

## 1. INTRODUCTION

Over several decades, education and outreach programs have been developed by dedicated staff within the University Corporation for Atmospheric Research (UCAR), the National Center for Atmospheric Research (NCAR), and the UCAR Office of Programs (UOP) to disseminate information about the atmospheric and related sciences to students, educators, scientists, and the general public. Educational tours and exhibits are the hallmark of public outreach at the Mesa Laboratory, reaching tens of thousands of people every year and receiving the Institution's baseline support on an on-going basis. Specific programs with unique missions and audiences have also significantly contributed to educational resources, training opportunities, and tools available to support the academic community from the elementary school level through professional training. Although these programs are each exceptional, they have not benefited from the opportunity to build upon each others' strengths and accumulated knowledge. In this environment, not only were opportunities for collaboration and leveraging reduced, it was also unclear how these activities collectively supported the larger-scale educational mission of the institution.

The role of academic institutions and national centers in education and outreach has become increasingly important. NSF now dedicates extensive financial resources to the development, implementation, evaluation, and dissemination of educational resources that enrich students' understanding of the sciences and enhance the scientific literacy of the nation. NSF also recognizes that education and outreach programs are better able to reach all Americans when these programs embed strategies specifically designed to include persons and communities that historically have been underrepresented in science, engineering, and mathematics.

The educational community has reinforced this message. In discussions with and surveys of colleagues in its member and affiliate institutions, UCAR has been asked to consider mechanisms by which it can support the educational missions of the universities, both for current students and in the recruitment of new students at the undergraduate and graduate level. Participants in a 29–31 January 2001 workshop at NCAR on Earth System Education Partnerships with Research Institutions specified priorities for action including:

- the importance of support of education activities by research institutions,

- the need to facilitate the participation of scientists in education and policy,
- the need for a full-spectrum approach to enhancing informal and formal science education and public scientific literacy, from K–12 through postgraduate training,
- the need to engage experts and professional partners in program development and in research about learning, and
- the importance of building integrated, interdisciplinary approaches to science education and outreach.

Therefore, it has become increasingly clear that an institution of UCAR's magnitude must have a coordinated education and outreach program that can serve UCAR members, the institution's professional staff, and the public. We have recently completed a strategic planning process, in which we developed a unified education and outreach plan for the institution as a whole, as well as our university community. Here, we highlight aspects of our new strategic plan, as well as new and on-going components of our education and outreach program.

## 2. UCAR Education and Outreach Strategic Plan

In July of 2000, UCAR initiated a strategic planning process to develop a unified education and outreach plan for the institution as a whole, spanning the interests of UCAR, NCAR, and UOP. A planning committee was established, with members recruited from representatives of UCAR programs that currently play a significant role in education and outreach, including sponsored programs as well as the indirectly funded programs of the Office of Development and Government Affairs and UCAR Communications. Together, these individuals provided expert perspectives on program development, content, and public outreach for the institution as a whole.

At a series of strategic planning meetings over 9 months, we developed a mission, vision, and set of values (see Table 1) for the institution's integrated education and outreach effort; specific goals and objectives by which the mission, vision, and values will be realized; and a draft strategic plan, which evolved in response to the comments and recommendations received from numerous reviewers. These included members of UCAR's Board of Trustees and University Relations Committee, NSF staff, several UCAR members' representatives, heads and chairs of university departments, and educators and scientists participating in the NCAR's January 2001 workshop. All of these people helped strengthen the plan's potential to

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reach the institution's many constituencies. In June of this year, the Board of Trustees approved the strategic plan, which is available on-line at [http://www.ucar.edu/educ\\_outreach/stratplan.html](http://www.ucar.edu/educ_outreach/stratplan.html) and in hard copy from the UCAR EO Office.

The scope of UCAR's education and outreach program described in the strategic plan addresses the needs of K-12 through postgraduate learners as well as informal science education in a diverse nation. We accept this broad scope because of the challenge the United States faces in motivating and engaging diverse students to prepare for future careers in the atmospheric and related sciences. It is likewise vital to increase the scientific literacy of all citizens to help them understand the implications of our community's research for their lives and future.

We have already begun implementing the strategic plan. Our first goal, *to create the institutional infrastructure and funding portfolio that will allow UCAR to have an effective education and outreach program*, is well under way through the establishment of the EO office and through our collaborative proposal efforts. Our second goal, *to support the formal education sector by developing, delivering, and promoting education resources for diverse audiences*, is, likewise, under way through our ongoing programs as well as new initiatives (such as planning for next summer's NCAR Geoscience Education Workshop for middle and high school educators).

Progress towards our third goal, *to foster an informed public through scientific literacy*, has been

made on a number of fronts. These include a renewed focus on upgrading Mesa Lab exhibits, expansion of Web sites dedicated to informal science education, and new collaborations with the media on major projects. Our fourth goal, *to build diversity in the geosciences by promoting the involvement of diverse and historically underrepresented populations in the geosciences*, is an overarching one inherent within the others. We plan to survey, model, and collaborate with successful academic bridging-and-training programs (including SOARS); glean recommendations from internal and external studies about how the overall goals of the institution can be met; support the UCAR community in attracting and retaining a diverse work force; and develop materials and exhibits that recognize contributions to the atmospheric and related sciences from a broad spectrum of groups and individuals.

### 3. Program Highlights

Our institution has a respected record of developing and delivering educational resources and training. Through the LEARN program, we developed excellent educational materials for middle school students, as well as the teacher training workshops needed to make use of these materials in the classroom (now available at <http://www.ucar.edu/learn/>). UCAR's education and outreach activities include programs that reach groups at a variety of educational levels, and in formal and informal educational settings. Through our programs that support K-12 through professional training, and our outreach programs to the general public, we support learners, educators, and scientists at all levels and in multiple venues.

**Table 1. Mission, Vision, and Values for the Education and Outreach Program**

#### **Mission**

In partnership with the university community, UCAR promotes scientific literacy and advances all levels of education and training in subjects related to Earth's atmosphere.

#### **Vision**

A successful education and outreach program at UCAR contributes significantly to creating an informed global community that lives responsibly with the atmosphere and the environment. UCAR, NCAR, and UOP effectively support expert communities of diverse scientific professionals who monitor weather and climate processes, enhance and integrate our understanding of them, and assess their impacts on society. Coordinated and expanded informal and formal education and outreach programs help to build a community of learners inspired to set off on a path of lifelong scientific learning.

#### **Values**

Our education and outreach activities demonstrate our commitment to excellence, scientific accuracy, intellectual freedom, and objectivity. We are responsive to the educational needs of our broad university constituency and collaborate closely with that community to meet these needs. We respect the intellectual contributions of all partners in our endeavors and safeguard the rights of our partners in our collaborative projects. We are committed to universal access to knowledge through age-appropriate programs. We focus our activities on integrative learning across disciplines, with an emphasis on open, shared learning environments that are inquiry-based. Our activities promote creativity and innovation as they are developed and as they are disseminated to their users. Through all of our programs, we demonstrate respect for cultural and gender diversity, as well as for diversity of learning styles. Through our programs implemented with these values, we provide leadership within the scientific and educational communities.

### **3.1 Supporting Formal Education from K-12 through Post-Graduate Training**

#### **3.1.1 Scientific Visitor Programs**

Scientific visitor programs, graduate research assistantships, postdoctoral appointments, colloquia, seminars and workshops support university programs to educate the next generations of scientists, engineers, and scholars in general. For example, the NCAR Advanced Study Program (ASP) provides an opportunity for highly qualified graduate and postdoctoral students to engage in research at NCAR and UOP, enriched by training opportunities designed to support them in building their careers. Specifically, ASP sponsors educational seminars and conducts an annual graduate-student colloquium that reviews recent research developments in emerging areas of research. The NCAR HAO Visitor Program provides opportunities for postdoctoral fellows and scientific visitors, graduate research fellowships, summer undergraduate student visitors, and short-term scientific visitor appointments. Scientific Computing Division (SCD) provides faculty and students access to high performance computing technologies in their classrooms through the Classroom Computing Grants program. The UOP Visiting Scientist Program (VSP) provides opportunities for practicing scientists to have extended research visits at NCAR and other research institutions across the country.

#### **3.1.2 SOARS**

The SOARS program is dedicated to increasing the number of African American, American Indian, and Hispanic/Latino students enrolled in master's and doctoral degree programs in the atmospheric and related sciences with the goal of increasing ethnic diversity within the scientific community of the future. A four-year program for undergraduate and graduate students interested in pursuing careers in the atmospheric and related sciences, SOARS includes a 10-week summer program at the National Center for Atmospheric Research (NCAR) or other national laboratories. SOARS provides educational and research opportunities, mentoring, career counseling and guidance, and the possibility of financial support for a graduate-level program and has been recognized by NSF and the U.S. Department of Energy as a model science and research mentoring program for undergraduate and graduate students from traditionally underserved populations.

#### **3.1.3 Undergraduate Programs**

In addition to our visitor programs and research opportunities, UCAR plays leadership roles in several programs that support undergraduate education. The Digital Library for Earth System Education (DLESE) is conceived as an information system dedicated to the collection, enhancement, and distribution of material that facilitate learning about the Earth system at all

educational levels (<http://www.dlese.org>). The DLESE Program Center was established by UCAR at the request of the Earth system education community to provide support to the emerging national digital library agenda. The Unidata program (program center located at UCAR) enables universities to acquire and use atmospheric and related data. Nearly 200 departments nationwide have become participants, thereby gaining access to real-time flows of weather data, comprehensive data sets from interesting past weather events, software, support, and membership in a virtual community of academicians.

#### **3.1.4 Professional Training**

The COMET Program provides and fosters intensive education and training for operational meteorologists, increased collaboration between the operational and research communities, and improved formal university education. COMET provides classroom based education and training through courses, symposiums and workshops and develops computer based learning materials. Its outreach program creates partnerships between the academic research community and operational weather forecasters. COMET is involved in activities to enhance meteorology education in universities and meteorological services throughout the world and finds innovative ways to enhance the performance of weather forecaster and improve the utilization of weather products to the public (<http://www.comet.ucar.edu/>).

#### **3.1.5 K-12 Programs**

UCAR also places a high priority on supporting K-12 education through programs that increase the understanding of atmospheric and related sciences. Because climate, pollution, and the environment are part of the everyday awareness of young people, the atmospheric sciences offer an unusual opportunity to teach science in engaging, relevant ways. Our institution has a respected record of developing and delivering educational resources and training. Through the LEARN program, we developed excellent educational materials for middle school students, as well as the teacher training workshops needed to make use of these materials in the classroom. Science Now, produced by the Office of Development and Government Affairs and published online by Mandarin SIRS Corporation, describes NCAR's scientific research to K-12 teachers.

In the coming year, NCAR will be initiating new professional development opportunities for K-12 educators. During the summer of 2002, NCAR will begin an annual Geoscience Education Workshop for middle school and high school educators. The workshop will focus on global change and climate change, and will build upon our experiences in LEARN and other professional development programs. We are also beginning work on another K-12 professional development opportunity, focusing on the role of modeling in the geosciences, and how models can be

used to enrich middle school and high school Earth science education.

### **3.2 Fostering Science Literacy**

UCAR has had a strong program in the public outreach arena for decades, centered on the Mesa Laboratory. Contributions from Friends of UCAR have supported the development of Mesa Lab exhibits, Super Science Saturday, the Weather Trail, and Web Weather for Kids. More recently, additional program elements have been added that expand our outreach to people throughout the rest of the country.

#### **3.2.1 Web Outreach**

Through our web outreach efforts, we support both formal and informal science education. Web Weather for Kids is a project that seeks to bring the excitement of weather and weather phenomena to middle school children through the web. The pilot, prize-winning web site was the product of collaboration between Science Discovery program of the University of Colorado and the Boulder Valley School District. A new Geosciences NSF grant is enabling the scientific content and activities of Web Weather for Kids to be enhanced and weather forecasting contests to become accessible on an on-going daily basis. Weather phenomena on the new Web site will be expanded to include clouds and fog, hurricanes, and blizzards, as well as thunderstorms and tornadoes. This new and improved version of Web Weather for Kids will be available by spring 2002.

#### **3.2.2 Windows to the Universe**

In July of 2000, the Windows to the Universe project, initiated at the University of Michigan under the direction of Dr. Roberta Johnson, officially transitioned to UCAR. Windows to the Universe is an award-winning Internet-based learning system for the general public. The web site includes ~6000 interlinked html content pages, spanning the Earth and space sciences - ranging from the Earth as a planet to astrophysics. In addition to extensive science content, the site is supplemented by arts and humanities content to enrich the experience for users. The site is used extensively in the home environment, classrooms, hands-on science museums, and libraries worldwide, by users with ages ranging from 5 to 70. The web site currently serves an average of 330,000 visitors per month (~2.7 million page hits and ~9 million hits per month). Approximately 67% of our users are precollege students, with an additional 16% undergraduate and graduate student users. The project was originally funded through the Public Use of Remote Sensing Data Program of the NASA High Performance Computing and Communications Office with additional support from the Office of Space Science as well as numerous NASA missions and NSF-supported collaborations with UCAR member universities.

#### **3.2.3 Public Visitor Program**

At NCAR/UCAR, on-site visits, primarily to the Mesa Lab, are arranged through the Education and Tour Program (ETP). Established in 1986, the program has grown from initially providing summer tours to providing year-round informational access to those who are not official visitors. In 2001, nearly 30,000 visitors of all ages participated in arranged. For visitors ranging from K-12 students and teachers, youth organizations and focus groups, college students, prospective graduate students, adults, and businesses, the ETP program provides a customized experience that meets the particular interests and needs of the visiting group.

#### **3.2.4 Exhibits**

NCAR's exhibit program is a vital community resource that provides public access to the atmospheric sciences, as well as NCAR/UCAR's research, while encouraging curiosity, creativity, and learning through the exploration of science, technology, and the arts. NCAR's exhibit program was greatly enhanced in this year by the addition of Atmospheric Odyssey. Developed as part of NCAR and UCAR's 40th Anniversary Celebration, this new exhibit combines interactive and non-interactive displays that trace the history of the atmospheric sciences and NCAR/UCAR's own development, many research achievements, and a vision for the role of the atmospheric sciences in serving society in the future. Among the exhibit's highlights are models of research aircraft, actual research instruments, and a touch-screen Weather Kiosk that downloads real time weather data, satellite images, and links to numerous related web sites.

#### **3.2.5 Events, Publications, and Awards**

Twice a year NCAR publishes and distributes EXPLORE (<http://www.ucar.edu/outreach/explore/>), an informal science education newsletter and calendar. Super Science Saturday, an annual event since 1995, provides a high energy day of informal science activities, workshops, special exhibits, and science demonstrations for the public. For the last two years, NCAR has been focusing on Earth Day and National Science and Technology Week (NSTW) through the Student Art Showcase and its Environmental Stewardship Awards. During the month of April, all NCAR public galleries are devoted to student art reflecting on the NSTW theme. NCAR initiated the Environmental Stewardship Awards in 1999 to highlight environmental issues and bring educational resources directly to the schools. Nicknamed the "Greenies," these awards fund special Earth Day projects in the areas of recycling, environmental education, energy, conservation, sustainability, and air and water quality.