

Presiding: **E Geary,** Colorado State University**; J D Fellows,** University Corporation of Atmospheric Research

ED21D-01 1020h

Implementing GLOBE in the New York City Metropolitan Area: Trials, Errors, and Successes

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The Queens College GLOBE NY Metro Partnership was created to introduce GLOBE to more than 1.5 million students in southern NY State and provide continuing support for their teachers. In our first 18 months, we have trained 185 teachers from 82 schools and will triple these numbers this year. Teachers and administrators are attracted to GLOBE by its scientific rigor, the authentic research it offers students, and its fit with NYS standards. They are also eager to interact with our science faculty. Early difficulties included problems with the "standard" 5-day GLOBE training format and misconceptions that protocols are not suitable for urban settings and that preparing for the NYS Regents exams leaves no room for GLOBE. We held information meetings for school districts and for Queens high schools before our first workshop. These identified the most committed schools, energetic teachers, and potential implementation problems. Creative participants at these meetings countered the misconceptions and suggested solutions to the problems better than any outsider could, and generated an atmosphere leading to nearly 100% recruitment. The following stratagems have worked well: a close working relationship with the NYC Dept of Education, BOCES, and other environmental educators; affiliations with government agencies and community environmental groups; two bribes (giving a GLOBE instrument kit and GPS unit to each school that we train and awarding graduate or professional development credits for GLOBE training); a user-friendly training format (an initial 3-day workshop followed by two optional days for hydrology and land use); lending seldom-used items (e.g. soil auger) when needed; building a sense of GLOBE community with a graduation "ceremony", local website (www.qc.edu/qcglobe) and newsletter, phone and email helplines, and annual pedagogy and student research conferences. We also urge that three teachers be trained from each school in order to build local GLOBE support systems. To stimulate data entry, one half-day during the 3-day workshop is devoted to exploring the GLOBE website, and another to generating student research problems using the site's advanced capabilities. Three "carrots" have also improved data submission: (1)a vendor gives a probe and software to the first school in each workshop that submits 250 data items, (2)individual competitiveness (the record is 22 hours from end of training to first submission of data), and (3)congratulatory emails to teachers when they submit their first data. The "stick": a threat to repossess the instruments if no data are submitted within 6 months. We also offer training in GLOBE-related skills, such as acquiring free satellite images and digital elevation data, and workshops on the geological and environmental settings of the NYC area. Suggestions from our teachers for the future include: urbanize protocols to better welcome inner city schools to GLOBE; add protocols involving flora and fauna to fit GLOBE better into Biology classes; develop more links with researchers so GLOBE participants feel they are making a real contribution; create a NYC area listserve so teachers can discuss common issues and concerns; and develop correlations between GLOBE protocols and NYS Curricula in Earth Science, Living Environment, Chemistry, and Physics. The last would vastly improve integration of GLOBE into these Regents-level courses. Our teacher trainees are vehement in their appreciation of GLOBE for its high standards and scientific rigor.

ED21D-02 1035h

An Evaluation of the GLOBE Surface Ozone Protocol After Five Years of Implementation

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The Surface Ozone Protocol has been a part of the GLOBE Program since 1998. Our goal has been to introduce the student to the subject of atmospheric chemistry and the relationship between air quality and other parameters such as temperature and cloud cover by providing teachers and students with a relatively accurate and inexpensive method to measure ozone. During the past five years, our group can point to both successes and disappointments. Vital elements for the successes include teacher training in data collection and analysis with integration into the core curriculum, a support structure within the schools and community to facilitate continuous data collection and reporting, quality assurance of the reported data and an open channel of communication between teachers and scientists. Once the protocol is implemented, we recognize that our GLOBE teachers require additional structure and support beyond the initial GLOBE training. Out of 57 GLOBE schools reporting ozone data, 47 schools have reported fewer than 100 data points, with 38 of those schools reporting fewer than 30 data points. However, four schools located in the Czech Republic are successfully implementing the surface ozone protocol and have reported over 500 ozone measurements with meta data providing continuous data sets over several years. We are currently developing the infrastructure for educator/community teams to facilitate yearround surface ozone measurements, and providing onsite training, follow up visits, and electronic based interactions to support the educator/community teams and students as they gather data. We present the successful strategies from the Czech Republic schools and provide suggestions for improving the involvement and retention for the U.S. schools.

ED21D-03 1050h

Locally Motivated GLOBE Investigations - A Key to Success

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The GLOBE program was set up to help students make a core set of environmental observations at or near their schools, report their data through the internet to share with other students and scientists, analyze their data both locally and globally, and use this knowledge to form a better understanding of their environment. While the GLOBE program has been successful promoting more meaningful data collection, many of the tools and much of the infrastructure available to schools to synthesize their observations are underused. Schools that integrate GLOBE protocols with locally motivated investigations are more likely to implement the higher-order analysis and synthesis components of the program. Indicators of a successful observational program are things like measurement persistence, high data quality, and regular data. Participation in community forums and student-based research projects are evidence of a successful integrated program. A locally motivated issue allows a school to mold their GLOBE investigations around a multifaceted question that they have first-hand knowledge of, that is both relevant and engaging to their students, and that can be supported by local expertise. In contrast, many GLOBE investigations are designed around abstract, non-site specific, narrowly focused and externally analyzed questions that limit local involvement and motivation. The main focus of this presentation is a few case histories of successful local investigations that incorporated GLOBE soil and air temperature data-logger measurements. The main example is drawn from Mr. Geery's fifth grade class investigation of why temperature differences exist between a local river bottom area and the school, which is located several kilometers away and 100 meters higher.

URL: http://www.hwr.arizona.edu/globe/sci/ST/

ED21D-04 1105h

GLOBE Science and GLOBE Education: Convergence or Divergence?

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The GLOBE Program is a partnership between scientists, classroom teachers, and students collaborating to monitor and study the global environment. GLOBE has trained more than 20,000 teachers. Yet only a small percentage of K-12 teachers who are trained in GLOBE consistently submit data to the program's data base and thereby actively contribute to the science goals of GLOBE. Based on a study of New England GLOBE teachers, this report argues that the goals of GLOBE, including consistent data submission, can be accomplished only when there is a greater congruence between the scientific goals of the program and the educational goals of the classroom. The results are discussed in terms of current educational policies and mandates, specifically the No Child Left Behind legislation. Some ideas are offered regarding how to achieve greater convergence between the goals of GLOBE scientists and the educational goals of classroom teachers.

ED21D-05 1120h

The Significance of Ongoing Teacher Support in Earth Science Education Programs: Evidence from the GLOBE Program

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The GLOBE program provides a rich context for examining issues concerning implementation of inquiry-oriented, scientist-driven educational programs, because the program has both a history of collecting evaluation data on implementation and mechanisms for capturing program activity as it occurs. In this paper, researchers from SRI International's evaluation team explore the different roles that regional partners play in preparing and supporting teachers to implement the GLOBE Program, an international inquiry-based Earth science education initiative that has trained over 14,000 teachers worldwide. GLOBE program evaluation results show the program can be effective in increasing students' inquiry skills, but that the program is also hard for teachers to implement (Means et al., 2001; Penuel et al., 2002). An analysis of GLOBE's regional partner organizations, which are tasked with preparing teachers to implement its data collection and reporting protocols with students, shows that some partners are more successful than others. This paper reports findings from a quantitative analysis of the relationship between data reporting and partner support activities and from case studies of two such regional partners focused on analyzing what makes them successful. The first analysis examined associations between partner training and support activities and data reporting. For this analysis, we used data from the GLOBE Student Data Archive matched with survey data collected from a large sample of GLOBE teachers as part of SRI's Year 5 evaluation of GLOBE. Our analyses point to the central importance of mentoring and material support to teachers. We found that incentives, mentoring, and other on-site support to teachers have a statistically significant association with higher data reporting levels. We also found that at present, teachers access these supports less often than they access listservs and e-mail communication with teachers after GLOBE training. As a follow-up to this study, SRI researchers used the data on student data reporting activity from different partners to identify candidate sites for case studies, where we might investigate the nature of follow-up activities provided by successful partners more closely. We worked to select 2 regional partners that had evidence of high percentages of teachers trained that reported data and that also offered follow-up to teachers. Case study researchers conducted observations within 2-3 active GLOBE schools supported by each regional partner organization and interviewed teachers, principals, and partner staff. On the basis of our observation data and transcripts from interviews, we compiled profiles of schools' implementation and analyzed the core activities of each regional partner. Researchers found that keys to promoting successful implementation in one partnership were: one partnership were: close alignment with state mathematics and science initiatives; mentors that helped teachers by modeling inquiry in GLOBE and by assisting with equipment set-up and curriculum planning; and allowing room for schools to adopt diverse goals for GLOBE. In the second partnership, keys to success included a strategic approach to developing funding for the program; a focus on integration of culturally-relevant knowledge into teacher preparation; follow-up support for teachers; and use of GLOBE as an opportunity to investigate local evidence of climate change. Both partner organizations were challenged by funding limitations that prevented them from providing as much follow-up support as they believe is necessary.

ED21D-06 1135h

Building Learning Communities for Research Collaboration and Cross-Cultural Enrichment in Science Education

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The GLOBE program has provided opportunities for environmental science research and education collaborations among scientists, teachers and K-12 students, and for cross-cultural enrichment nationally and abroad. In Alaska, GLOBE has also provided funding leverage in some cases, and a base for several other science education programs that share a common goal of increasing student interest, understanding, process skills and achievement in science, through involvement in ongoing research investigations. These programs that use GLOBE methodologies (standardized scientific measurements and learning activities developed by scientists and educators) are: Global Change Education Using Western Science and Native Knowledge also known as "Observing Locally, Connecting Globally" (OLCG); Alaska Earth System Science Education Alliance: Improving Understanding of Climate Variability and Its Relevance to Rural Alaska; Schoolyard Long Term Ecological Research; Alaska Rural Research Partnership; Alaska Partnership for Teacher Enhancement; Alaska Lake Ice and Snow Observatory Network; Alaska Boreal Forest Council Education Outreach; Calypso Farm and Ecology Center; Environmental Education Outreach; and also GLOBE Arctic POPs (persistent organic pollutants) a program that involves countries in the circumpolar North. The University of Alaska GLOBE Partnership has collaborated with the BLM Campbell Creek Science Center Globe Partnership in facilitating GLOBE Training Workshops and providing teacher support. GLOBE's extensive website including data entry, archive, analysis and visualization capabilities; GLOBE Teacher Guide, videos and other materials provided; excellent GLOBE science research and education staff, training support office, GLOBE help desk, alignment of GLOBE curriculum with national science education standards and GLOBE certification of teachers trained on even just one GLOBE investigation, have made it easier to implement GLOBE in the classroom. Using GLOBE, whole classes of students have engaged in and contributed data to science investigations. In Alaska, classes and individual students have conducted their own inquiry studies and have successfully presented their investigations and competed at science fairs and statewide high school science symposium and international conferences. Two students presented their research investigations at the GLOBE Learning Expedition in Croatia and four students presented their study at the GLOBE Arctic POPs Conference in Sweden. These students increased not only their understanding and knowledge of science but also in appreciation of people in other countries and their cultures. Friendships have also bloomed. The learning community in Alaska has expanded to include family and community members including Native elders (using OLCG), teachers, scientists and students from other countries. The following challenges remain: 1) getting funds to be able to provide GLOBE equipment and continuous support to GLOBE teachers and students throughout the year, 2) reaching teachers and students in remote areas, 3) rapid teacher turn-over rate in rural areas, 4) using inquiry-based pedagogies during GLOBE professional development workshops including the opportunity for teacher participants to conduct their own inquiries during the workshop, 5) time, school curriculum and national education requirement constraints, 6) involving school administrators, and more local scientists and community members, and 7) providing culturally relevant and responsive science education programs and life-long learning communities.

ED21D-07 1150h

Ideas for GLOBE's Future Drawn from the 7-Year Experience of the CERES S'COOL Project

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As the outreach portion of the Clouds and the Earth's Radiant Energy System (CERES) project, the Students' Cloud Observations On-Line (S'COOL) project is of smaller scale and scope than GLOBE; but its aims and methods are quite similar. As a result, lessons learned from S'COOL since its beginnings in 1997 may provide useful ideas for the future of GLOBE. This is particularly true as the director of S'COOL has also been a GLOBE science principal investigator for the last year (leading the contrail investigation within GLOBE). This paper will discuss a number of lessons learned from the experience with the S'COOL Project, and will make some suggestions for the future of GLOBE based on that experience. It will include discussion of most of the important elements of GLOBE, including 1) teacher training: S'COOL recently conducted its 5th annual Summer S'COOL Teacher Workshop; 2) data collection: S'COOL is nearing 26,000 complete student cloud observations; 3) integration of scientific research with classroom teaching and learning: S'COOL promotes use of real, student-reported, scientific observations for use in the classroom and in student projects. S'COOL also makes scientific satellite data available and accessible to students and teachers; 4) use of data by scientists: S'COOL pursues a statistical analysis of student data which was requested and obtained for a specific purpose. The paper will also present some observations and ideas for GLOBE based on the author's year of experience as a GLOBE principal investigator.

ED21D-08 1205h

The GLOBE Program in Alabama: A Mentoring Approach to State-wide Implementation

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Established in 1997, the GLOBE in Alabama (GIA) partnership has trained more than 1,000 teachers in almost 500 schools - over 25% of the total number of K-12 schools in Alabama. Over those five years, GIA has strived to achieve recognition of GLOBE as the "glue" to Alabama's new education program, the Alabama Math, Science and Technology Initiative (AMSTI). In 2003, GIA trained over 370 AMSTI K-8 teachers at two AMSTI hub sites in north Alabama. As the AMSTI program grows with the addition of future hub sites (eleven are planned), GIA must ready itself to train thousands of AMSTI teachers during the

two-week summer professional development institutes that are part of AMSTI. A key component of AMSTI is a mentoring program conducted by math and science specialists - classroom educators loaned to the AMSTI hub sites by the school systems each hub site serves. The AMSTI mentoring program mirrors the GIA mentoring model begun in 1999 that originally funded regional GLOBE master teachers to provide technical assistance, feedback, and coaching for other GLOBE teachers. In schools where GIA mentor teachers were working, nearly a 100% increase in GLOBE student data reporting was noted. The GIA mentors now work within the hub site framework to ensure implementation of GLOBE as an integrated part of AMSTI. With the continued support of the State of Alabama, GIA will establish a network of mentors who work with the AMSTI hub site specialists in providing support for all AMSTI teachers. GIA is administered by the National Space Science and Technology Center, a partnership between NASA and the State of Alabama's seven research universities. Operational funding for GIA has been provided by the University of Alabama in Huntsville's Earth System Science Center, the NASA Marshall Space Flight Center, the Alabama Space Grant Consortium, The Alabama Department of Economic and Community Affairs, the Alabama State Department of Education, and Legacy. GIA has been able to build on these strong funding partnerships by leveraging the infrastructure provided by the NASA-led GLOBE Program (www.globe.gov).

ED22A MCC: Level 2 Tuesday 1330h

Earth and Space Science Materials for Students With Special Needs Posters

(joint with P, C)

Presiding: **C Runyon,** College of Charleston**; K Watt,** Arizona State University

ED22A-1225 1330h POSTER

AudioGuides at a National Research Laboratory Supporting Visitors With Special Needs: Initial Lessons Learned

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The National Center for Atmospheric Research (NCAR) Mesa Laboratory offers the public an opportunity to visit an internationally recognized research laboratory housed in an architectural landmark located in a dramatic geological setting. The Mesa Lab's exhibits are viewed by over 80,000 people each year. Exhibits provide information about NCAR's scientific mission, current research efforts, technology, and the societal benefits of weather and climate research. Nearly 13,000 of NCAR's visitors are served with staff-led guided tours, including 3,000 students in school groups. Frequently, these tours are tailored to address the interests, ages, nationality, and special needs of the visitors. In June 2003, an audioguide was unveiled in English and Spanish versions for both adults and children. Based on preliminary summer usage figures, the audioguides may reach an additional 7,000 visitors in the coming year, many of whom may have special needs. With this in mind, the University Corporation of Atmospheric Research (UCAR) Office of Education and Outreach (EO) contracted local experts as advisors on the needs of people with low-vision, hearing loss, and Spanish language accessibility as the audioguide was developed. The script was written with the help of scientists and an internationally recognized audioguide production firm. Since the installation of the audioguide in July, visitors of all ages appear to be enthusiastic about this service and better focused on their learning experiences while viewing the exhibits. Interviews are helping EO to learn more about how the audioguide is helpful or may be revised to more effectively serve visitors in general as well as visitors with special needs. The audioguide was made possible by grants from the National Science Foundation Geoscience Education Program and the Friends of UCAR Fund.

ED22A-1226 1330h POSTER

Space Science IS Accessible to Students with Exceptional Needs: Results from Exceptional Needs Workshops

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The majority of students with disabilities in the US are required to achieve the same academic levels as their non-impaired peers. Unfortunately, there are few specialized materials to help these exceptional students. To assist students in meeting their goals, SERCH, a NASA Office of Space Science Broker/Facilitator, has been working with NASA education product developers and educators from informal and formal settings to identify what kinds of materials they need and what mediums will work best. As a result of both direct classrooms observations and hands-on workshops we have begun generating adaptive lessons plans that meet the national standards for Science, Technology, Engineering and Mathematics. During the workshops, participants simulate various disabilities (e.g., hearing, vision, orthopedic impairments, learning difficulties) while working through Space Science activities and discuss necessary adaptations/modifications in real-time. For example, we modified the Solar System Distance activity first designed by ASU to include the use of larger beads or pom-poms instead of the suggested small plastic beads. This simple adaptation permits students with orthopedic impairments to more readily take part in the lesson and to actively "observe" the distance between the planets. Examples of this activity and more will be illustrated. In addition to making modifications and suggestions for adaptations, workshop participants shared many simple recommendations that can help ALL learners participate more readily in classroom activities and discussions. Among these are: (1) Use simple, sans-serif fonts and high contrast presentation media (e.g., white text on black is most effective); (2) Repetition and use of multiple presentation modes is very helpful. (3) Actively involve the learner, and (4) Keep things simple to begin with, then work toward the more complex - think of the audience, the ultimate user.

URL: http://serch.cofc.edu/serch/special/workshops.htm

ED22A-1227 1330h POSTER

Tactile Approaches for Teaching Blind and Visually-Impaired Students in the Geosciences

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Hearing and touch are perhaps the two most important senses for teaching visually-impaired students in any context. Classroom lectures obviously emphasize the auditory aspects of learning, while touch is often relegated to either Braille texts or raised–line drawings for illustrative figures. From the student's perspective, some lecture topics, especially in the sciences, can be a challenge to grasp without additional stimuli. Geosciences have a distinct visual component that can be lost when teaching blind or visually-impaired students, particularly in the study of geomorphology and landform change. As an example, the matters raised concerning volcanic hazards can be difficult to envision without due attention to the limitations of visually-impaired students. Here, we suggest an example of a tactile approach for introducing the study of volcanoes and the hazards associated with them. Large, visually-stimulating images of a volcanic, populated region in southern Peru are supplied for those students who have poor but extant visual acuity, while precise, clay-based models of the region complement the images for those students, as well as for students who have no visual ability whatsoever. We use a model of the terrestrial volcano El Misti and the nearby city of Arequipa, Peru, to directly reflect the volcanic morphology and hazardous aspects of the terrain. The use of computer-generated digital elevation models from remote sensing imaging systems allows accurate replication of the regional topography. Instructors are able to modify these clay models to illustrate spatial and temporal changes in the region, allowing students to better grasp potential geological and geographical transformations over time. The models spawn engaging class discussions and help with designing hazard mitigation protocols.

ED22A-1228 1330h POSTER

Making Astronomy and Space Science Accessible to the Blind and Visually Impaired

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One of the biggest obstacles blind and visually impaired people face in science is the ubiquity of important graphical information, which is generally not made available in alternate formats accessible to them. Funded by NASA's Initiative to Develop Education through Astronomy and Space Science (IDEAS), we have recently formed a team of scientists and educators from universities, the SOFIA NASA mission, a science museum, an observatory, and schools for the blind. Our goal is to develop and test Braille/tactile space science activities that actively engage students from elementary grades through introductory college-level in space science. We will discuss effective strategies and low-cost technologies that can be used to make graphical information accessible. We will also demonstrate examples, such a thermal expansion graphics created from telescope images of the Moon and other celestial objects, a tactile planisphere, three-dimensional models of near-Earth asteroids and tactile diagrams of their orbits, and an infrared detector activity.

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Special Education Students Improve Academic Performance through Problem-Based Learning and Technology

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Boulder High School Special Education students work in teams on donated wireless computers to solve problems created by global climate change. Their text is Richard Somerville's The Forgiving Air. They utilize Wheeling Jesuit University's remote sensing web site and private computer bulletin board. Their central source for problem-based learning (PBL) is www.cotf.edu, NASA's Classroom of the Future Global Change web site. As a result, students not only improve their abilities to write, read, do math and research, speak, and work as team members, they also improve self-esteem, resilience, and willingness to take more challenging classes. Two special education students passed AP exams, Calculus and U.S. Government, last spring and Jay Matthews of Newsweek rates Boulder High as 201st of the nation's top 1000 high schools.

URL: http://www.bvsd.co.us/boulderhs

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NASA's Astro-Venture Engages Exceptional Students in Earth System Science Using Inquiry

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Astro-Venture is an educational, interactive, multimedia Web environment highlighting NASA careers and astrobiology research in the areas of Astronomy, Geology, Biology and Atmospheric Sciences. Students in grades 5-8 role-play NASA careers, as they search for and design a planet with the necessary characteristics for human habitation. Astro-Venture uses online multimedia activities and off-line inquiry explorations to engage students in guided inquiry aligned with the 5 E inquiry model. This model has proven to be effective with exceptional students. Students are presented with the intellectual confrontation of how to design a planet and star system that would be able to meet their biological survival needs. This provides a purpose for the online and off-line explorations used throughout the site. Students first explore "what" conditions are necessary to support human habitability by engaging