

P1.23 RESEARCH EXPERIENCES FOR UNDERGRADUATES AT THE OKLAHOMA WEATHER CENTER: SUMMER 1998

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1. INTRODUCTION

The purpose of the National Science Foundation's REU program is to provide American undergraduate students with opportunities to conduct authentic scientific research under the supervision of professional research scientists. As students are exposed to research, field work, seminars, group discussions, and written projects, they get a better idea of what a research career represents (Cortinas et al. 1996). Many REU programs design their research activities to coincide with major field projects or laboratory experiments. Others may concentrate on the development of professional and personal development skills (Murphy and Martinez 1997). In addition, some institutions design their programs to meet the needs of minority students (May 1997) or other underrepresented groups in science and mathematics.

There are several sources of information regarding the design and development of REU site programs. The American Institute of Physics published an informative guide to planning undergraduate research programs at scientific institutions. The publication suggests that there are two models (low resource and high resource) for developing undergraduate research programs at any educational institution (Neuenschwander 1992). Other useful information regarding undergraduate research and mentorships can be found in a document published by the National Academy of Sciences (National Academy of Sciences 1997).

A small number of journal articles investigate student research opportunities in the atmospheric sciences. Students and faculty from the University of Nevada, Reno conducted research in conjunction with the National Center for Atmospheric Research using the Electra aircraft and on-board instrumentation (Hallett, Hudson, and Schanot 1990). Harold D. Orville and Nancy C. Knight describe the planning and administration of a 1989 REU program held at the South Dakota School of Mines and Technology,

featuring field activities associated with the North Dakota Thunderstorm Project (Orville and Knight 1992).

The State University of New York Colleges at Brockport and Oswego used a Research in Undergraduate Institutions (RUI) program to enhance undergraduate research opportunities related to winter storms. The program traced the paths of students who participated between 1988 and 1993, as a method of evaluating the program's impact on the participants (Byrd et al. 1994).

This paper will describe the 1998 Oklahoma Weather Center (OWC) REU program in terms of planning, development, student selection, program infrastructure, research, and student evaluations. A description of the Oklahoma Weather Center REU philosophy and administration methodology can be found in (Lewis and Maddox 1991; Cortinas et al. 1996).

2. HISTORY

The spirit of undergraduate research opportunities in Norman began at the National Severe Storms Laboratory (NSSL) in the mid-1980s. These opportunities were seen as a way to address several problems including: 1) increasing the number of young severe weather researchers, 2) providing research opportunities for domestic underrepresented groups, and 3) providing real-life research experiences for undergraduates. Under the leadership of Dr. Robert Maddox, NSSL sponsored a total of 17 undergraduate researchers in 1987, 1989, and 1990 (Lewis and Maddox 1991). To further propagate the NSSL program, William Beasley and John Lewis wrote a proposal to the National Science Foundation for the first Oklahoma Weather Center REU program. The proposal was funded for the summer of 1991. Since 1991, the Oklahoma Weather Center has hosted three more REU programs: 1992, 1995, and 1998. These four programs supported a total of 35 students from across the country.

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3. THE 1998 PROGRAM

3.1 Student Recruitment Efforts

Our recruiting efforts began in the fall of 1997. At that time, we had two primary goals in mind: 1) receive applications from quality students and 2) increase the number of applications received from underrepresented groups in science (Native Americans, Hispanic Americans, African Americans, and women). Program announcements were sent to all member universities of the University Corporation for Atmospheric Research, to all Native American Tribal Colleges and Universities, Hispanic Association and Universities (HACU), and Historically Black Colleges and Universities (HBCU). Program announcements were also posted on various internet newsgroups and on the OWC REU homepage.

In an effort to increase the number of applications from underrepresented groups in science, we conducted recruitment visits to the 19th Annual American Indian Science and Engineering Society (AISES) conference, submitted program announcements to AISES chapters in the U.S. southwest, visited Northern Arizona University, and Clark-Atlanta University. We placed a high priority upon recruiting Native American students for the following reasons: 1) the OWC REU has never received an application from a Native American student, 2) the OWC REU program is geographically located within "Indian Country", and 3) the principal investigator for this REU is a member of the Kiowa tribe, with many years experience working with Native American organizations.

3.2 Selection Criteria

We followed the same selection procedures as past OWC REU programs. To complete an application for the program, we asked for: 1) a copy of the applicant's college transcript(s), 2) two or three letters of recommendation from persons familiar with the applicant's academic background, 3) a 200 to 300 word essay describing how and why the research experience could benefit the applicant, and 4) a list of the applicant's extracurricular activities. We received over 100 quality applications from students with outstanding grade point averages and from outstanding science programs. The quality of these applications actually made the selection process more difficult. Nevertheless, our primary goal was to select a group of students who we believed could benefit most from the experience.

We targeted students who had just finished their junior or late sophomore semesters. In addition, we looked for students who had very little if any research

experience and had not participated in a previous undergraduate research program elsewhere. Next, we took into consideration whether or not an applicant's college or university provided undergraduate research opportunities. Finally, we closely examined the essays which helped the committee select those students who could benefit most from a research experience.

In 1998, we received a total of 109 applications, of which 94 were complete. Of the 94 complete applications 59 (63%) were from male students and 35 (37%) were from female students. Compared with figures from the 1995 OWC REU, the total number of female applicants increased by 10% in 1998. In terms of ethnic diversity, 3 applicants were Native American, 7 were African American, 2 were Pacific/Islander, and 1 was Hispanic American. This represents 14% of all applicants which applied and is a 4% increase over the 1995 OWC REU program. These statistics are encouraging as they show the number of applicants from underrepresented groups increasing over time. Of these applicants, we selected 10 students of whom 6 were male and 4 were female. One of our participants was of Native American descent.

3.3 Stipends

Each student received a base stipend of \$2,750, plus room and board. Stipend payments were distributed at the end May, June and July. The grant also paid for transportation to and from Norman. In terms of housing arrangements, students were paired according to gender and compatibility. To determine compatibility, we required each participant to fill out a short questionnaire regarding personal living habits, likes/dislikes, and study habits.

3.4 Lectures

Student participants attended two lectures per week over the course of the program. The lectures were broken up into two categories: 1) informative, and 2) scientific. Informative lectures included subjects such as an introduction to Weather Center organizations, lightning safety, the graduate school experience, and private sector research. The science lectures focused primarily on mesoscale meteorology, numerical weather prediction, meteorological instrumentation, and remote sensing.

3.5 Field Experiences

Students participated in several field projects hosted by the NSSL and CIMMS. The students chased supercell thunderstorms with the Sub-VORTEX field

project, three students gathered data for the MCS Electrification and Polarimetric Radar Studies project (MEApERS) while on board the NOAA P-3 Hurricane Hunter aircraft, one student gathered lightning data in the field, and one student constructed meteorological instrumentation towers and gathered data for the Oklahoma Atmospheric Surface-layer Instrumentation System experiment (OASIS98).

3.6 Student Research

Upon arrival, each student participant was assigned a working space, access to a PC, an e-mail account, and ID card which gave them access to NSSL and University of Oklahoma facilities. As an orientation to research, we conducted a presentation on the development of a research problem and proposal. Students were also introduced to the Environmental Computational Application System (ECAS) laboratory and attended two hands-on workshops on numerical modeling.

The participants conducted research on a broad range of topics in the areas of mesoscale meteorology, meteorological instrumentation, operational forecasting, and climatology. A list of the student's research projects are found in Table 1. The mentors supervised the progress of their students, but required them to struggle with their projects and come up with solutions on their own. Some of the students adapted well to this situation, while others felt like they needed additional guidance. A list of the students and their mentors are shown in Table 2.

At the conclusion of the program, students presented their research findings to members of the Oklahoma Weather Center scientific community. The presentation format we followed was similar to an American Meteorological Society (AMS) conference presentation session (12 minutes per speaker). Both the scientists and students felt that the final presentations were beneficial and the highlight of the entire program.

Table 1. Students and their research topics.

STUDENTS	RESEARCH TOPICS
Cacciola	Shortwave Troughs and Violent Tornadoes
Casto	Shortwave Troughs and Tornado Development
Decker	PV Anomalies and Flash Floods
Derby	MCSs and their Environments
Fuller	Moisture Surges and Monsoons
Gallina	CWA Database and Testing
Hannon	Lightning Strikes and Storm Structure
McAloon	Surface-layer Instrumentation
Rozoff	Hail Forecasting Schemes
Teabeault	Size, Spacing, and Predictability of Storms

A final research paper was required of each student at the conclusion of the program. These papers will be published along with the program's final report. These documents will be sent to each student participant, their mentors, the REU administrators, and the Division of Atmospheric Sciences at the National Science Foundation.

Table 2. Students and primary mentors

STUDENTS	SCHOOL	MENTOR
Cacciola	SUNY Alb. Jr.	Johns, SPC
Casto	Lyndon St., Jr.	Doswell, NSSL
Decker	Iowa State, So.	Shultz, NSSL
Derby	NC State, Jr.	Hane, NSSL
Fuller	Northland, Jr.	Stensrud, NSSL
Gallina	Valparaiso, Jr.	Johnson, NSSL
Hannon	OU, So.	MacGorman, NSSL
McAloon	Plymouth St, Jr.	Richardson, CIMMS
Rozoff	UW-Milw., Jr.	Brooks, NSSL
Teabeault	OU, Jr.	Droegemeier, CAPS

3.7 Student Evaluations

At the time this paper was being prepared, principals at the Oklahoma Weather Center were analyzing the final results of the 1998 program. In the final questionnaire, we asked the student participants to describe their overall REU experience (1 being poor and 5 being excellent). Overall, the students rated their 1998 REU experience as excellent. In the final tally, 8 of the students rated the program as a five, the other two students rated the program a four. Most felt that they had gained a great deal of knowledge about the research process and what it's like to be a research scientist.

Each student was asked if they planned on attending graduate school. On the first questionnaire, 8 said yes and 2 were unsure. On the final questionnaire, 8 said yes, 1 said no, and 1 remained unsure. The participants were also asked if they thought of themselves as potential research scientists. On the first questionnaire, 6 students said yes, 1 said no, and 3 were unsure. On the final questionnaire, 5 said yes, 1 said no, and 4 were unsure.

The only element of the program that clearly received poor reviews was the program's ground transportation policy. The students who did not have cars complained that they had a hard time getting around during the weekends. In addition, the lack of transportation restricted their freedom. The program did offer daily transportation to and from their work sites. However, the van was not available on the weekends.

Because of liability reasons and university policy, we could not provide the students with rental cars.

4. SUMMARY

Principals investigating the results of the Oklahoma Weather Center REU consider the 1998 program a success. We achieved our goal of increasing the number of applications from underrepresented groups in science, provided significant research projects for the 10 students, participated in exciting field operations, and conducted a successful final presentation program for all involved. Preliminary results suggest that the 1998 student participants learned a great deal about the research process and what it means to be a professional researcher. For some of the students, the experience re-verified their intentions of pursuing a graduate degree and becoming professional researchers. Others questioned whether or not they were cut out for such work. All of the lessons learned, during the summer of 1998, will help the participants examine various career options and decide for themselves whether or not a research career is in their future.

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