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ABSTRACT

This program was initiated because of the failure of secondary schools to inform their students adequately about contemporary scientific career opportunities and to establish criteria for determining whether or not a scientific career is suitable for a student's interests and capacity. The purpose of the program is: (a) to provide an opportunity for high school teachers to improve their awareness of current areas of scientific interests, problems, methods, and technology, and (b) to help the teacher interest and guide qualified students into appropriate scientific careers. The means to accomplish this involved selected high school science teachers in laboratory research programs during an 8-week period. Highlighting the project were lectures, discussions, tours by scientists working in various fields, and direct in-depth involvement of each participant in an on-going research project. Described in this paper are the planning of the program, the selection of the participants, the proceedings themselves, and the program evaluation. (JA)

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A SUMMER RESEARCH INSTITUTE FOR HIGH SCHOOL SCIENCE TEACHERS*

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INTRODUCTION

Many of our secondary schools today are failing to inform their students adequately about contemporary scientific career opportunities and to establish criteria for determining whether or not a scientific career is suitable for the students' interests and capabilities. This problem is particularly acute in urban or otherwise culturally disadvantaged areas, where attitudes and goals are too often shaped by misguided peer-group or family pressures. Also, teachers and counselors are often poorly informed as to present opportunities and therefore frequently find it difficult to recognize or direct a qualified student toward an appropriate program. Instead, such students are often told that science is "too hard" and are discouraged in favor of a vocational program.

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To deal with these challenges, a research institute was conducted at the Lawrence Livermore Laboratory during the summer of 1971. Specifically, the intent of this program was

1) to provide an opportunity for high school science teachers to improve their awareness of current areas of scientific interests, problems, methods, and technology, and

2) to help the teacher interest and guide qualified students into appropriate scientific or technical careers.

This was to be accomplished by involving selected high school science teachers in laboratory research programs during an 8-week period. The two major aspects of the program were

1) a broad overview of contemporary research projects through expository lectures, discussions, and tours by scientists working in those specific fields; and

2) direct in-depth involvement of each participant in an ongoing research project, selected to best match the participant's field of training or interest.

The thrust of this program focused on those schools or school districts with high student populations from racial minority, urban, or otherwise culturally disadvantaged groups.

PLANNING

The institute was operated as a pilot program, with eight participants selected from areas within commuting distance (up to 50 miles) from the Laboratory. The program schedule and timing were adapted from the standard National Science Foundation format of 8 weeks during the early part of summer, with a modest stipend and 12 quarter units of University of California extension credit.

Approximately 35 1-hour talks were to be scheduled by various Laboratory volunteers. Speakers were selected to give expository presentations on topics in which they were directly involved. Special emphasis was placed on topics representing new and expanding fields that appear to offer promise of future career opportunities for students now in high school.

Early contacts of prospective research supervisors at the Laboratory turned up an abundance of positions in various research projects. The Laboratory supervisors were told of the aims of the institute and were made aware that adequate supervision was essential and that adequate thought would have to be given to the participants' roles in the projects.

Supervisors who passed screening at the Laboratory were given a memo delineating the terms of the agreement and were asked to detail the assignments for the teachers. Written assignments helped supervisors organize their thoughts on working effectively with participants. Each assignment was condensed and included in the application prospectus.

SELECTION OF PARTICIPANTS

"Application packages," including a letter describing the program, a list of speakers and topics, and a list of possible assignments, were prepared for teachers interested in the program.

We contacted science supervisors in several high school districts in the San Francisco Bay Area; we usually arranged to interview prospective applicants in groups, and we distributed the applications during the group interviews. These screening interviews were vital to both the potential applicants and ourselves and should be considered necessary for similar programs.

The eight applicants were accepted from the fields of Physics, Chemistry, Biology and Earth Science, and each was asked to select his preferred research assignment from the prospectus. Concurrently, Laboratory supervisors evaluated the applicants personnel files and stated their preferences. With an excess of research openings, almost all applicants were placed in either their first or second choices.

These research programs (and the fields of the respective participants) were as follows:

1) Development of a quantitative method for measuring the weight of neutral lipids (Biology).

2) Uptake and organification of tritium in plants (Biology).

3) Measurement of biological availability of radionuclides in various laboratory animals (Biology).

4) Computer coding for operating the Cyclograaff charged-particle accelerator (Chemistry).

5) Computer coding related to the electron linear accelerator operation and experimental program (Physics).

6) Development of numerical methods for analyzing the Superconducting Levitron, a controlled thermonuclear reaction device (Physics).

7) Neutron flux mapping in the core of the research reactor (Earth Science).

8) Trace element detection in air pollution samples by activation analysis (Chemistry).

PROCEEDINGS

We arranged to meet every morning in a small conference room. To give continuity to these seminars, one of us acting as the convener (usually D. H. White) was always present.

By developing an informal dialog early in the session, we usually found it possible to get formal speeches redirected into discussions, with the participants following the lead of the convener in frequent dialog with the speaker. We also discouraged requests from other Laboratory scientists or summer visitors to sit in on these lectures, feeling that the speaker might be tempted to raise the level of his presentation to the most advanced portion of the audience. (Tours of relevant facilities were included when appropriate.)

Topics were ordered to provide participants with necessary tools as early as possible. The timetable, and priority, was as follows: basic information on nuclear radiation and its detection, environmental safety, computations and computer facilities, other technical topics, final perspective, and career opportunities. The topics themselves were as follows:

1) Nuclear Science—Since most research at the Laboratory is connected in some way with nuclear science, we believed it to be appropriate to acquaint the teachers with this field as soon as possible. This was done with two 1-hour lectures on nuclear radiation and detection methods.

2) Safety—Three presentations on Environmental Safety and Industrial Hygiene were given in the context of problems that teachers may be exposed to in their work at the Laboratory as well as in their school environments.

3) Computations—We believed that, since the computer is of major importance in modern research, most of the participants would be involved in some computer work. The second week was therefore devoted solely to computations studies. The objectives of the program were for the participants to learn to use the time-sharing system, to tour the computer facilities, and to learn about programming languages, input/output devices, and computer graphics. A talk on careers in computations concluded this survey. Concurrently, the participants received several lessons in FORTRAN coding.

4) Physical Sciences—After the third week, we covered various topics of current interest, such as x-ray astronomy, solar-produced electron currents, heavy elements, lasers, and superfluids.

5) Environmental Research—Talks during the fourth week were on particulates, detection of trace elements, meteorological modeling, etc.

6) Bio-Medical Studies—This 1-week series covered topics such as the genetic code, metabolic pathways, and protein synthesis.

7) Particle Physics—Several talks were given on particle accelerators, some with appropriate tours of the Linear Accelerator, Cyclograaff, etc.

8) Applications of Nuclear Energy—Two sessions were devoted to controlled thermonuclear research. One session was devoted to various applied uses of underground nuclear explosives.

Several all day tours were also taken to various Bay Area science research and science education centers, primarily at the University of California at Berkeley.

During the fourth and fifth weeks, each participant gave a preliminary oral report to the group, to describe the project he was working on. Each person, therefore, had to investigate the background of his research project. The participants gave final oral reports to the group during the last 2 weeks, to describe the results of the summer research project.

On the final day of the program, a talk was given on career opportunities.

An evaluation request was given each participant to write up and return later, and an evaluation request was also sent to each supervisor.

EVALUATION

The value of this program must be determined in the context of its long-range purposes. Since such a value cannot be measured directly, we must base our judgment on opinions of the participants, the supervisors, and others directly involved. In terms of the first goal of the program, an awareness of current science research, the evidence appears to support the conclusion that the program was an outstanding success. Participants felt from the start that this program was a real plum, with stipend, course credits, and exposure to top-level speakers and research. They all expressed having new insights into the nature of research, and wished they had more time with their research groups. They also felt that the ideas, perspective, and enthusiasm developed during the summer institute would carry over into their subsequent classroom work.

The supervisors generally felt the program to be satisfying to both themselves and the participants, although many put in considerable time in supervision and often felt that time still to be inadequate. The direct benefit to the various research programs was initially low, although the supervisors generally felt that by the end of the program the participants had reached a point of positive production and were satisfied with their work.

In spite of the wide variation in age, field, and experience, the group developed considerable esprit de corps, as evidenced, for example, by their frequent voluntary meeting at the cafeteria for lunch.

The speakers for the most part enjoyed speaking on their research activities and generally appreciated the informal setting. Participants relished hearing about research subjects by speakers who were directly involved. Successful speakers were generally characterized by their enthusiasm rather than their subject matter.

Finally, and perhaps most important, it became evident that the participants should be selected on the basis of their attitude and interest, rather than their "qualifications." The least experienced participants were often the ones who worked hardest and who probably benefited most from the program.

In terms of the second goal, to better counsel qualified students, an evaluation is somewhat premature. However, several factors indicate success here too. During the school year following the program, participants brought classes to the Laboratory, they asked speakers from the Laboratory to give talks at high schools, and they referred several students to the Laboratory as summer employees. It is hoped that these examples are characteristic of a broader outreach between the science research community and the high school system, and that this program may become a model upon which future research institutes can be based.

FIGURE CAPTION

Dr. Eugene Goldberg describes the construction and operation of the newly installed Cyclograaff proton accelerator at the Lawrence Livermore Laboratory.