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THE NATIONAL TEACHER ENHANCEMENT PROGRAM (K-8)
COORDINATED BY THE OAK RIDGE NATIONAL LABORATORY

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**THE NATIONAL TEACHER ENHANCEMENT PROGRAM (K-8)
COORDINATED BY THE OAK RIDGE NATIONAL LABORATORY.**

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Abstract

Teachers need help, not harassment. So do the establishments in which teachers practice their profession. Community resources must be marshalled to provide help to local schools and teachers. In 1990 the National Science Foundation (NSF) established a unique educational activity named the National Teacher Enhancement Program (NTEP). NSF took advantage of the Department of Energy (DOE) sponsored educational programs and resources at several large DOE contractor labs that had had prior experience with DOE supported teacher enhancement programs. While DOE concentrated on teacher enhancement activities for secondary teachers, the NSF concentrated on teachers from grades K-8. The Oak Ridge National Laboratory (ORNL) is the lead organization for both administering and coordinating the grant. Other participating laboratories are Argonne National Laboratory (ANL), Fermi National Accelerator Laboratory (FERMI), Battelle-Pacific Northwest Laboratory (PNL), Lawrence Livermore Laboratory (LLNL) with some support functions provided by Brookhaven National Laboratory (BNL) and the Oak Ridge Associated Universities (ORAU). The program calls for a three week duration workshop to be conducted at each lab followed by in-service training and other activities during the year. The NSF/NTEP protocol calls for networking among the participating organizations and some of the teachers. An assessment effort is also an integral part of the program.

Educational Reform -- A Team Effort

A Time For Action

Our nation has recognized the pressing need for educational reform. We have also realized the urgency for taking actions that will improve our educational institutions and result in better educated students who become the voters, the work-force and the decision makers of tomorrow. Statistics clearly suggest how poorly our students rank internationally as regards illiteracy and innumeracy. Many papers have been written on

our national educational problems since the appearance of "A Nation at Risk" in 1983 [1]. We know the problems. The time for talking about the problem has passed; the time for action is now.

The U. S. Department of Energy report entitled *Math/Science Education Action Conference Report* [2] is an excellent example of an action-oriented plan to assist in educational reform. The Chairmen's (Glenn T. Seaborg and James D. Watkins) statement for the conference was, "We believe that strengthening mathematics and science education is not just the right course of action for the Nation - it is the only course." Other federal and private organizations have been active in educational reform and enhancement activities; an example of the latter is the Mathematical Sciences Education Board of the National Research Council.

National Education Goals

The United States now has specific national goals and objectives for education. These goals are:

□By the year 2000, all children in America will start school ready to learn.

□By the year 2000, the high school graduation rate will increase to at least 90 percent.

□By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency over challenging subject matter including English, mathematics, science, history, and geography, and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.

□By the year 2000, U. S. students will be first in the world in mathematics and science achievement.

□By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.

□By the year 2000, every school in America will be free of drugs and violence and

will offer a disciplined environment conducive to learning.

It should be abundantly clear that we must marshal all of our national resources, both public and private, if we are to achieve these national goals. We must also enlist the aid of individuals and organizations. We must use volunteers from the public and private sector, from the rapidly growing retirement community, and from professional societies. We must also use resources at institutions such as our national laboratories for these institutions are also the recipients (employers) of some of the products of our educational system. At the same time we must develop specific strategies and methodologies to tell us what we are now doing and what we must do to measure our progress in working to achieve these goals.

Basic Operating Philosophy

The basic philosophy underpinning the science education programs is action oriented. We use a 'hands-on' approach rather than the 'sit still and listen' approach. We believe in designing situations that challenge the student to think rather than to learn by repetition and memorization. Science is a process of asking questions and attempting to find answers. Science is not a process of learning all the answers to questions that may be asked. This is clearly an impossible task yet many schools treat science education in this manner. It should come as no surprise that the system is malfunctioning. If everyone contributes toward the attainment of these goals we increase the probability of success on a national basis. Innovation and change are necessary ingredients. We must be eclectic and clone the best existing models and programs. Doing more of what is currently being done will only exacerbate rather than improve the national situation.

Often, the product of inquiry, be it in advanced research or what a student does in the eighth grade, is additional questions needing answers. However, science teaching in our schools today often consists of asking students for answers without first teaching the students to be inquisitive and to give them the individual experiences to

learn the process of seeking answers. In many existing educational situations, it is the regurgitation of a specific answer or answers that seems to be of prime importance rather than the development of the inquiry process by which one can seek answers to questions.

At ORNL we use many of the available resources of a large multipurpose laboratory to assist in our science education activities. Whenever possible we use the best teachers "to teach teachers" and we develop situations in which students can engage in "hands-on" learning experiences. Involvement in learning is essential as indicated in the following Chinese proverb:

"Tell me and I hear.
Show me and I observe.
Involve me and I understand."

The project I will summarize in this paper is an example of one approach used at ORNL to apply our educational philosophy and our collective resources to the attainment of our national education goals. We realize much must be accomplished during the decade to attain our national goals.

Workshops and Follow-on Activities

The original goal of NTEP was to include 400 teachers in workshops during the three-year period. However, by supplementing the NTEP with funding from other sources many teachers participated in the workshops at the five participating laboratories during the first summer. Participants in the summer 1990 workshops totaled 278 teachers at the five locations across the country. Most teachers participated in workshops lasting three weeks. Others participated in several one week institutes at one laboratory. Collectively, the program involved a total of 572 participant-weeks at the five laboratories. College credit was offered to each teacher for their participation in the program. In some cases, state specific credit was also received. The workshops at each of the five participating laboratories stressed familiarization with science through hands on demonstrations.

Workshop-related academic-year follow-up and in-service activities were conducted or will be

completed in the spring of 1991. These programs emphasize the transfer and extension of the workshop experience gained by the teachers to other teachers through meeting presentations or demonstrations, and in-service training sessions. These post-workshop activities substantially multiply the number of teachers benefiting directly and indirectly from the workshops and their impact on the quality and content of science education.

Oak Ridge National Laboratory

I will use the ORNL experience as an example of the summer workshops. At ORNL the workshop theme was Materials Science. This seemingly broad topic allowed the introduction of subjects such as mathematics, chemistry, and physics. More importantly, the use of a broad theme introduced the teachers to the reality that science subjects taught in school are often combined in the real world and that they are often used as tools in a broad area of application. In other words, physics is not just for physicists, chemistry is not just for chemists and mathematics is not just for mathematicians.

Summary of Workshop Program

Workshop participants were all teachers in grades K-6 and administrators from school systems in East Tennessee. The total of 46 teachers and principals represented 25 different elementary, middle, and junior-high schools in 10 counties--Anderson, Hamilton, Jefferson, Knox, Loudon, McMinn, Morgan, Roane, Scott, and Sullivan. They were selected from among more than 100 applicants.

The selection process emphasized participation by teams of two to five teachers at different grade levels within individual schools or school systems. Where possible, each team included an administrator, coordinator, or central staff person. Preference was given to teachers who had not previously participated in federally sponsored teacher enhancement activities. Individual school systems in general were limited to one team. But supplementary funding by the U.S. Department of Energy (DOE) allowed the number of participants to be increased from the 35 provided under the NSF budget to the final total of 46. These additional places were allotted to a second team

each from the host school system, Oak Ridge; the Knox County Schools, specifically a newly adopted (by ORNL) Knoxville inner-city school, Vine Middle; and two systems, Roane County and Chattanooga City, who had just been selected as pilot school systems for Project SMART (Science and Mathematics Action for Revitalized Teaching).

Geographically, the schools from which participants were drawn extended, on the south, from Chattanooga on the state's border with Georgia; to rural communities to the north of Oak Ridge near the border with Kentucky; to Knox County, East Tennessee's largest metropolitan area; and to the Tri-Cities area (Bristol, Kingsport, and Johnson City) in Upper East Tennessee. This selection included a mix of rural and urban school systems as well as schools that serve predominantly disadvantaged and minority populations.

The workshop approach was based primarily on "teachers teaching teachers," with ORNL volunteer technical staff members and facilities as a special added resource for presentations and visitations to laboratory research facilities. The curriculum provided 22 half-day sessions in which "hands-on" approaches to materials-related topics were presented and demonstrated by selected East Tennessee and outside teacher resource persons. Another five (5) half-days were devoted to activities conducted by ORNL staff members. The context for these presentations was provided at the workshop opening, first, with an introduction and historical overview of the cultural role of humankind's innovations in materials developments from the earliest days of civilization and, second, with discussion of the State of Tennessee Curriculum Guide for elementary science instruction.

The first-year program was designed around two primary commitments by the teachers and their sponsoring school systems: 1) regular attendance at the three-week summer workshop, whose sessions were conducted at the Willow Brook Elementary School in Oak Ridge; and 2) six days of required follow-up and in-service activities by each participant during the 1990-91 academic year. This latter time was committed by school

superintendents and administrators as part of the application process. In early Fall 1990, each teacher submitted his or her plans for meeting this requirement through one or more of the following activities: presentations at regional meetings of the National Science Teachers Association and/or the annual meetings of the East Tennessee Education Association and Tennessee Science Teachers Association; in-service workshops conducted for fellow teachers in their own or other systems; a final follow-up session to be conducted by the workshop director in late Winter or early Spring.

For the "hands-on" workshop sessions, teachers were teamed in small groups (6-8 persons) that were organized variously both by individual school or system and by grade level. With each presentation, printed resource materials were provided for notebook-building. Sessions ran five days a week from 8:30 to 11:30 am and from 1 to 4 pm. The extended lunch period was designed specifically to encourage networking and exchange among participants.

At the beginning of the workshop, more than half the participating teachers were enrolled on-site for three hours of graduate-level credit offered by The University of Tennessee at a reduced (50 percent) tuition rate, based on the minimum 80 hours of instruction provided. Another three hours of credit will be available to registrants upon successful completion of scheduled academic-year follow-up and in-service activities.

Professional organization and leadership for the Oak Ridge program was provided by a Director and Co-Director whose services were obtained under Personal Services subcontracts with ORNL. The Workshop Director, Dr. Phyllis E. Huff, is Professor of Science Education in the Department of Curriculum and Instruction at The University of Tennessee, Knoxville. Her specialty is the elementary level. She brought to the assignment not only career-long experience in the academic preparation of many hundreds of teachers throughout the State of Tennessee but also special skills in leading prior teacher-enhancement and in-service programs as well as first-hand knowledge of many outstanding teacher resource persons. Co-Director Jane T.

Whitaker, Physical Sciences Instructor in the Lenoir City (Tennessee) Schools and current Vice President of the Science Association of Tennessee, is recognized both for her excellence in the classroom and as a leader in the development of innovative science-education approaches and materials, including co-authorship of a nationally distributed curriculum unit on High Temperature Superconductivity.

Willow Brook Elementary School in Oak Ridge provided two oversize classrooms and other supporting facilities at no cost as the host site for the workshop. The sessions were conducted daily over a three-week period, beginning June 13, and continuing through July 3. Besides the Workshop Director and Co-Director, the total of 37 presenters included: ORNL Director Alvin W. Trivelpiece, who gave the workshop "Commencement" address; Chester R. Richmond, Director of Science Education Programs and External Relations at ORNL; James O. Stiegler, Director of the ORNL Metals and Ceramics Division, who gave the opening scoping talk, including demonstrations) on "The Age of Materials"; fifteen ORNL research staff members who led sessions or tour groups at ORNL; and seventeen teacher resource persons, including one from out-of-state.

Major topics, elaborating the "Materials Science" theme, were as follows: What Is Matter/States of Matter, Natural Attraction (Gravity), Matter and Energy, Fun with Chemistry, Fun with Materials, Fun with Physics, Simple Machines, Energy, Energy Sources, Sound/Heat/Light, Electricity and Magnetism, Superconductivity, Scientific Myths and Misconceptions. Three half-day visits to ORNL gave participants a first-hand look at how research and development is conducted in materials-related areas. They were organized around the following topics: Solid State Science (Microelectronics, Surface Modification, Surface Analysis); High Temperature Materials (Ceramics Processing, Scanning and Transmission Electron Microscopes, Diamond Films); and Energy for the Future (Biomass, Fission, and Fusion).

Several examples of leveraging from the workshop can be cited. Eastport Elementary School in Knoxville's inner city has developed an

expanded science-education program that involves students at each grade level in regular weekly, team-taught, "hands-on" science experiences. ORNL was asked and has "adopted" a spot in their science laboratory. Eastport's Principal, the science chair, and three other teachers participated in the ORNL summer workshop. They credit that experience not only with a strong role in their preparations to establish the expanded science program but also with providing many specific ideas for the curriculum.

In addition to their professional presentations and workshops, program participants from both Chattanooga and Roane County contributed to a panel discussion and demonstration of materials from their summer experience as part of the initial ceremonies for the DOE supported Project SMART (Science and Mathematics Action for Revitalized Teaching) which took place November 15, 1990, at Harriman, Tennessee.

Planning is now in progress for the anticipated second-year program in Oak Ridge, tentatively scheduled for the same late June to early July time frame, during the summer of 1991.

Participant Demographics

The forty-six kindergarten through sixth-grade teachers and administrators representing twenty-five elementary, middle, and junior-high schools in ten East Tennessee counties represented a mix of schools that variously serve urban, predominantly rural, minority, and economically disadvantaged populations.

Teacher Distribution by Grade Level

K-2	16
3-4	11
5-6	15
Administrators	4

Sex

Female	33
Male	13

Ethnic Distribution

Black	9
Native American	1

Caucasian 36

Years of Teaching Experience

1-5	6
6-10	6
11-15	11
16-20	9
21-	14

Age

20-25	2
26-30	4
31-35	3
36-40	8
41-45	13
46-50	13
50-	3

Networking

The NSF/NTEP protocol calls for networking among the participating organizations and some of the teachers. One of the networking goals is to maintain contact with and provide information to program participants. Another is to enable the participating laboratories to efficiently share their program results and to assist them in reaching out to other organizations and agencies. Information obtained by sharing experiences developed at the laboratories, from local schools and successful educational programs

The networking component of the NTEP is comprised of five phases:

- General survey of existing systems and services
- Definition of local and inter-laboratory networks functions
- Review of summer teacher education programs
- First order implementation
- Teacher training program dissemination.

Task Related Strategies for Networking

Each phase contains specific tasks related to four strategies. These are communication, assessment, and dissemination strategies.

Resources Available for Networking

The networking activity will draw on existing resources to facilitate the dissemination of information. Examples of these include the following:

- **SCIENCE LINE** (National Teachers Association). A specific example within this source is the National Center for Earth Sciences, Electronic Exchange Network (ESEENET).

- **PSI-NET** ((National Computer Conferencing Network for Education). Started via NSF funding in 1983, PSI-NET includes science supervisors in all states, National Science Teachers Association, National Research Council, AAAS, Triangle Coalition, NASA, DOE and others.

- **Teacher Line BBS** Example of a school based bulletin board near BNL with more than 1000 registered users.

- **FrEDMail**. A network of school based bulletin boards.

- **NASA Spacelink**. Diverse menu includes class room materials.

- **FEDIX**. An on-line information service that links the higher education community and the federal government to facilitate research, education and services. Currently used by DOE, NASA and the Office of Naval Research as source of information about facilities, programs, equipment availability, etc.

- **Star Schools** (Technical Education Research Center). About 200 participating schools linked through Telenet.

- **NGS Kidsnet** (National Geographic Society)

- **National Science Resource Center** (Smithsonian Institution and the National Academy of Sciences).

- **LabNet Program** (Technical Education Research Center)

- **ERIC** (Department of Education). Educational Resources Information Clearinghouses and other materials.

- **DOE Supercomputing Center**. Available for use for students working with approved mentor.

planning between the NSF, DOE and a consortium of national laboratories. Both agencies are to be commended for their efforts. It is our goal to develop a successful teacher enhancement program that can be used as a model by other organizations at other locations. The successful components of our program will be amplified by teachers benefiting directly from participating in the program and those teachers who are in turn inspired and helped by the participating teachers. This leveraging effect can be a powerful multiplier to help us reach more teachers and students.

References

[1] A Nation At Risk: The Imperative for Educational Reform, National Commission on Excellence in Education, Washington, D. C., U. S. Government Printing Office, 1983

[2] Math/Science Education Action Conference Report, Department of Energy, National Technical Information Service, U. S. Department of Commerce, Springfield, 1990.

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Summary

The NSF/NTEP is a good example of a program that is the result of interagency cooperation and

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