The UCAR/NCAR Human-Environment Learning Project (HELP)

A Concept Paper

“Wisdom is not the product of schooling, but the lifelong attempt to acquire it.”
Albert Einstein

by

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The Human-Environment Learning Project

This concept paper provides the philosophical framework for a UCAR/NCAR/University collaboration: the Human-Environment Learning Project (HELP). The goal of HELP is to further the use of active, collaborative learning methods and tools in the geosciences. HELP will be a community-led project that creates the technical and social conditions for broad participation in design activities. The project aims to stimulate and support interdisciplinary subprojects that explore the opportunities for active and visual learning methods and tools in undergraduate, graduate, and professional education in colleges, universities, and research institutions. Our initial effort will be dedicated to the design and implementation of an Internet-based Climate Discovery Center (CDC). The products of the CDC might include role playing simulations related to climate-society issues, interactive modeling tools for exploring impacts of climate variability and change, dynamic educational simulations on weather and climate processes, and interactive visual and empirical data resources.

Expanding the Role of Active Learning
For more than a century, American education has been primarily designed around the concept of a systematic and progressive transfer of facts and knowledge from the expert teacher to the novice student. This approach is clearly not adequate, by itself, for the rapidly changing “post-industrial” society that will dominate the twenty-first century (e.g., see Senge et al., 2000; Beare, 2001). Today’s leading research institutions are global in scope and influence, with a network of rich alliances and interactions. They are active in the use of innovative information technologies for both distance education and specific goal-oriented learning (Schank, 1997; Brown and Duguid, 1999). The “one-size-fits-all” approach to mass education was a worthwhile experiment, but it has failed to fully adapt to today’s rapid rate of societal change and increasingly diverse lifestyles. While traditional systems of education are remarkably resistant to change, there are clear signs of new forms of teaching and learning taking hold around the world. This new era in higher education and lifelong learning requires a blend of disciplinary and cross-disciplinary learning that can adapt to rapidly changing needs. We believe that interactive and visual learning methods and tools will make an important contribution to the evolution of educational systems in coming decades.

HELP aims to develop innovative educational materials and technologies that inspire a creative, diverse, and adaptable workforce for the twenty-first century. Particular emphasis is placed on strengthening the link between earth system science knowledge and societal benefits. This project is a dedicated effort to further the NCAR/UCAR goal of “science in service to society.”

The Climate Discovery Center (CDC)

A quick Internet search for “climate and/or weather information” produces links to hundreds of significant sites with information and vast data resources on the atmosphere. However, existing Internet resources on weather and climate focus primarily on traditional methods of distributing “expert” knowledge and advice (i.e., the passive learner), access to enormous, rapidly expanding data on earth system properties (primarily for expert users), and science/policy perspectives by a wide variety of special interest groups.
The central problem for an educated explorer looking for knowledge on past, present, and possible future human uses of the environment is not too little information but too much, with much of it incomplete, misleading, and inaccurate. The “down side” of the Internet is that anyone with a computer can become an instant author, editor, and publisher—valid science and snake oil are hard to distinguish for the early explorer of a topic such as the influence of climate variability and change on human history and futures. HELP aspires to design an Internet Climate Discovery Center (CDC) that will be a digital destination with the following characteristics:

- The CDC will be the focal point for a knowledge community—a place where people can discover and manipulate knowledge, as well as encounter and interact with others who are exploring human-environment interactions. We have adopted the philosophy that learning is deeply social in nature and must be approached by integrating human and social factors into site design and activities (Thomas et al., 2001).

- The CDC will employ design tools to facilitate navigation through large quantities of data, information, and learning pathways. This work builds on the outstanding skills and talents of current UCAR program staff in COMET, DELESE, Education and Outreach, and UNIDATA. In addition, we will utilize leading expert consultants from the IBM Thomas Watson Research Center, MIT Media Lab, University of Colorado Center for Lifelong Learning and Design, the Hybrid Institute, and many others in the design process. We will use participatory design methods that seek to involve users in the design process as co-designers (e.g., Greenbaum and Kyung, 1991; Schuler and Namioka, 1993).

- The CDC will monitor and maintain links to other sites that provide unique data and knowledge resources to support and complement our goals of active learning about human-environment interactions. Designing an architecture that seamlessly links the CDC to the considerable climate-related complementary resources on other UCAR/NCAR websites will be a high priority.

- NCAR and UCAR will commit the resources required to maintain a timely, useful Internet resource that supports undergraduate education and adult lifelong learning in the area of earth system science.
The CDC will address the challenge of using educational technologies to support productive dialogue and education among dispersed communities of university students and lifelong learners in the area of the earth system and environmental sciences. We aim to facilitate “open learning,” rather than distance teaching. The current UNIDATA and COMET architectures are good models for our vision of coordination-intensive, strategic alliances that support open learning. The UCAR Internet site “Windows on the Universe” [www.windows.ucar.edu] is a model for content, design, and usability.

**Rationale for the Climate Discovery Center**

No one really knows what kind of world we will live in when today’s kindergartners graduate from college. The safest prediction is for change. With environmental trends and indicators suggesting that the United States will be more crowded, its population more diverse, and its natural biodiversity under additional stress (e.g., Gunderson and Holling, 2002), change is inevitable. But the technology base of the knowledge economy is extraordinarily powerful, as evidenced in how quickly discoveries in one research arena lead to breakthroughs in other fields (Kaku, 1998).

Technology accelerates many trends, both positive and negative. Change in many dimensions of our lives is no longer measured in centuries or decades, but in years and sometimes months. The telephone took 35 years to get into one-quarter of U.S. homes. TV took 26 years and personal computers 16 years to reach the same market. The Internet was in one-quarter of American homes 7 years after going public. The critical learning conversations for many students now don’t take place in classrooms; they take place online where they find a global network of peers creating the future. Sadly, much of the education reform effort in the United States looks backward in an attempt to re-create the schools we adults remember from childhood. It is urgent that we explore new ways to organize geoscience knowledge for more effective learning and usability by a broad segment of society.

**New Ways of Learning: Systems and Visual Images**

During the decade of the 1970s, the concept of “systems” moved from academic disciplines into popular culture (Ferguson, 1980). Environmental
and biological scientists such as Miller (1978), Watt (1982), Odum (1988), and Lovelock (1988) preached the gospel of “everything is connected to everything else,” although interpretations of the consequences of these ubiquitous connections differed significantly. Kaku (1998) argued more recently that one chapter of scientific work has closed, and we are making the transition into a new era of discovery that will involve an “intelligent planet.” The metaphor of living systems is replacing the mechanistic, reductionist paradigm that dominated learning theory and practice during the past century. Quantum physics is a spectacular example of the dramatic changes that have taken place in ways of thinking about the fundamental nature of the “system” we live in. Fields as diverse as ecology to medicine to psychology now see the world as a “complex system.” (See a special issue on “Complexity” in Science, 2 April 1999.)

There is substantial literature in cognitive psychology that suggests imagery is a preferred way of human learning (e.g., Neville, 1989). Beare (2001) concludes that there is convincing evidence from all countries and cultures that people use pictures “as a framework within which to coordinate action and will.” The CDC will rely heavily on the use of computer-aided tools for the visual display and envisioning of complex information. We will be guided by the profound work of Edward Tufte on visual methods of learning and explanation (1990, 1997, 2000).

Materials and tools available on the CDC will aim to stimulate the user to explore the many dimensions of the human interface with the climate system through model building, role-playing, and working through nested systems of learning that range from daily life activities to global change. The pathways of exploration offered by the CDC will blend science, technology, the arts, and more. Each addition to the CDC collection will reflect our philosophy of designing an “open learning” environment. Decisions on materials to include will be based on the following criteria:

- **CDC materials will stress learner-centered learning rather than expert-centered teaching.** The **CDC** will stress future-oriented content and tools to encourage and empower the rapidly growing web world of geoscience student leaders and innovators to cultivate his or her own unique set of skills and potentialities.

- **CDC materials will encourage and stimulate the exploration of variety and complexity in thinking and problem solving.** We believe that a
future, more resilient human society will embrace multiple intelligences and diverse learning styles; and

- **CDC** materials will emphasize a world of interdependency and change rather than memorizing facts and striving for right answers.

The first task for a **CDC** design team will be to develop specific priorities for the initial content focus. A focus on activities that emphasize local-to-regional, cross-scale (temporal and spatial) understanding of impacts of extreme weather and climate events meets several UCAR/NCAR strategic goals. This focus could have the following implications:

1. The multimedia materials, models, and interactive learning modules on the **CDC** website would be designed to promote the concept of a more disaster-resistant and resilient society. For example, system dynamic modeling tools (e.g., STELLA) would allow users to explore disaster dynamics from both social and natural science perspectives.

2. The **CDC** would initially highlight the work being done by the NCAR strategic initiatives that relate to extreme atmospheric events (e.g., wildfires, flood hazards, hurricanes, etc.). Research on interactions of climate, wildfire, and society are ongoing across several UCAR and NCAR programs. The **CDC** project would bring a synthetic and dynamic perspective to this important topic.

3. The **CDC** would aim for a significant role in the next U.S. National Assessment of Climate Variability and Change. One possibility would be to design the information and educational technologies to support an interactive network for university faculty and students to document local and regional environmental indicators and trends related to weather and climate impacts. This activity could evolve into an experimental environmental forecasting competition among participating universities.

**Organization and Implementation of the Climate Discovery Center**

The Human-Environment Learning Project will be organized as an NCAR/UOP/ University partnership activity. The Steering Committee will be the UOP and NCAR Directors and the Chair of the UCAR University Relations Committee. Tim Killeen and Jack Fellows will serve as co-chairs.
of HELP. Bob Harriss will serve as the initial project coordinator. The Steering Committee will review proposals and progress reports related to all project activities. Most of this work will be conducted electronically.

The Climate Discovery Center, a first subproject of the HELP that will begin in 2002, will have the following Advisory Group:

Jack Fellows, UCAR, Co-Chair
Arthur Few, Rice University
Dave Fulker, UCAR
Roberta Johnson, UCAR/NCAR
Don Johnson, Univ. of Wisconsin
Tim Killeen, NCAR, Co-Chair
Michael Knoelker, NCAR
Mary Marlino, UCAR
Don Middleton, NCAR
Cindy Schmidt, UCAR
Tim Spangler, UCAR
UCAR URC Chairperson

We plan to announce the CDC in Staff Notes and recruit volunteers to join the design team that will develop, evaluate, and demonstrate our educational products. We need a team and open process that can blend science, technology, and the arts into an innovative and engaging multimedia materials for the CDC. The first task for this team is to design a work statement for the project. University collaborators will participate through an annual workshop, visits to NCAR, and electronic interactions. A library of individuals and organizations that are currently working on the design and evaluation of active learning tools and methods for the geosciences will be compiled. For example, the current and past participants in the NASA ESSE program would be candidates for joining the CDC design process.

The Annual HELP/CDC Faculty-Student Workshop

A primary metric of success will be related to the degree to which university faculty and students become active participants in the project. We plan to hold an annual summer workshop to bring faculty and students together with the UCAR/NCAR design team for “hands-on” design and evaluation activities. Following the NASA Earth System Science Education
(ESSE) model, we will also seek federal agency support to provide modest funding to our university participants for on-campus design, testing, and evaluation of CDC products.

**Summary**

We propose a long-term institutional commitment to shaping the future of environmental education in America with the establishment of the UCAR/NCAR/University Human-Environment Learning Project. The HELP vision of contributing to the evolution to a new era of lifelong learning will be enabled by a revolutionary cyber-infrastructure that is highly collaborative and future-oriented. We believe that UCAR/NCAR can make an important contribution to reshaping ways people learn about and make decisions on their relationship to nature. The HELP initiative takes an “earth system” approach to learning that requires both disciplinary and cross-disciplinary education and research. Our initiative includes the following goals:

- **HELP** aims to catalyze education and research programs that ascertain how the interaction of human and natural processes affects the capacity of natural systems to meet human needs and support an increasing quality of life for all people. The initial focus will be on the design and implementation of an Internet-based Climate Discovery Center;

- **HELP** will facilitate collaborative research and education on the use, effects, and value of computer-aided, active learning methods and tools. A principal focus will be on visual, interactive, multimedia materials to serve college undergraduate, graduate, and lifelong learning programs. Faculty from UCAR member institutions and other external partners will be actively recruited to participate in the design, evaluation, and implementation of content; and

- **HELP** will include a specific focus on information and education technologies, tools, and methods to turn the explosive growth of data in the geosciences into usable knowledge for exploring, learning, and designing the future.

The HELP and CDC are a direct contribution to NCAR’s strategic goal of developing a “world-class” web presence. The CDC complements
the NCAR Data Portal project, Windows on the Universe, and the numerous other excellent web resources at UCAR and NCAR. The unique features of the HELP/CDC effort are the UCAR/NCAR/University partnership and its emphasis on active learning. Our vision would have the CDC become a widely respected educational resource and toolkit for undergraduate and graduate interdisciplinary studies of human-environment interactions. The initiative also maps onto the goals of the NSF Geoscience 2000 plan and the draft NSF document on “A 10-Year Agenda for Environmental Research and Education at NSF.”

**Budget and Deliverables in Year 1**

The 2002-2003 budget for the CDC project is $200K. This funding will be supplemented by at least an equal amount of co-sponsorship from NCAR Division funds. The $200K from the NCAR Director’s Office will be dedicated to the following activities:

1. UCAR and NCAR Design Team Members working on the CDC can charge time to the project budget. The Design Team will develop several prototype web products that will be used focus discussion at a faculty-student workshop in the Summer 2003 (see #4 below). These products will emphasize the integration of UCAR/NCAR research and education.

2. A website will be established to support communication and collaboration by participants in the HELP and CDC efforts.

3. Expert consultants from universities and the private sector will be invited to UCAR/NCAR to present brainstorming seminars and to work with the CDC design team in specific problem areas. The topic areas emphasized will include the information sciences, educational technology and design, and simulation and gaming.

4. In Summer or Fall 2003, we will convene a CDC design workshop involving UCAR and NCAR staff and university faculty and students. The focus of the workshop will be the design of interactive learning tools for implementation on the CDC website. STELLA and other user-friendly modeling tools will be emphasized. The workshop is important to the social facilitation of what we hope will become the UCAR-NCAR-University HELP community.
Selected References


