

ED12E-02 1715h INVITED

Sun-Earth Day 2004: Venus Transit

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The NASA Sun-Earth Connection Education Forum annually promotes an event called Sun-Earth Day. For Sun-Earth Day 2004 SECEF has selected the transit of Venus as the theme. Opportunities are available to prepare for the viewing of this event. The event last occurred in 1882, so no one alive today has ever witnessed the transit of Venus. Through parallax measurements, it allowed astronomers to define, for the first time, a fairly accurate number for the A.U. and therefore, the distance to all the other known planets. The website <http://sunearth.gsfc.nasa.gov/sunearthday> has been developed to provide the necessary resources and opportunities for participation in Sun-Earth Day. This is the fourth year that we offer new and exciting space science. This year in particular the content area crosses all of space sciences offering activities and resources for every classroom and museum event. The goal is to involve as much of the student population and the public in this event as possible and to help them understand the immense importance and excitement surrounding this and previous transits. Through engaging activities focused on US and world history, technology, math, and astronomy, classrooms and museums can create their own event or participate in one of the opportunities we make available. Comparisons of Venus with the Earth and Mars, calculations of the distances to nearby stars, and the use of transits to identify extra-solar planets will all add to the excitement of this cosmic occurrence.

URL: <http://sunearth.gsfc.nasa.gov/sunearthday>

ED12E-03 1730h INVITED

Kepler Education and Public Outreach: Finding Earth-sized planets

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Astronomers are discovering Saturn size extrasolar planets, and have already sparked broad public interest. But can smaller planets - Earths - be found? This is a powerful and exciting question that can motivate student learning and public interest in the Kepler search for habitable planets. The Kepler Mission Education and Public Outreach (EPO) program capitalizes on the excitement of discovering Earth-size planets in the habitable zone, stimulating student learning and public interest in astronomy and physics. Kepler is a NASA Discovery mission, selected in December 2001, with launch and the search for extrasolar Earths commencing in 2007. During the first year, we expect Kepler to rapidly detect large planets similar to 51 Peg and smaller Earth-size planets in Mercury-like orbits. By the fourth year, we anticipate the discovery Earth-size planets in habitable zones. The goals and plans of the Kepler EPO program, which began in October 2002, are to: - build public interest during development, - to engage students and the public throughout the initial four-year mission and beyond if an extended mission is conducted, - increase public awareness and understanding of the Kepler Mission - involve scientists and contractors in EPO efforts, - establish collaborations with planetarium programs and science museums, - build on existing programs and networks that maximize the leverage of NASA EPO funding in this project and optimize the impact of EPO. These goals and plans embodying key principles set forth in NASA's Partners in Education and Implementing the OSS Education/Public Outreach Strategy. Details of our planned EPO projects and products are given in this paper.

URL: <http://www.lawrencehallscience.org/kepler/>

ED12E-04 1745h INVITED

PlanetQuest: Engaging the Public and Students in NASA's Search for New Worlds

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NASA's Navigator Program consists of four groundbreaking missions that span a twenty-five year time horizon. Two space-based and two ground-based missions will contribute to the overall goal of detecting and characterizing Earth-like planets around stars other than the Sun. The Keck Interferometer began its science mission in 2002, and the Large Binocular Telescope Interferometer will become operational in 2006, while the two space-based missions, the Space Interferometry Mission and the Terrestrial Planet Finder, will launch in 2009 and 2015 respectively. The science operations and analysis of all missions will be supported by the Michelson Science Center, operated by the California Institute of Technology. Navigator Public Engagement initiatives (which can also be found under the heading of "PlanetQuest") span the areas of formal education, informal education, and general public outreach. Two initiatives-improving astronomy instruction at community colleges, and the "Night Sky Network: Engaging Amateur Astronomy Clubs"-stand out as significant new investments for Navigator, and may serve as platforms for the participation of more NASA missions in the future. Other programs involve creating activities for "girls in science," continuing to support minority university research experiences, and developing museum exhibits, a planetarium show and other visualizations. The core values of all Navigator E/PO initiatives include involving scientists and engineers, creating effective partnerships, reaching underserved populations, and evaluating and measuring program impact.

URL: <http://planetquest.jpl.nasa.gov/>

ED21A MCC: 3012 Tuesday 0800h

Enhancing K-12 Earth Science Education Through Partnership I (joint with OS, PA)

Presiding: M J Smith, American Geological Institute; A E Benbow, American Geological Institute; R Brame, Wright State University

ED21A-01 0800h

A Partnership to Align Digital Resources to Educators' Needs

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The Digital Library for Earth System Education (DLESE) is a community-led, NSF-funded effort to promote access to high-quality digital resources for teaching and learning about the earth. It is an operational library, with over 20,000 web visits a month and nearly 5000 resources available to educators and learners. As the library enters a new operational phase that targets widespread use in K-12 and undergraduate settings, DLESE has partnered with the United States Geological Survey (USGS), the University of California at Berkeley (UCB) Museum of Paleontology, the California State Science Teachers Association (CSTA),

and several California school districts. These partners are initiating a pilot program intended to ensure that resources in the library align with the needs and curricula of K-12 teachers. This partnership represents a major advance in DLESE's utility to the K-12 teaching community and affords a number of advantages to each partner. The school districts benefit from materials that meet their unique curricular needs. The USGS and UCB Museum of Paleontology are able to integrate teacher needs into the design of their materials and promote wider use of their resources. DLESE gains a focused user group to participate in the user-centered design of new services and to support onsite evaluation of the library's educational impact. Finally, the overall project provides a vehicle to evaluate the effectiveness of these partnerships and apply successful practices to more general efforts.

URL: <http://www.dlese.org>

ED21A-02 0815h

Building Partnerships Between Research Institutions, University Academic Departments, Local School Districts, and Private Enterprise to Advance K-12 Science Education in Texas

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The University of Texas at Austin Institute for Geophysics (UTIG) is engaged in six K-12 education and outreach programs, including two NSF-sponsored projects-GK-12: Linking Graduate Fellows with K-12 Students and Teachers and Cataclysms and Catastrophes-Texas Teachers in the Field, Adopt-a-School, Geoscience in the Classroom, and UT's Science and Engineering Apprenticeship Program. The GK-12 Program is central to UTIG's effort and links the six education projects together. While the specific objectives of each project differ, the broad goals of UTIG's education and outreach are to provide high-quality professional development for teachers, develop curriculum resources aligned with state and national education standards, and promote interaction between teachers, scientists, graduate students, and science educators. To achieve these goals, UTIG has forged funded partnerships with scientific colleagues at UT's Bureau of Economic Geology, Marine Science Institute and Department of Geological Sciences; science educators at UT's Charles A. Dana Center and in the Department of Curriculum and Instruction in the College of Education; teachers in six Texas independent school districts; and 4empowerment.com, a private education company that established the "Cyberways and Waterways" Web site to integrate technology and education through an environmentally-based curriculum. These partnerships have allowed UTIG to achieve far more than would have been possible through individual projects alone. Examples include the development of more than 30 inquiry-based activities, hosting workshops and a summer institute, and participation in local science fairs. UTIG has expanded the impact of its education and outreach and achieved broader dissemination of learning activities through 4empowerment's web-based programs, which reach ethnically diverse students in schools across Texas. These partnerships have also helped UTIG and 4empowerment to secure additional funding for other education projects. Finally, UTIG has helped sustain educational innovation locally through informal partnerships with the Texas Education Agency, which oversees the public education system of Texas, the Texas Regional Collaboratives for Excellence in Science Teaching, a state-based science education alliance, and UTeach, a program for pre-service teachers at UT Austin.

URL: <http://www.ig.utexas.edu/outreach/index.htm>

ED21A-03 0830h

Collaboration and Inquiry: Cornell University Partnerships with Rural School Districts

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Cornell University's location provides valuable opportunities for university-community collaboration. Schools in the area tend to be rural, with limited access to resources. Two projects in place at Cornell

provide opportunities for collaboration between graduate students and local K-12 schools. These programs yield benefits for K-12 students by exposing them to resources (and expertise) otherwise unavailable to them; for K-12 teachers, by providing access to knowledge and resources brought to them by the graduate students; and for the graduate students who participate in the program, by giving them opportunities to teach and design curricula. The two programs provide options for outreach that fit many schedules, teaching goals, and interests. The Graduate Student School Outreach Program (GSSOP) is open to all graduate students and local K-12 teachers. Students and teachers often participate for several years in a row. Graduate students prepare a 6-8 session "mini-course" in an area of their interest, and they are matched to local teachers with similar interests or needs. Graduate student participants are required to submit a final formatted curriculum for the lessons that they have taught, and these curricula are made available to the public on the GSSOP web site. GSSOP is currently in its twelfth year as a student-coordinated program, and its funding comes primarily from Cornell's Public Service Center and alumni donations. The Cornell Science Inquiry Partnership (CSIP) provides an opportunity for graduate students in the sciences to participate in longer-term collaborations with regional schools. CSIP is administered under the National Science Foundation GK12 initiative and is currently in its fourth year. CSIP fellows make a year-long commitment to teaching and outreach and receive a full fellowship. Fellows may work with several middle- or high-school teachers over the course of the year, and they may teach many lessons over different time scales. As in GSSOP, CSIP fellows prepare curricula that are made available to the public. CSIP courses focus on inquiry-based instruction, and fellows attend weekly seminars in which inquiry-based teaching and lesson planning strategies and theory are discussed.

ED21A-04 0845h

Leveraging Exceptional Teachers as Trainers in Geoscience Education: The National Center for Atmospheric Research Model for K-12 Teacher Professional Development

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At the National Center for Atmospheric Research (NCAR), we have developed a model for educator professional development that builds upon the existing knowledge base of educators, their training experience, and the support of their educational institution. NCAR hosts two professional development workshops for middle and high school educators each summer - the NCAR Climate and Global Change Workshop and the NCAR Modeling in the Geosciences Workshop. Both of these workshops provide advanced science content, requiring that we select participants that already have significant background in one of the geosciences. In addition, participants are selected based on their demonstrated experience and success in peer training, courses taught, the support of their institution, their geographic distribution, plans for dissemination and outreach to underrepresented groups, and the populations served by their institution. Successful applicants are required to provide training to a minimum of 40 educators in their region in the year following the workshop. Our best practices come from formal program evaluation as well as informal interactions and observations. Ranging from big concepts to minutiae, careful planning and successfully taking care of the details can make the difference between a successful workshop and a disaster. Methodologies include leadership and content training, field experiences, hands-on inquiry-based activities, computer modeling, experience in presentation, preparation for local training sessions, and discussion. Reflection on relevance to national education standards is a necessary underlying theme of a successful workshop. Likewise, involving scientists not only in lecture presentations but also in some of the more informal components of a workshop such as hands-on activities and social events provides additional opportunities for scientists and teachers to get to know each other and build on-going relationships. Follow-up evaluations assess the impact of the training provided to workshop participants, in addition to evaluations of the workshops held by participants in their own communities. Throughout the year, we remain in contact with workshop participants to provide support in their continuing educational efforts. Our goal is to build a network of trained geoscience educators across the country that can work collaboratively to improve the training of their colleagues.

URL: http://www.ucar.edu/educ_outreach/k-12.html

ED21A-05 0900h

Geology at Our Doorstep: Building a Partnership for Standards-Based Curriculum and Professional Development in Middle School Earth Science

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Geology at Our Doorstep is a collaboration between a science outreach program (CIRES Outreach), students and faculty in a university geology department (U. Colorado at Boulder), and a local school district (St. Vrain Valley) to develop locally relevant geology classroom resources for use by the district's middle-school teachers. The project grew out of direct conversations with teachers about their ideas and needs and was explicitly based on district and state standards in Earth science and scientific thinking, drawing on close work with the district on standards implementation and assessment over the past two years. We intended to draw on existing curriculum resources and substitute local geologic examples to construct a "place-based" teaching resource. However, we found that generic, national-level curricula did not effectively match the rich geologic resources of our area, and instead developed a rather more substantial set of original materials, including classroom collections of regional rocks, reference materials on local geology, classroom activities, and media resources, all shared with teachers at a series of professional development workshops. While the original project was small in scale, a number of spin-off projects have evolved. This project models several important features in the development of university-K12 partnerships: consultation with districts, piloting of small projects, and the role of outreach programs in facilitating participation of university faculty and students.

URL: <http://cires.colorado.edu/~k12/>

ED21A-06 0915h

Alabama's Education Coalition Focuses on Supporting the State's Math, Science and Technology Initiative and on Building Distance Learning Programs

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The Alabama Math Science Technology Educational Coalition (AMSTEC) was formed as a non-profit after a 1998 NASA Linking Leaders program brought in education and corporate leaders to address systemic education reform in Alabama public schools. AMSTEC was instrumental in the creation of the Alabama Math Science Technology Initiative (AMSTI), a K-12 program designed using data from national and international research and local teacher survey. In the face of dwindling government support in a state ranked last in education funding, AMSTEC believes that its best hope for improved STEM education lies in strengthening its community/industry partnerships and building upon the Department of Education's newly created AMSTI program. NASA's GLOBE program is the primary earth science education component being integrated into AMSTI. AMSTI is structured to provide teachers with (1) the materials, equipment, technology and supplies necessary to deliver high quality, inquiry-based instruction; (2) professional development linked directly to the educational resources with the intent of strengthening content knowledge, instructional strategies, and use of assessment tools; and (3) on-site support and mentoring throughout the year in the interest of achieving these goals. Roles for community partners to support these objectives far exceed that of mere funding - especially in the area of mentoring and professional development. Currently, AMSTEC consists of 100+ members including classroom teachers and district officers, education department representatives from higher educational institutions, policy makers and administrators, and government and industry representatives. AMSTEC remains partially tied to NASA fiscally and is administratively housed by the National

Space Science and Technology Center's Earth System Science Center. AMSTEC's partnership emphasis is focused on increasing corporate and industry participation to support the implementation of AMSTI and its hub-site-based program. Future foci for AMSTEC are development and implementation of distance learning programs across Alabama's K-12 public schools.

URL: <http://www.amstec.org>

ED21A-07 0930h

Enhancing K-12 Ocean Science Education Through Multi-level Partnership

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This paper highlights the results of long-term collaborations between the University of South Florida's College of Marine Science (CMS) and the Pinellas County school district (22nd largest nationally) to advance and improve K-12 Earth/Ocean science education. The 12-year mission of Education and Public Outreach (EPO) in the College of Marine Science has been to meaningfully integrate ocean science research and science learning to enhance K-12 education for teachers and students. Our interactive and interdisciplinary programs include research cruises, field trips, authentic research projects, satellite broadcasts, and web-based technologies. This paper will focus on two programs, the Oceanography Camp for Girls and Teachers and Project Oceanography. We will address impact of these programs, what works, the role and value of partnerships, sustainability and future initiatives. An especially critical aspect of EPO is partnerships. Our partners include people, scientific facilities, community, and donors. Financial partnerships provide sustainability and continuity. For example, private donors have built a series of endowments to support the Oceanography Camp for Girls currently valued at over \$1 million. Given the recent shift in state and federal funding priorities, private funding is a vital element of successful EPO programs. To date, marine science EPO partnerships have included 34 state agencies, universities, private research laboratories, schools, and museums; 75 scientist, advanced graduate students and teachers as co-instructors; 4 television stations and 2 production companies; and over 2,000,000 participants in 7 countries. Multi-level partnerships are enhancing K-12 classrooms around the world with relevant ocean science content and resources to further science interests, ocean awareness, and informed decision making.

URL: <http://www.marine.usf.edu>

ED21A-08 0945h

Building Trust and Commitment in Scientist-Teacher Partnerships

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Scientific partnerships bring individuals from different cultures together to achieve mutual goals, make decisions, exchange ideas, and contribute resources (Gomez et al., 1990.) These collaborations have the potential to benefit both parties, but forming functional partnerships between two different work-environment cultures is difficult. We were interested in determining what governs their success. CATTs (Collaboration to Advance Teaching Technology and Science) is an NSF GK-12 fellowship program that fosters relationships between graduate and undergraduate CATTs scientists and K-12 teachers. A case-study approach was used to examine the dynamics of partnership development. Specifically, we looked for patterns in the behavior and attitudes of partners to understand why some partnerships are successful and others fail. We used classroom observations, journals, surveys, and interviews with scientists and teachers to establish these patterns. By their nature, the evolution of every scientific partnership is unique, and the outcome is unpredictable. However, the case-study approach allowed us to understand some of the attributes of successful and unsuccessful partnerships. Frequent communication was essential, especially in defining the roles and responsibilities of the teacher and scientist. Setting mutual goals and expectations was necessary, but the flexibility of both partners was also crucial as goals and expectations typically evolved as the partnership progressed. The most

successful partners shared classroom and planning responsibilities in ways that utilized the strengths of each partner. This promoted greater exchange of scientific and pedagogical knowledge and experience between the partners and made the scientist and teacher feel as though their respective contributions were important. When both partners felt welcomed, invited, and appreciated, investment in the partnership remained high. Because it takes time and negotiation to build trust and commitment, forming partnerships is an iterative process.

ED21B MCC: Level 2 Tuesday 0830h

Polar Attraction: Linking Polar Science With Education and Outreach II Posters (*joint with C*)

Presiding: S L Pfirman, Barnard College, Columbia University; R E Bell, Lamont-Doherty Earth Observatory

ED21B-1207 0830h POSTER

From Pole to Pole: Educating Tomorrow's Leaders

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The high northern and southern latitudes of the earth share an extreme climate, but are vastly different in their histories, ecological systems and human cultures. Polar regions are increasingly under threat from climate change, resource extraction, and the collapse of large-scale marine ecosystems. These systems are important indicators of human influence on global scale processes (ozone depletion, global warming) and are valued for their biodiversity and uniquely adapted cultures. Unfortunately, the polar regions are often poorly understood by our citizens. Dartmouth College offers a liberal arts undergraduate education that trains tomorrow's leaders in politics, humanities, science and medicine. Through the Dickey Institute of Arctic Studies at Dartmouth College, we designed and taught an undergraduate interdisciplinary course to introduce the major physical, ecological and human systems of high latitudes, including the circumpolar northern Arctic regions and the continent of Antarctica and its southern oceans. Using an interdisciplinary approach we examined the science, societies, politics and policies that shape our viewpoint of cold regions. The connections of the polar regions to global processes and international issues were emphasized. In this paper we will describe our use of differing viewpoints to examine varying topics of importance in the polar regions. Starting the course as a tourist, we proceeded as traveler, explorer, scientist, resident, and politician to reach our final goal as informed voter at the end of the semester. A variety of invited speakers enhanced the course. Hoping before the course to attract twenty students, the fifty students enrolled in the course gave us high ratings.

ED21B-1208 0830h POSTER

Exploring Science Through Polar Exploration

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Exploring the Poles is a First Year Seminar course taught at Barnard College, Columbia University. First Year Seminars are required of incoming students and are designed to encourage critical analysis in a small

class setting with focused discussion. The class links historical polar exploration with current research in order to: introduce non-scientists to the value of environmental science through polar literature; discuss issues related to venturing into the unknown that are of relevance to any discipline: self-reliance, leadership, preparation, decisions under uncertainty; show students the human face of science; change attitudes about science and scientists; use data to engage students in exploring/understanding the environment and help them learn to draw conclusions from data; integrate research and education. These goals are met by bringing analysis of early exploration efforts together with a modern understanding of the polar environment. To date to class has followed the efforts of Nansen in the Fram, Scott and Amundsen in their race to the pole, and Shackleton's Endurance. As students read turn-of-the-century expedition journals, expedition progress is progressively revealed on an interactive map showing the environmental context. To bring the exploration process to life, students are assigned to expedition teams for specific years and the fates of the student "expeditions" are based on their own decisions. For example, in the Arctic, they navigate coastal sea ice and become frozen into the ice north of Siberia, recreating Nansen's polar drift. Fates of the teams varied tremendously: some safely emerged at Fram Strait in 4 years, while others nearly became hopelessly lost in the Beaufort Gyre. Students thus learn about variability in the current polar environment through first hand experience, enabling them to appreciate the experiences, decisions, and, in some cases, the luck, of polar explorers. Evaluation by the Columbia Center for New Media, Teaching and Learning shows that combining historical texts with current data/simulations is an extremely powerful way of engaging non-scientists in science, and explaining the role of science and the environment in decision-making.

ED21B-1209 0830h POSTER

Polar Meteorology: An Interactive Educational Web Module

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The author has created a public web module that explores topics related to polar meteorology and climatology. Currently, the module contains sections on vessel icing, polar climates, climate change and web resources. The key feature of the web module is interactivity; each section has an exercise that requires the student to actively participate in his/her education rather than just absorb information. The climate section features active maps of the Arctic and Antarctic regions; when the user clicks on a region, a plot of the annual temperature cycle is displayed. The exercise requires the user to analyze factors that control climate by comparing regions and analyzing the differences in the temperature patterns. The climate change section features a global energy balance model that can be run online in less than two minutes. An easy-to-use online form is used to provide inputs such as surface albedo, horizontal advection, solar input and several other geophysical parameters into the model. The associated exercise examines how changes in these inputs affect global temperatures as a function of time of year and latitude, sea ice extent and sea ice thickness. All the exercises feature multiple choice questions with instant feedback after each question is answered. The module can and has been used in a stand alone fashion and in conjunction with other educational materials and media. This presentation will showcase the module in an online environment. You may examine the module for yourself by following the link below.

URL: <http://www.weather.nps.navy.mil/~psguest/polarmet/>

ED21B-1210 0830h POSTER

A New Antarctic Field Course for Undergraduates at Michigan State University

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Field courses in remote and extreme environments immerse students in new and unfamiliar cultural and environmental settings where the impact from learning is high and the conventional wisdom, mindsets, and life skills of students are challenged. Through the Office of Study Abroad at Michigan State University (MSU), a new field course for undergraduates entitled Studies in Antarctic System Science¹ embraces these principles. The three week, 6 credit course will be convened for the first time during the 2003-04 austral summer and will feature field based activities and classroom sessions beginning in Ushuaia, Tierra Del Fuego, Argentina. The defining experience of the program will be a cruise of the Antarctic Peninsula on a tourist ship partnered to the International Association of Antarctic Tour Operators (IAATO). This cruise will include landings on a daily basis at various sites of interest and international research stations en route. In 2003-04, the course will comprise 20 students and three faculty members from MSU. The non-major course curriculum has been compiled from materials based on original research by program faculty, relevant literature, information obtained directly from the international research community, and the Antarctic tourist industry. Subject areas will span multiple disciplines including palaeohistory and ecology, oceanography, climatology, geology and glaciology, marine, terrestrial and aerobiology, early exploration, policy and management, and the potential impacts from climate change and humans. It is intended that the course be repeated on an annual basis and that the curriculum be expanded to include greater coverage of ongoing research activities, especially NSF funded research. We welcome contact and feedback from educators and scientists interested in this endeavor, especially those who would like to broaden the impact of their own education interests or research by offering materials that could enhance the curriculum of the course and/or create opportunities for collaboration.

URL: <http://www.cevl.msu.edu/acl/projects/antarctica.html>

ED21B-1211 0830h POSTER

Edge of the Arctic Shelf: an Online Education Expedition

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The Edge of the Arctic Shelf website communicates scientific results and the beauty of the Arctic Ocean to a broad audience (junior high to PhD). The website supports the physical oceanographic component of the Western Arctic Shelf-Basin Interactions Experiment (SBI), an extensive three-year field program in the Chukchi and Beaufort Seas. The website features four main segments: expedition overview, daily updates, images and facts, and science highlights. Starting this year (2003), I enlisted ten junior high classrooms to participate "virtually" in the cruise. While at sea, I received questions from the students via email. My daily updates incorporated answers to these questions, plus observations and digital photos of the science activities and environment. I then created the html and transmitted the pages to our server. In this fashion, students, scientists, and the general public interacted with our cruise in "near-real-time." This presentation will focus on highlights from the website and lessons learned.

URL: <http://www.whoi.edu/arcticedge>

ED21B-1212 0830h POSTER

A Friend Acting Strangely: an Exhibition on Climate Change in the Arctic

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