

Education and Public Outreach Addendum

Earth System Modeling Framework

Background

Enhancing the science, math, and technology literacy of our population is a vital national interest, as has been expressed eloquently in the national planning document, "Science in the National Interest".

"The scientifically literate society that America will need to face in the 21st century will require orientation to science early in life and frequent reinforcement.... The lifelong responsibilities of citizenship increasingly rely on scientific and technological literacy for informed choices. Our scientific community must contribute more strongly to broad public understanding and appreciation of science. Our education system must provide the necessary intellectual tools at twenty-first century standards."

This statement is particularly relevant for the geosciences. Recent test results have shown that middle and high school students have only a poor understanding of key concepts that could otherwise help them understand the world around them. Improvements in geoscience education have been identified as a primary area for focusing efforts to improve science literacy of children. Environmental concerns are becoming increasingly pressing and complex, requiring citizens to have a much better understanding of Earth systems and processes, and the methods scientists use to unravel this complexity to develop an understanding of the underlying systems.

It is unfortunate that there are few K-12 educators with direct training in the geosciences, but this may be reflected in the low content mastery displayed by students in this subject area nationwide. In order to assist students in building the knowledge they need to be competent in the geosciences, training and educational opportunities need to be made available that will provide educators with the background they need to be confident and enthusiastic models of interest and knowledge in the relevant subject areas and skills sets. Similarly, educators need access to resources that are readily useable in their classrooms, are integrated into the curriculum requirements within which the educators operate, and are relevant and engaging to both students and teachers.

E/PO Objectives and Planned Activities

The objective of the education and public outreach addendum of the suite of Earth System Modeling Framework proposals is to develop and implement professional development opportunities on the Earth system sciences for middle and high school educators. Building upon and extending existing resources, a series of nationally-advertised professional development workshops for middle school and high school educators will utilize the concept of global change to explore aspects of the coupled

Earth system. This project will be implemented by UCAR scientists, education specialists, and nationally recognized experts in professional development in the geosciences for middle and high school educators.

Workshops

The most effective way to improve the scientific literacy of students is to work to improve the training of those responsible for educating them. The focus of this effort will be to build upon our extensive experience and existing resources to develop and implement a series of professional development opportunities for middle and high school educators that provides the training they need to enrich the learning of their students. In order to ensure the highest leverage to educators, we propose to target our training activities on educators with a proven track-record of providing training opportunities in their own regions or districts.

The workshops proposed here will extend upon the highly successful model used for the Michigan Space Grant Consortium (MSGC) Geoscience Education Workshop. The yearly workshop series will target 20 educators per year, and will include an intensive 2-week summer semester at NCAR in Boulder, followed by 2 additional 2-day professional development opportunities during the school year. In addition to providing background content on the Earth system that highlights issues of global change and climate change, the workshops will provide opportunities to explore modeling concepts through state-of-the-art Earth system models (the science focus of this suite of proposals) as well as simplified STELLA models of components of the Earth system relevant to curriculum needs of educators as expressed in the National Science Education Standards. Educators will be trained on easy to implement hands-on, inquiry-based classroom activities that illustrate concepts of modeling and aspects of the Earth system. The workshop will include opportunities for educators to gain field experience - for observations and data collection that will be utilized in their studies and also expand their appreciation of the Earth sciences. Finally, the workshop will provide guidance on techniques participants can use to bring the training they have received back to educators in their own districts.

The workshop opportunities will be advertised nationally. Participants will be selected from the applicant pool based on their previous experience and success in regional or local professional development for science educators, as well as our programmatic

desire to have a diverse and geographically distributed set of workshop participants. Travel and living expenses for workshop participants will be covered during the workshops, and each participant will receive a stipend to support their efforts to bring the training they have been provided back to educators in their own districts. In return for the training and support they have received, participants will be expected to train an additional 20 educators per year in their own districts. Materials needed for this training will be provided from the project.

A dedicated project web site will be developed that provides access to information about the project, all lectures, labs, and other training resources, and also provides a venue for communication among project participants.

Previous Relevant Education and Outreach Activities of Project Personnel

Science and education personnel participating in this proposal have extensive experience in development of highly-valued educational resources and successful professional development opportunities for K-12 educators. Over the past decade, UCAR has developed a number of professional development resources with funding from NSF for middle and high school educators on global change, climate change, and the ways in which components of the Earth system are interconnected. In addition, NCAR has been responsible for the development of an influential series of documents – “Reports to the Nation” that highlight our understanding of the Earth system and the potential contributions of humans in changing our climate. With funding from NSF, UCAR developed Project LEARN, in which science education faculty, scientists, and professional development specialists provided training to over 2000 middle school educators on the atmospheric sciences. After six years of funding, resources developed through this program are being made available on-line to support educators nationwide.

Prior to moving to UCAR, Dr. Roberta Johnson (the Director of the UCAR Office for Education and Outreach) developed, in collaboration with colleagues, a highly successful workshop for middle and high school Earth science educators while she was the Director of the MSGC (funded by NASA). This workshop utilized the concept of global change as a vehicle for exploring the breadth of the geosciences, covering topics ranging from recycling to anthropogenic effects on ozone and greenhouse gases to the role of plate tectonics in determining planetary climates. Workshop activities included a combination of lecture, computer-based training and activities (with an emphasis on modeling illustrated through STELLA), training on hands-on inquiry-based activities, field experience, and project development. Resources utilized in the workshop included content and activities available through the NASA sponsored Windows to the Universe project (also PI-d by Dr. Johnson), content and labs available through the NASA and NSF sponsored Introduction to Global Change Course developed by Dr. Timothy Killeen (the PI of this suite of proposals) while he was faculty at the University of Michigan, as well as other quality resources developed by other groups addressing relevant geoscience topics (Topex-Poseidon CD, Ozone Challenge, Blue-Skies, etc).

Management and Coordination

Dr. Johnson will be responsible for the directing the educational activities described in this addendum. She will be assisted by the staff of the UCAR Office of Education and Outreach, including Dr. Sandra Henderson, who will manage the project and assist in design and implementation of the workshop. Dr. Killeen and other selected science Co-Is on the project will participate in the educational effort by giving lectures to project participants and participating in other workshop activities.