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SUMMER RESEARCH INTERNSHIP PROGRAM (FY94)
BROOKHAVEN NATIONAL LABORATORY

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Abstract

The Summer Research Internship Program is a new program that allows high school teachers to participate and assist scientific staff at national laboratories in specific research assignments. This participation allows the high school teachers to become familiar with new technology and have "hands-on" experience with experiments and equipment which utilize both mathematics and science skills. Teachers also have the opportunity to advance their computer skills and use new and well-developed software. This enlightenment and experience is brought back into their schools and classrooms in the hopes that their peers and students will realize the excitement that knowledge and education in the areas of mathematics and science can bring.

The Safeguards, Safety & Nonproliferation Division of the Department of Advanced Technology at Brookhaven National Laboratory utilized five high school teachers during FY94 in various projects. The project assignments and internship activities are outlined in this paper.

Table of Contents

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Introduction -

All across the nation it appears more and more evident each day that there is a decline in interest in mathematics and science in our education system. Some of this decline may be due to lack of interest in school and excitement in the learning process reflected by both students and teachers. In the science-related fields, the ever-growing and ever-changing technology makes it difficult for high schools to remain current and knowledgeable about technological advances especially with the limited amount of funding that is available to each school district. In an effort to try and narrow this gap, the Department of Energy (DOE) has launched a program where high school science and mathematics teachers are afforded the opportunity to participate in active research programs at the DOE national laboratories, and thus, in turn, become acquainted with state-of-the-art science and technology. Through this program, it is hoped that what the high school teacher interns learn about the new technology can be brought back into the classrooms. Teachers who have the opportunity to participate in this program will be able to motivate students by their newly-found enthusiasm and knowledge. Furthermore, these teacher interns will learn how they can develop laboratories based on the experiments they have done through this program at BNL, and thus expose their students to projects that normally would not have been done. The experience of working at a national laboratory allows the teacher interns to make mathematics and science "real" to students.

The Safeguards, Safety & Nonproliferation (SSN) Division at Brookhaven National Laboratory (BNL) is one of ten Divisions within the Department of Advanced Technology (DAT). During the summer of 1994, the SSN Division participated in the Summer Research Internship Program. The project description of this program as initially outlined in the FY94 Project Lifecycle Plan was to provide high school teachers with the opportunity to refresh their understanding of science and to participate in current state-of-the-art research, with an emphasis on the technology developed under the verification, nonproliferation and environmental remediation areas, including hands-on experience with computers and other hardware. In addition, we were tasked with working with the high school teachers in order to incorporate new material and information into their current curriculum at school.

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Background -

The Safeguards, Safety & Nonproliferation Division carries out research, development, testing, evaluation, and analysis in the following technical areas:

- Nuclear materials safeguards and security systems;
- Arms control and international safeguards verification systems;
- Nonproliferation and arms control policy analysis;
- Safety policy analysis; and
- Proliferation detection and treaty compliance systems.

The DAT/SSN Summer Research Internship Program was coordinated in conjunction with the DOE Teacher Research Associates (TRAC) Program at BNL. The TRAC Program is open to both middle and high school teachers. Through the TRAC Program, our teacher interns were eligible to receive certain awards; such as the DOE TRAC Program Follow-On Activity (FOA) Award. The purpose of this award is to enable the teachers to pursue activities related to their intern experience and to encourage transfer of the knowledge and experience they have gained to their peers, associates, and students. All five of the SSN teacher interns received this FOA Award, ranging from $250.00 to $400.00. This Award money was utilized to help purchase graphic calculators, attend a math tournament, and develop a small spectroscopy lab, among other things.

Summary of FY94 Activities -

Five high school teacher interns participated in the internship program at BNL during FY94. The initial work descriptions for the teachers are listed below.

Two of the five teacher interns were requested by our division to be assigned to assist the International Safeguards & Technical Analysis Group of SSN. These projects were to include:

- Use of computer networks to facilitate IAEA communications;
- Extension of a recently-developed Agency resource planning program to include practical features of inspector travel scheduling, realistic costing, and more disaggregated reporting;
- The inclusion of semi-quantitative and qualitative factors in the analysis of new safeguards approaches;
- Development of simple models for two "advanced safeguards" ideas, one dealing with encrypted declarations and the other with tracking nuclear materials by whole country versus by facility;
- Preparation of background papers on special nuclear materials production in other countries; and
- Development of decision algorithms/methodology which might be used for calling IAEA special inspections.

These projects involved data collection, some computer program manipulation, understanding of both theoretical and practical aspects of planning, and generalized multivariate statistical analysis. Interns were required to have a mathematics and/or science background and familiarity with PC's (IBM or Macintosh).

Two other teacher interns were requested to work with SSN's Arms Control & Nonproliferation Group assisting in:

- Participation in the optical spectroscopy group whose goal is to develop a device for the remote detection of pollutants;
- Current effort centering on Ultraviolet Resonance Raman (UVRR) scattering as a technology for detection, identification and quantification of various pollutants regardless of the phase (i.e., gases, liquids or solids). Application of this technique involves a frequency-doubled, excimer laser-pumped dye laser system and state-of-the-art detection instrumentation; and
- Examination of the potential of photoacoustic spectroscopy (PAS) as a monitoring device for pollutant samples as well.

The interns' general assignment was to participate in the Resonance Raman remote chemical sensor project in the capacity of hardware development, data collection and interfacing instrumentation to Macintosh computers. In addition, the interns were expected to help with the design and optimization of the PAS project which involved optics, electronics, Fourier-Transform spectroscopy (FTS), and extensive computer interfacing.

The interns were required to have either experience or interest in Fourier-Transform Spectroscopy, optics, lasers, software and hardware development, computers and interfacing with computers, and mechanical drawing. Academic requirements were mathematics, physics, and chemistry.

A fifth teacher was to assist with a project within the Technical Support Organization Group of SSN. The project consisted of the further development, refinement, and demonstration of a device known as Special Nuclear Material (SNM) Source Simulator, which utilizes the Compton scattering of gamma rays, X-ray fluorescence, and selective absorption to generate gamma-ray energy distributions which are equivalent to those emitted by special nuclear materials (plutonium or high-enriched uranium). The device is intended to replace those sensitive materials at facilities in the DOE complex for purposes of calibration and testing of radiation detectors.

The intern was required to have a background in physics, mathematics, and some practical laboratory experience. The work consisted of designing and overseeing modifications to internal structures of the device, gamma-ray spectrum measurements and analysis, and demonstration of the modified device.

The selection process of the high school teachers involved reviewing resumes of suitable prospective teachers. Once these applicants were selected, verification of their availability was attained.

In late March, 1994, SSN received notification of the names of the five teachers that had been placed within the Division. This placement was as follows:

Walt Adamko	Mentor:	Walter Kane
Laura Fagan	Mentor:	Jonathan Sanborn
Madeline Schindel	Mentor:	Theodor Teichmann
Eric Cohen	Mentor:	Arthur Sedlacek
George Bartunek	Mentor:	Arthur Sedlacek

The teachers and advisors met formally on June 26, 1994, when a dinner was held at Brookhaven Lab. This dinner gave both teachers and advisors the opportunity to discuss expectations about the program. The teachers officially arrived on June 27 and began working on assigned projects.

During the first two weeks of the eight-week Teacher Intern program, the five teachers were given basic safety training, an orientation of the work that they would be involved in, and an overview of the work performed by this Division. Initially, and understandably, interaction between the mentors and teachers was daily. Over the course of their internship, however, the teachers felt more confident in their abilities and were able to work more independently.

The actual hands-on experience of the teacher interns throughout the entire eight-week period included, but was not limited to:

- Assistance in spectroscopic analysis using FT-Raman scattering of various chemicals;
- Experience with instrumentation evaluation and fundamental research to help build a spectroscopic database;
- Developing a database of scans of several different organic compounds;
- The use of Microsoft Excel software in order to input and analyze data on nuclear facilities onto a spreadsheet. This data would eventually be used in the PAIR program for estimating the inspection requirements of the IAEA; and
- Assistance in the design, modification, construction, and testing of a special nuclear material test source simulator which will be used in the calibration of portal monitors, SNM monitors, and radiation detectors that are used to comply with IAEA safeguards at Fast Critical Assembly Facilities.

Other BNL Activities -

Along with the high school teacher interns' daily work assignments, they also participated in safety training, site tours, and regular lunch-time and group discussions. These roundtable discussions enabled the teachers throughout the eight-week period to confer and consult with other teachers on-site who were also assisting with projects at BNL. Discussions included what possible applications this summer internship would bring to their classrooms. This activity helped the

teacher interns to foster a sense of sharing and camaraderie that they admitted does not happen very often within the teaching environment. The teacher interns were also required to produce and present reports at the end of the program based on the research that they assisted with.

Conclusion -

The high school teacher interns departed on August 19, 1994. At the request of the SSN Division Head, a questionnaire was developed for this program (Attachment 1). Each teacher was asked several questions regarding their experiences here at Brookhaven Lab. All questionnaires were completed and turned in before their departure. Based on the answers to that questionnaire, all of the teacher interns seemed very pleased with their participation in the program. The interns stated that they would welcome another opportunity to participate in this program again. The teachers also expressed interest in getting involved in even more of our scientific projects and especially enjoyed the opportunity to have "hands-on" experience.

This program proved to be very worthwhile. The teachers expressed that there were many rewards that they attained through their participation in this internship program. In addition, the teacher interns gained college credits towards a Masters degree. It was also very important to them that they were able to learn new technology. This fostered enthusiasm in the teachers, which in turn meant the ability to motivate their students. The teachers' own science and mathematics awareness was broadened so that they were able to do projects in their classrooms that they normally would not have done. The confidence level of these high school teacher interns was built up through their hands-on experience with computers and new software. After having to absorb so much new material in such a short amount of time, some teachers felt that they would be more sympathetic to their students since the teachers themselves had been in the same situation during their first weeks here at BNL.

Finally, those teachers who participated in the Summer Research Internship Program at BNL were able to make mathematics and science "real" to their students so that the students could see the applicability and viability of knowledge in these subjects to actual daily life activities and future careers.

Attachment 1

SUMMER TEACHER INTERNSHIP PROGRAM

QUESTIONNAIRE FOR

SAFEGUARDS, SAFETY & NONPROLIFERATION DIVISION
DEPARTMENT OF ADVANCED TECHNOLOGY
BROOKHAVEN NATIONAL LABORATORY

Name: _____
(First) (Middle) (Last)

Date: _____

1. Please give a detailed description of the project you assisted in this summer:

2. Your research mentor(s) was: _____

3. Contact with your mentor(s) was maintained:

Daily ___ Weekly ___ Little Contact ___

Explain _____

4. How would you rate the interaction and communication between you and your mentor? Explain.

Very Good ___ Good ___ Moderate ___ Not Good ___

5. How much direction did you receive and/or require from your mentor? Explain.

A Great Deal ___ Initially a lot ___ Little ___ None ___

6. All told, do you feel that your program participation will contribute to your effectiveness as a teacher in the areas of science and/or mathematics? If yes, explain.

Yes ___ No ___

7. Were you able to observe scientific research or have "hands-on" experience? Explain.

Yes ___ No ___

8. How would you rate your overall experience with this program? Explain.

Very Good ___ Good ___ Moderate ___ Not Good ___

9. Major strengths of the program were:

10. Major weaknesses of the program were:

11. Would you participate in the program again? Explain.

Yes ___ No ___

12. Additional Comments: