careers. The K-12 PRISM outreach initiatives are being developed and implemented in a collaboration with the Advanced Learning Technology Program (ALTec) of the High Plains Regional Technology in Education Consortium (HPR*TEC). ALTec is associated with the KU School of Education, and is a well-established educational research center that develops and hosts web tools to enable teachers nationwide to network, collaborate, and share resources with other teachers. An example of an innovative and successful web interface developed by ALTec is called TrackStar. Teachers can use TrackStar over the Web to develop interactive, resource-based lessons (called tracks) on-line for their students. Once developed, tracks are added to the TrackStar database and can be accessed and modified (if necessary) by teachers everywhere. The PRISM project has added a search engine for polar related tracks, and has developed numerous new tracks on robotics, polar exploration, and climate change under the guidance of a K-12 teacher advisory group. The PRISM project is also developing and hosting several other web-based lesson design tools and resources for K-12 educators and students on the PRISM project web page (http://www.ku-prism.org). These tools and resources include: i) "Polar Scientists and Explorers, Past and Present" covering the travels and/or unknown fate of polar explorers and scientists; ii) "Polar News" providing links to current news articles related to polar regions; iii) "Letter of Global Concern", which is a tool to help students draft a letter to a politician, government official, or business leader; iv) "Graphic Sleuth", which is an online utility that allows teachers to make lessons for student use; v) "Bears on Ice" for students in grades K - 6 that can follow the adventures of two stuffed bears that travel with scientists into polar regions; and vi) "K-12 Polar Resources," which provides teachers with images, information, TrackStar lessons, and a search engine designed to identify polar related lessons. In our presentation, we will describe and show examples of these tools and resources, and provide an assessment of their popularity with teachers nationwide.

URL: http://www.ku-prism.org

ED21B-1218 0830h POSTER

Integrating research and education in a study of Arctic frost-boil ecosystems

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We have integrated the field course Arctic Field Ecology with an interdisciplinary research project investigating the interactions of climate, vegetation, and permafrost in the study Biocomplexity of Arctic Frost-boil Ecosystems. Arctic Field Ecology is designed to introduce undergraduate and graduate students to field studies in the Arctic to gain an understanding of the structure and function of arctic ecosystems and the current state of Arctic research. The integration of the field course and research is designed to 1. Give students sufficient background in regional ecology and ecological issues to place the Biocomplexity project within the context of current directions in science, 2. Introduce students to the project objectives, methods, and personnel, 3. Provide for interaction with all the participating scientists, including discussion and field experience, 4. Encourage students to develop questions and hypotheses for future research, and 5. Give students the opportunity to interact with indigenous people with interests in Traditional Ecological Knowledge. Arctic Field Ecology is offered by the University of Minnesota. Formal and informal seminars are provided by the course leaders, project scientists, and native speakers. Students are involved in field sampling activities and discussions associated with the biocomplexity project goals. Each student develops and presents a research proposal based on their interests and understanding of the current trends in ecological research in the region. A major philosophy of the course is that the natural arctic environment is a key source of ideas and inspiration, guided and augmented by the interaction with instructors, project scientists and native people.

ED21C MCC: Level 2 Tuesday 0830h

Assessment of Geoscience Education Tools and Approaches I Posters *(joint with C)*

Presiding: **C Gautier,** University of California, Santa Barbara**; D Schweizer,** NASA Headquarters

ED21C-1219 0830h POSTER

Analyzing Student Perceptions of Geological Time Through the Use of Graphic Timelines

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Students' understanding of geological concepts has been studied through drawings but work with regard to geological timelines is lacking. Approximately 80 semi-structured interviews were conducted with introductory and non-science major college students at a large Midwestern university. Students were asked to make drawings of a variety of topics involving the Earth system; drawings included the Earth's interior, and features of the Earth's surface such as mountains or volcanoes. Additionally, the students were asked to mark and date major events in the earth's past on a timeline. Analyses of the student generated timelines indicate the lack of understanding of the true timescale of the geological history of the earth. Furthermore, the data revealed a lack of knowledge of the accepted dates of the major events in the earth's past. Uncovering this lack of understanding has significant implications for both teachers of earth science and teacher education programs.

ED21C-1220 0830h POSTER

The Field-tested Learning Assessment Guide (FLAG): A Community Repository of Proven Alternative Assessment Instruments for STEM Education

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FLAG, the Field-tested Learning Assessment Guide (http://www.flaguide.org/) is a NSF funded website that offers broadly-applicable, self-contained modular classroom assessment techniques (CATs) and discipline-specific tools for STEM instructors creating new approaches to evaluate student learning, attitudes and performance. In particular, the FLAG contains proven techniques for alterative assessments—those needed for reformed, innovative STEM courses. Each tool has been developed, tested and refined in real classrooms at colleges and universities. The FLAG also contains an assessment primer, a section to help you select the most appropriate assessment technique(s) for your course goals, and other resources. In addition to references on instrument development and field-tested instruments on attitudes towards science, the FLAG also includes discipline-specific tools in Physics, Astronomy, Biology, and Mathematics. Building of the Geoscience collection is currently under way with the development of an instrument for detecting misconceptions of incoming freshmen on Space Science, which is being developed with the help of the Committee on Space Science and Astronomy of the American Association of Physics Teachers. Additional field-tested resources from the Geosciences are solicited from the community. Contributions should be sent to Michael Zeilik, zeilik@la.unm.edu. This work has been supported in part by NSF grant DUE 99-81155.

ED21C-1221 0830h POSTER

Interpretation of Assessment Results in General Education Sciences Laboratories: the TA Effect

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A significant part of student learning relates to the way the student is taught. Assessment of class goals with multiple sections needs to take into account complexity introduced by having several teaching assistants (TAs). The TAs bring different levels of expertise in the subject matter, in pedagogy, and self confidence, creating highly variable experiences for the students in the classroom. It was observed that assessment results for a general education sciences laboratory are skew by the novice TAs in two ways. First, the inexperienced TA may cover material superficially, where the students are not given the tools to reason at higher orders of thinking. For example, students may be able to recall information, but they will not be able to thoroughly evaluate a given situation using the material learned in the lab. Second, the novice TA may teach to a question. Thus, the students in her/his section will have disproportional high scores in the assessment. To minimize the effects that novice TAs may have on assessment, it is very important to properly screen and train the TAs on the subject matter and on pedagogical issues. These steps will minimize the effects that novice TAs may have on the assessment results, but will not eliminate them. Thus, it is important to design the assessment tool to be as transparent to TA shortcomings as possible and try to get to the student understanding. Common assessment tools used for laboratory settings with large number of students include lab work and exams. Results of assessment of lab work are easier to compare when there is a clear rubric for students and TAs. Furthermore, the effect of the novice TA may be minimized because in the laboratory setting, students are encouraged to work together and to answer each other questions. Thus, allowing for more self-guiding by the students. For exams to be meaningful assessment tools, the TAs must have input on designing the exams. However, consensus must be reached on the wording of the questions so that students in all sections will be asked the same question. Ideally, the assessment questions will be prepared after the lab has been taught so the less experience TAs do not teach to the question. Regardless of the assessment tool used, it is important to take more than one sample per section (e.g. three samples per section) to draw meaningful conclusion on whether or not the assessment results are biased by inexperience TAs.

ED21C-1222 0830h POSTER

Educational Testing of an Auditory Display of Mars Gamma Ray Spectrometer Data

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A unique, alternative educational and public outreach product was created to investigate the use and effectiveness of auditory displays in science education. The product, which allows students to both visualize and hear seasonal variations in data detected by the Gamma Ray Spectrometer (GRS) aboard the Mars Odyssey spacecraft, consists of an animation of false-color maps of hydrogen concentrations on Mars along with a musical presentation, or sonification, of the same data. Learners can access this data using the visual false-color animation, the auditory false-pitch sonification, or both. Central to the development of this product is the question of its educational effectiveness and implementation. During the spring 2003 semester, three sections of an introductory astronomy course, each with ∼100 non-science undergraduates, were presented with one of three different exposures to GRS hydrogen data: one auditory, one visual, and one both auditory and visual. Student achievement data was collected through use of multiple-choice and open-ended surveys administered before, immediately following, and three and six weeks following the experiment. It was found that the three student groups performed equally well in their ability to perceive and interpret the data presented. Additionally, student groups exposed to the auditory display reported a higher interest and engagement level than the student group exposed to the visual data alone. Based upon this preliminary

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.
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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.

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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 year-round surface ozone measurements, and providing on-site 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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