ED71C MCC: Hall C-TH Sunday 0830h

Geophysics Data in the Classroom I
(joint with NG, OS, S, T, PA)

Presiding: **J Taber,** Incorporated Research Institutions for Seismology (IRIS)**; M Hamburger,** Indiana University

ED71C-01 0830h

Using Geophysical Data to Improve Science Literacy

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Although relatively few students will become professional geoscientists (i.e. producers of scientific information), essentially every student is a future consumer of scientific information. Government agencies, environmental organizations, businesses, and special interest groups use scientific arguments to set policy, create legislation, and develop international agreements. Often, decisions must be made even though the data are incomplete, ambiguous, or contradictory. In addition, such decisions frequently have severe social, economic, and political consequences.

At Princeton University, we have developed courses designed to make students sophisticated consumers of scientific information. The courses are among the most popular and top rated courses in the University. Through a series of actual case studies that use geophysical data, students learn how to make decisions using scientific information in concert with engineering, economic, political, and social considerations. For each issue, they analyze the scientific arguments, evaluate the geophysical data upon which they are based, and determine the scientific credibility, political feasibility, and economic consequences of the various options. The classs actions are then compared against those of the actual decision-makers, and the accuracy of their predictions is evaluated against the outcome. Students gain first-hand experience with concepts such as valid inference, representative sampling, boundary values, and data discrimination.

ED71C-02 0845h INVITED

Using Geophysical Data in the Texas High School Course, Geology, Meteorology, and Oceanography

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Science educators working directly with scientists to develop inquiry-based instructional materials in Earth science yield some of the best results. The TEXTEAMS (Texas Teachers Empowered for Achievement in Mathematics and Science) Leadership Training for the Texas high school science course, Geology, Meteorology and Oceanography (GMO) is one example of a successful program that provides high-quality training to master teachers using geophysical data collected by scientists at The University of Texas Institute for Geophysics (UTIG).

TEXTEAMS is a certification program of professional development and leadership training sponsored by the National Science Foundation that is part of the Texas Statewide Systemic Initiative. UTIG scientists teamed with science educators at the Charles A. Dana Center for Mathematics and Science Education at UT and the Texas Education Agency to develop inquiry-based instructional materials for eight GMO modules. Our learning activities help students and teachers understand how Earth scientists interpret the natural world and test their hypotheses, and provide opportunities for the use of technology in classroom science learning; they are aligned with national and state teaching standards.

Examples of TEXTEAMS GMO learning activities that use geophysical data.

1. Neotectonics: radiocarbon dates and elevation above current sea level of raised coral reefs in the New Georgia Islands are used to calculate rates of tectonic uplift and as a basis for the development of a conceptual model to explain the pattern of uplift that emerges from the data.

2. Large Igneous Provinces:geophysical logging data collected on ODP Leg 183 (Kerguelen Plateau) are analyzed to identify the transition from sediment to basement rock.

3. The Search for Black Gold: petroleum exploration requires the integration of geology, geophysics, petrophysics and geochemistry. Knowledge gained in previous GMO modules is combined with fundamental knowledge about economics to construct a petroleum prospect for a small oil and gas company.

TEXTEAMS GMO Leadership Training uses mentoring of teachers by fellow teachers to implement effective teaching strategies and rigorous science curricula. More than 75 GMO teachers participated in the institutes and they in turn have trained about 2,250 other teachers. The number of students reached is about 67,500. The success of the GMO institutes have led to new partnerships between scientists and educators, and allowed UTIG to secure additional funds to promote K-12 Earth science education in Texas. They can serve as a template for other programs that are relevant to local communities and which utilize geophysical data and science.

ED71C-03 0900h

Near-real-time Earthquake Notification and Response in the Classroom: Exploiting the Teachable Moment

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Earthquakes occur globally, on a regular but (as yet) non-predictable basis, and their effects are both dramatic and often devastating. Additionally they serve as a primary tool to image the earth and define the active processes that drive tectonics. As a result, earthquakes can be an extremely effective tool for helping students to learn about active earth processes, natural hazards, and the myriad of issues that arise with non-predictable but potentially devastating natural events. We have developed and implemented a real-time earthquake alert system (EAS) built on the USGS Earthworm system to bring earthquakes into the classroom. Through our EAS, students in our General Education class on Natural Hazards (Earth101 - Natural Disasters: Hollywood vs. Reality) participate in earthquake response activities in ways similar to earthquake hazard professionals - they become part of the response to the event. Our implementation of the Earthworm system allows our students to be paged via cell-phone text messaging (Yes, we provide cell phones to the 'duty seismologists'), and they respond to those pages as appropriate for their role. A parallel web server is maintained that provides the earthquake details (location maps, waveforms etc.) and students produce time-critical output such as news releases, analyses of earthquake trends in the region, and reports detailing implications of the events. Since this is a course targeted at non-science majors, we encourage that they bring their own expertise into the analyses. For example, business of economic majors may investigate the economic impacts of an earthquake, secondary education majors may work on teaching modules based on the information they gather etc. Since the students know that they are responding to real events they develop ownership of the information they gather and they recognize the value of real-time response. Our educational goals in developing this system include: (1) helping students develop a sense of the global distribution and impact of natural hazards, and the implications of non-predictable events; (2) encouraging students to think about how understanding science related events can be crucially important in analyzing societal issues; and (3) developing an approach to understanding important earth science topics in a way in which students 'own' their data, and are entrained into thinking about linkages between science and society. Finally, systems such as our real-time earthquake alert system take science out of the classroom and into the students lives. What better way to broaden the discussion of science, and bring earth science issues to center stage then to have a student receive an earthquake alert when she is socializing on a Friday evening at a campus hangout!

ED71C-04 0915h INVITED

Enrichment of Science Education Using Real-time Data Streams

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For the past six years, Rutgers Marine & Coastal Sciences (RMCS) has capitalized on human interest and fascination with the ocean by using the marine environment as an entry point to develop interest and capability in understanding science. This natural interest has been used as a springboard to encourage educators and their students to use the marine environment as a focal point to develop basic skills in reading, writing, math, problem-solving, and critical thinking. With the selection of model science programs and the development of collaborative school projects and Internet connections, RMCS has provided a common ground for scientists and educators to create interesting and meaningful science learning experiences for classroom application. Student exposure to the nature of scientific inquiry also prepares them to be informed decision-makers and citizens.

Technology serves as an educational tool, and its usefulness is determined by the quality of the curriculum content and instructional strategy it helps to employ. In light of this, educational issues such as curriculum reform, professional development, assessment, and equity must be addressed as they relate to technology. Efforts have been made by a number of organizations to use technology to bring ocean science education into the K-12 classroom. RMCS has used he Internet to increase (1) communication and collaboration among students and teacher, (2) the range of resources available to students, and (3) opportunities for students and educators to present their ideas and opinions. Technology-based educational activities will be described.

ED71C-05 0930h

Guided Inquiry for Teacher Enhancement Utilizing Internet-Delivered Geophysical Data

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The Education Program of the American Meteorological Society (AMS) designed and nationally implemented two distance-learning courses for K-12 teacher enhancement that model scientific inquiry through investigations written that employ Internet-delivered geophysical data. DataStreme Atmosphere, launched in 1996, has introduced almost 6000 teachers nationwide to the basics of meteorology. DataStreme Water in the Earth System (WES), now in its fourth semester offering, employs the global water cycle as a vehicle to explore the flow and transformations of water and energy in the Earth system. By Spring 2003 almost 1000 teachers will have completed DataStreme WES. In both 12-week courses, participants complete two investigations per week and submit their work to a mentor on their Local Implementation Team (LIT) for discussion and evaluation. AMS staff scientists write part of each investigation to a current or archived situation utilizing specially formatted meteorological, hydrological, or oceanographic data. This component of the investigation is posted to the course homepage and has proven to be an exciting and highly motivational aspect of the DataStreme courses. In many cases, teachers learn scientific concepts by investigating a case (e.g., hurricane, flash flood) as it is happening, in near real-time. Participants who successfully complete a DataStreme course agree to serve their schools and school districts as a resource teacher and to offer peer training on the use of Internet-delivered geophysical data to upgrade science in the classroom.

ED71C-06 0945h INVITED

Using Earth Data in an Introductory Oceanography Course

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Activities that engage students in the use and interpretation of real earth data provide an effective way of promoting an understanding of the science process. In UCSBs introductory Oceanography course, major goals are to improve student understanding of how science works and how to interpret science claims in the popular media. Activities are modeled after those of practicing scientists. These include: a) posing a solvable problem, b) choosing and acquiring relevant data, c) describing the data, d) interpreting the data, e) giving talks to peers, and f) publishing and reviewing findings. Each of these activities poses pedagogical challenges that must be addressed in carefully sequenced course assignments that build upon each other, and respond to a variety of learning styles.

The use of earth data in education also presents significant challenges in creating effective data acquisition and display tools. However, only item b, above, is pertinent to these tools. The other items present similar challenges. During the course, learners must acquire enough subject knowledge to successfully interpret the data. They must understand the theory or model they are testing, how the relevant data can be used to test the model, and how to illustrate and present their findings orally and in writing. Some of the assignments that support this are: online homework, online subject area mini-quizzes (randomly created from a database of questions), questions of the day in lecture, online short answer thought questions, lab section guided mini-investigations, lab section group presentations, short writing exercises, and 2 longer writing assignments.

Students rate the writing assignments as the most effective course component that contributes to their learning. The writing assignments focus student effort and also produce a product that we can study in an attempt to measure student learning. Prof. Gregory Kelly and Prof. Charles Bazerman (UCSB Graduate School of Education) are studying student papers using rhetorical analysis and are developing a model that we hope will allow us to reliably measure the quality of a student paper, and also measure student understanding of science process. We are also using the results of these studies to refine the way we teach the science writing process to students.

URL: http://oceanography.geol.ucsb.edu

ED71C-07 1020h INVITED

Using Geophysical Data in a Secondary Education Environment

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Data from geophysical research has the potential to increase active, inquiry-based learning in a secondary classroom. Student collected data can be used to support individual classroom investigations, or be contributed to national or global collection databases. Students can access a variety of text, numerical and graphic data from student, university, and government archives. These data can then be used to support quantitative and qualitative investigations of geophysical phenomena. This session will focus on the tools that can be used (spreadsheets, image processing, geographic information systems) and the ways in which such data can be used (mapping, statistical trends, forecasting).

ED71C-08 1035h

Solar and Geomagnetic Investigations: High School Astronomy Unit Focusing on the Sun/Earth Connection

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Solar and Geomagnetic Investigations is a self-contained 6 to 8 week integrated unit developed specifically for high school astronomy classes that focuses on the Sun-Earth Connection. It contains comprehensive subject matter relating to the electromagnetic spectrum, the Sun, and the effects of solar activity on the Earth. It also includes several student activities allowing hands-on experience with a small radio telescope. Students collect and analyze solar and geomagnetic data using a variety of techniques and equipment.

The unit products include a Student Booklet, a CD-ROM, and a Teachers Edition. The Student Booklet includes background information and reading questions; topic activities; sunspot data collection and analysis; daily magnetometer data collection and correlation to on-line geomagnetic data; analysis of the solar flux data at 1415 MHz from Sagamore, Massachusetts; daily collection of solar flux data using the SRT (Small Radio Telescope) and correlation to Sagamore data; and a final project including all data, graphs, and analysis via directed questions. The Teacher Edition provides comprehensive support material for the unit and includes multiple PowerPoint presentations on waves and the electromagnetic spectrum, the Sun-Earth connection, and radio telescopes; review games and unique song reviews; suggestions for future study; blank data collection cards; and an analysis of the units alignment with the Massachusetts Science Curriculum Frameworks.

Solar and Geomagnetic Investigations was created under the NSF funded Research Experience for Teachers Program conducted at the MIT Haystack Observatory during the summer of 2002. The RET participants worked closely with research staff to develop this unit.

We will show examples of the unit material and describe the overall unit concepts. Sample student work will be presented as well.

ED71C-09 1050h

A tool for Exploring Geophysical Data: The VGEE-IDV

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The Visual Geophysical Exploration Environment (VGEE) is a suite of computer tools and accompanying online curricular units that enable students to develop physical insight from geophysical data sets. The VGEE curriculum is inquiry and visualization based. The curriculum begins by asking students to compare visualizations they construct from authentic geosciences data to their own conception of the geophysical phenomenon. This comparison encourages students to identify and challenge their own prior conceptions of the phenomenon, a necessary prerequisite to successful learning. Students then begin building correct understandings by identifying patterns and relationships within their visualizations. Students use idealized concept models that highlight physical principles to explain these patterns and relationships. Research, however, has shown that the physical insight gained from these idealized models isnt often applied to either the real world or to the data visualized. To address this, students can easily embed these idealized concept models into their visualizations; there the idealized models respond to the real physical conditions of the geophysical data.

The entire inquiry process is built around multi-dimensional and multi-variable visualizations of real geophysical data. Advantages of visualization include its using a natural human talent and its removing mathematics as a barrier to insight. Multi-dimensional and multi-variable visualizations offer the additional advantage of integrated perspectives; rather than asking learners to mentally combine two-dimensional representations of different variables, the learners can navigate through a three-dimensional time-varying representation and get a holistic view. Finally, learner constructed visualizations offer the students a experience with scientific tools, a chance to tailor their investigation to their own misconceptions, and the potential for more robust understanding than prepared visualizations.

The heart of the VGEE is the visualization environment. The visualization environment is a customized version of the Integrated Data Viewer, or IDV, a platform-independent software package being developed by Unidata for display and analysis of geophysical data. In addition to the learner-centered functionality mentioned above, this environment allows the ability to locate and analyze remote data sets, including both archived and real-time data. As such, the tool represents a road toward creating a data web where educational users can browse and use data in a seamless way. While our discussion of the VGEE will highlight its use in specific curricula; we will point towards the development of the next generation data web in the Digital Library for Earth Science Education (DLESE). Our discussion will also summarize the data gathered while using the VGEE in an entry-level geoscience laboratory course.

URL: http://www.dlese.org/vgee

ED71C-10 1105h

Education Modules for Teaching About Earthquakes, Volcanoes and Plate Tectonics Using the SEISMIC Computer Program

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We are developing educational modules for teaching about earthquakes, volcano eruptions and related plate tectonic concepts using an interactive computer program called SEISMIC (written by Alan Jones). The program includes up-to-date earthquake and volcanic eruption catalogs and allows the user to display earthquake and volcanic eruption activity in speeded up real time on global, regional or local maps that also show the topography of the area in a shaded relief map image. SEISMIC is an interactive program that includes a number of tools that allow the user to analyze earthquake and volcanic eruption data and produce effective displays to illustrate seismicity and volcano patterns. The program can be used to sort data and provide results for statistical analysis, to generate detailed earthquake and volcano activity maps of specific areas or for specific purposes, to investigate earthquake sequences such as foreshocks and aftershocks, and to produce cross section or 3-D perspective views of earthquake locations. The program can be a powerful and effective tool for teaching about plate tectonics and geologic hazards using earthquake and volcano locations, and for learning (or practicing) fundamental science skills such as statistical analysis, graphing, and map skills. The teaching modules describe and illustrate how to use the SEISMIC program effectively in demonstrations, classroom presentations and interactive presentations, and independent study/research. Because the program has many useful options and can be used to examine earthquake activity and volcanic eruption data, the modules provide instructions and examples of quantitative analysis, graphing of results, creating useful maps and cross section diagrams, and performing in-depth exploration and research. The program and the teaching modules can be used effectively middle school, secondary school and college classes.

ED71C-11 1120h

Discover Our Earth: Web-Based Geophysical Data in the Classroom

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Discover Our Earth is a web-based system designed for classroom use, allowing access and display of geospatial data sets . It is an education and outreach module built as part of Cornell University's Geoscience Information System, originally constructed as a tool for geophysical research (http://atlas.geo.cornell.edu). Discover Our Earth has been used in university, high school and middle school classrooms. Working with real data is a powerful tool for helping students learn scientific principles, content, and the processes of scientific inquiry. In order to give students access to data that is otherwise difficult to work with, Discover Our Earth is comprised of several elements. The central component is a Java applet called QUEST (Quick Use Earth Study Tool). QUEST allows students to query and display data from three data sets selected from the 100+ housed within the Information System. Any attribute of earthquake, volcano, or topographic data can be selected and displayed, and multiple data sets can be overlain on each other, or on assorted background images (such as a geographic base map, age of the sea floor etc). Each image is saved in the QUEST history window, allowing students to compare multiple selections, or to animate a series of images as a "filmstrip." In order to help students better understand their results, the QUEST applet is supported by several other components. There are guides for both teacher and student. The student guide gives step-by-step instructions for a series of problems, and suggests others that will help students answer questions of local and global interest. The teacher guide provides background material, context, and answers to the student exercises. There are animations and 3-D visualizations that allow students to better interpret their maps. Additionally, there are interactive experiments on topics such as continental drift, isostasy, viscosity, that allow students to explore the physics that underlie the processes they are investigating through the use of real geophysical data. Finally, there is an opportunity for users to provide

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feedback to the developers. Through these efforts we hope to provide teachers and students with access to a wide variety of data applicable to problems in Earth science, along with the ability to easily display and analyze multiple data types-thus providing all users with access to state-of-the-art information.

URL: http://atlas.geo.cornell.edu/education/

ED71C-12 1135h

The U.S. Educational Seismology Network (USESN)

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A new national science outreach initiative, the U.S. Educational Seismology Network (USESN), has been initiated under the auspices of the IRIS Consortium. The mission of the USESN is to promote the use of seismo-graphs and seismic data for science education. This project has emerged out of several independent educational seismology initiatives, whose collective efforts to develop a national school seismograph network include: (1) the Princeton Earth Physics Project (PEPP), which links ten university-based regional networks, currently serving 80 schools nationwide; (2) Michseis/Ohioseis, which has built a network of 18 school and college-based stations in Michigan, Indiana, and Ohio; (3) the South Carolina Earth Physics Project (SCEPP), which is in the process of developing a 50-station education-al seismic network in South Carolina; (4) the Los Angeles Physics Teachers Alliance Group (LAPTAG), a network of eight stations in the Los Angeles area, (5) IRIS 'Seismographs in Schools' program, (6) the Public Seismic Network (PSN) an informal coalition of amateur seismologists, which includes stations at a number of schools, and (7) a number of smaller local-area educational seismic networks that are developing across the country. The USESN effort will include support for a full range of educational seismograph options, from display-oriented, stand-alone systems to networked broadband instruments. USESN seeks to provide an organizational structure for the coordination of the numerous educational seismology activities that are developing across the country. The primary goals of the USESN initiative are to: (1) promote the installation and operation of educational seismographs and effective use of seismic data; (2) disseminate high-quality curricular materials and educational services that promote the use of seismology in science education; and (3) provide an organizational framework for coordination and advocacy of educational seismology across the country.

URL: http://www.indiana.edu/∼usesn

ED71C-13 1150h

Retrospective on the PEPP Experience

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The Princeton Earth Physics Project (PEPP) has installed research-quality, broadband, digital seismographs at over 70 educational institutions across the country. PEPP was envisioned to forge a marriage between seismology research and science education and outreach. Each PEPP school participates as a member of a regional group sponsored by an IRIS University, which provides training workshops and technical support needed to keep schools active. The PEPP network relies on the internet for data and information exchange. Stations are intended to provide high quality data for the limited broadband range .03 to 10 Hz, permitting the recording of both local and teleseismic events. Notice of approximately 30-40 global events each year is sent to schools, which are then asked to upload waveforms to the PEPP website. PEPP provided a baseline of online curriculum material about seismology, and initial training workshops were used to provide teachers with hands-on experience working with seismic data.

The pedagogical aims of PEPP were to (1) involve students and teachers in a networked data-collection effort, (2) to provide an experience in the research applications of seismic data, (3) to illustrate the interdisciplinary nature of seismology/geophysics by incorporating exercises in earth science, physics, and computers, and (4) to improve connections between the research and education communities. As a network of seismometers, PEPP started as a "one size fits all" standard model for a school seismic station. As an educational enterprise, each school evolved its own idiosyncratic approach, determined by the factors which shape all schooling at the local level: mandated curriculum, staffing levels and background, administrative attitudes, and, the heavy workload of the science teachers. There are two distinct uses of the PEPP instruments: a short-term use in the context of a seismology component in earth science or physics classroom; and a long-term use to engage motivated students in inquiry-based scientific research. As a result, only a few schools routinely manage data flow for the full year; many take up the program only during specific subject periods. The major evolution in internet technology in the past 8 years has greatly enhanced the connectivity and data flow in PEPP, while it has also put many practical obstacles in the way of schools, particularly installation of firewalls and increased controls on installation of software on PEPP computers. The most successful schools have implemented an informal club-like program, by which a few interested students in each class can continue through the school year with station operations. The most successful outcomes take the form of projects which may be presented locally or statewide in science fair programs. [An example would be the annual student research symposium held by the Indiana PEPP group].

Major shortcomings in this educational model have been identified. They are almost all institutional factors revolving around how teachers do their work, and how their university mentors participate in the program. Most participants are already overcommitted for time, and not funded at even the most rudimentary level (beyond the PEPP startup funding). Although the model attempts to implement the principles of hands-on, inquiry-based science teaching as widely promulgated in the National Science Education Standards, the great increase in standardized testing and top- down curriculum prescription, has pushed teachers toward a management-driven program, dominated by standardized testing. Also well-known are the frequent lack of adequate teacher preparation for science teaching, and the low value accorded this kind of outreach by universities.

ED72A MCC: 135 Sunday 1545h

Improving Diversity in the Earth and Space Sciences: Programs That Work II *(joint with B, OS, P, S, SA, SH, SM, T, V, PA)*

Presiding: **F R Hall,** University of New Orleans**; K Grove,** San Francisco State University

ED72A-01 1545h

Enhancing Diversity in the Geosciences through National Dissemination of the AMS Online Weather Studies Distance Learning Course

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Our nation faces a serious challenge in attracting young people to science and science-related careers (including teaching). This is particularly true for members of groups underrepresented in science, mathematics, engineering, and technology and is especially acute in the number of minority college students majoring in the geosciences. A formidable obstacle in attracting undergraduates to the geosciences is lack of access, that is, no opportunity to enroll in an introductory geoscience course simply because none is offered at their college or university. Often introductory or survey courses are a student's first exposure to the geosciences. To help alleviate this problem, the American Meteorological Society (AMS) through its Education Program developed and implemented nationally an introductory weather and climate course, Online Weather Studies, which can be added to an institution's menu of general education course offerings. This highly successful course will be offered at 130 colleges and universities nationwide, including 30 minority-serving institutions, 20 of which have joined the AMS Online Weather Studies Diversity Program during 2002. The AMS encourages course adoption by more institutions serving large numbers of minority students through support from the National Science Foundation (NSF) Opportunities for Enhancing Diversity in the Geosciences (OEDG) and Course, Curriculum and Laboratory Improvement-National Dissemination (CCLI-ND) programs. Online Weather Studies is an innovative, 12- to 15-week introductory college-level, online distance-learning course on the fundamentals of atmospheric science. Learner-formatted current weather data are delivered via the Internet and coordinated with investigations keyed to the day's weather. The principal innovation of Online Weather Studies is that students learn about weather as it happens in near real-time-a highly motivational learning experience. The AMS Education Program designed and services this course and makes it available to colleges and universities as a user-friendly turnkey package with electronic and printed components.

The AMS Diversity Program, in cooperation with the National Weather Service (NWS) facilitates institutional participation in Online Weather Studies. Prior to an instructor's initial offering of the course, he or she is invited to attend a one-week course implementation workshop at the NWS Training Center at Kansas City, MO. Participants then join an interactive network to share best practices ideas in science content and teaching strategies related to their offering of Online Weather Studies. They participate in a mentoring program that networks students with professional meteorologists and provides opportunities for internships, summer research, and career counseling. Meteorologists-in-Charge at NWS Weather Forecast Offices across the nation have volunteered their time to help make these opportunities possible. Also, participants are invited to attend the Educational Symposium of the AMS Annual Meeting where they will attend a special Diversity Session and are encouraged to present a paper or poster.

URL: http://www.ametsoc.org/amsedu/online/info/diversity.html

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Significant Opportunities in Atmospheric Research and Science (SOARS)

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Science education is rapidly changing. It is becoming more exciting and challenging, and also more accessible. Little more than a decade ago, the dreams of students from historically underrepresented groups to successfully pursue careers in science were admirable, but mostly elusive. Today, while African Americans, Chicano/Hispanic/LatinoAmericans, and Native Americans make up 25% of the U.S.A. population, these groups combined constitute fewer than 7% of scientists and engineers in the labor force and approximately 3% of the current AMS membership. Achieving the goal of a diverse, internationally competitive, and globally engaged workforce of scientists, engineers, and well prepared citizens calls for different educational goals and strategies. In 1995 UCAR teamed up with NSF and established a program, SOARS, that extends science education and encourages university students from diverse backgrounds to sustain interests, develop skills, and create paths that lead them to careers in the atmospheric and related sciences. SOARS combines research opportunities with a comprehensive mentoring component and a number of other proven learning strategies to create a student (protégé) centered learning community. To date, seventy-two protégés have traveled this pathway. Thirteen protégés have completed their masters degrees and are SOARS alumni: Ten have entered the professional scientific workforce; four are enrolled in Ph.D. programs; and two are Ph.D. candidates. Twenty-four protégés are enrolled in graduate programs: Three are AMS graduate fellows; one an NSF graduate fellow. Forty-two protégés have completed bachelors degrees; three have completed associates degrees and are now enrolled in a four-year research university. SOARS sponsorship has expanded to include DOE, NASA, and NOAA. Though SOARS continues to learn from the experiences of its community of protégés and mentors, results to date suggest that it is a successful model.