# LINCOLN ADVANCED SCIENCE AND ENGINEERING REINFORCEMENT (LASER) PROGRAM

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## ABSTRACT

Lincoln University, under the Lincoln Advanced Science and Engineering Reinforcement (LASER) Program, has identified and successfully recruited over 100 students for majors in technical fields. To date over 70% of these students have completed or will complete technical degrees in engineering, physics, chemistry, and computer science. Of those completing the undergraduate degree, over 40% have gone on to graduate and professional schools.

This success is attributable to well-planned approaches to student recruitment, training, personal motivation, retention, and program staff. Very closely coupled to the above factors is a focus designed to achieve excellence in program services and student performance.

Future contributions by the LASER Program to the pool of technical minority graduates will have a significant impact. This is already evident from the success of the students that began the first year of the program. With program plans to refine many of the already successful techniques, follow-on activities are expected to make even greater contributions to the availability of technically trained minorities. For example, undergraduate research exposure, broadened summer and co-op work experiences will be enhanced.

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## Introduction

LASER is a program sponsored by the National Aeronautics and Space Administration (NASA), Office of Naval Research (ONR), and the Department of Education (DOE) to explicitly encourage minority students to pursue engineering and science studies. The program was established in 1980 by NASA and Lincoln University as a joint effort to increase the number of students entering careers in engineering. Since then, the program has been expanded to include Physics, Mathematics, Computer Science and Chemistry majors. Lincoln was chosen as the site for the program because of its long history of providing students with the preparation skills needed to succeed in science and engineering careers. The program consists of summer and academic year components in an overall effort to prepare talented students for a course of study leading to a B.S. degree in Chemistry, Physics, Biology, Mathematics, or Computer Science or a dual degree: a bachelor of science in engineering and a bachelor of arts in liberal arts. Students are annually recruited nationwide to fill the twenty slots available.

The summer program provides the opportunity for participating students to begin their early course of study in an environment that has support services for success. Class sizes are small to provide the opportunity for students to work closely with instructors. In addition, special math, writing, and reading labs are maintained to provide additional help as needed. Each student is assigned a faculty advisor and counselor to offer academic and career guidance.

The program also provides the opportunity to work and interact with engineers and scientists. In subsequent summers, NASA, ONR, and other agencies provide employment with an opportunity to gain first hand knowledge of the careers in science and engineering.

LASER participants receive financial support to cover the cost of normal college expenses such as room and board as well as tuition for the summer program. In addition, the student receives a stipend to help cover his or her personal expenses.

The remainder of the paper provides a detailed discussion of the program components and review of the program's successes.

## Philosophy

The LASER Program is a quest for excellence! In these times of diminishing quality and expectations, the LASER Program still stands for excellence and the best one can be. Like its acronym, the LASER Program is a very narrowly focused project aimed at producing an excellent and outstanding group of young men and women for careers in science and engineering. It is no accident that the expectations are so high. Each student is hand-picked based on high school performance, academic potential, natural ability, drive and motivation. Each student selected becomes a member of a select group that will make a major contribution to the world of engineering and related fields. From the very

outset the founders of the LASER Program designed a concept of excellence in every aspect of the program and conveyed it to the students accepted into the program.

Students are expected to achieve their highest potential. No second rate work or efforts are tolerated. Everyone must strive to be the very best he or she can as a student, as a person, as a human being. Nothing less than each student's individual best effort is ever accepted. The student's foremost concern must be achieving good grades in all course work. A "C" grade is not satisfactory, only "A" and "B" are grades worthy of a LASER student.

Students serve as role models of excellence in math and science and throughout the entire university. The LASER student is with few exceptions the best in all his or her classes and extra-curricular activities. He or she is a leader, setting goals and standards to be met by all.

Achievement and success in the LASER Program represent the collective efforts of LASER students, parents, staff, the Director and other university officials, all striving for excellence. In fact, excellence in LASER can only come as a result of this collective effort. The achievement of excellence is the single most important goal that runs throughout the LASER Program. All activities, tasks and specific objectives are set up to help achieve this excellence.

**Program Objectives**

*Objective 1:* To seek out and identify future minority scientists and engineers to meet the future requirements of our technical society.

The hallmark of LASER over the years has been an ability to understand the needs of students and, through the application of special aid and support, money, and technical skill, devise means to assist these young men and women to become successful. However, if one does not have an understanding of the student needs, no amount of money or technical skill will result in successful students.

A good understanding of the student requirements does not just happen. It takes hard work and a thorough understanding of the students themselves. One must deal actively and prudently with the environment that the students come from, as well as the environment that students find themselves in while attending the program. One must insure that the student involvement with the local environment is controlled and does not become counter productive for overall program goals.

*Objective 2:* To help LASER students achieve success by providing opportunities for advancement based on their academic performance, recognizing their individual achievements, and insuring the personal satisfaction that comes from a sense of accomplishment in their work.

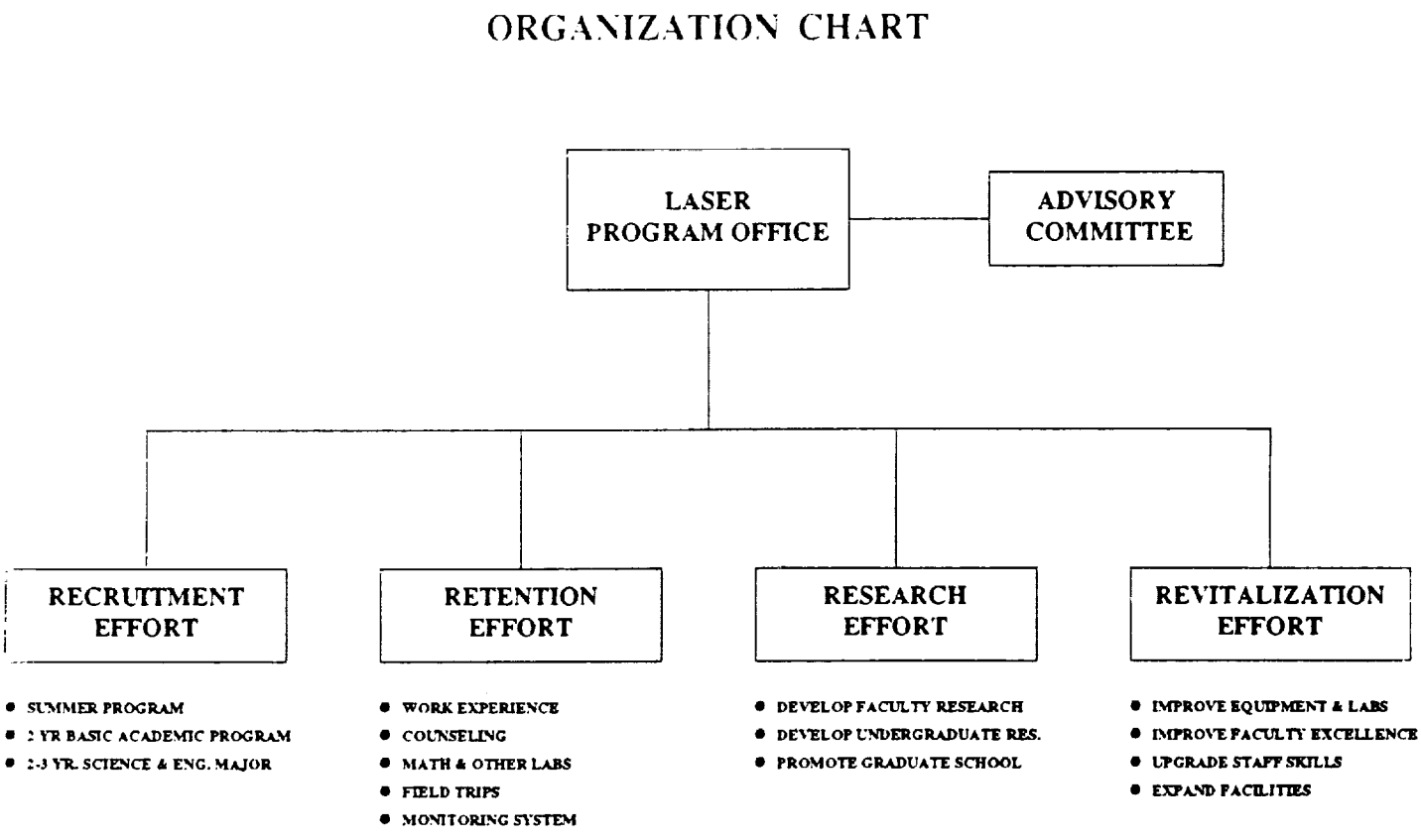
One can take pride in the students and people in the LASER Program, their performance, and their attitude toward their jobs and toward the program. The LASER Program has been built around these individuals, the personal dignity of each, and the recognition of personal achievements.

The general policies and attitudes of the staff toward students and the people that work with them are more important than any specific person. Staff and student relationships will be good only if people have faith in the motives and integrity of their supervisors and the program management. On the other hand, relations will be poor if they do not.

## Administrative Overview

### Organization

The LASER Program is organized into four major efforts. The first of these involves the identification, recruitment, and training of minority students for careers in science and engineering. The second and equally important component of these efforts is the student reinforcement and retention activities. After careful analysis,the focus here is to provide the all important support system each student requires to be successful. This represents the bulk of the effort to date. The third component is the introduction of research and development experiences as well as exposure to national facilities like NASA, Fermi Lab, Stanford Accelerator Lab, Bell Labs, etc.The final component of the program tries to address the required facilities and equipment needed to maintain current, and when possible state-of-the-art, experience and exposure to emerging science and engineering concepts.



**Participants**

Students are recruited nationwide for the program. However, major efforts are concentrated within a radius of about 150 miles beyond the campus. Such areas as Baltimore, Philadelphia, New York, and Washington are target cities. The number of participants sought range form 12 up to 20, depending on the amount of available funding during a given year. The number 12 is regarded as the minimum number to be cost effective. Table 1 below summarizes the results for the past several years.

**TABLE 1**

| | 1981-82 Group I | 1982-83 Group II | 1983-84 Group III | 1984-85 Group IV | 1985-86 Group V | 1986-87 Group VI | 1987-88 Group VII | 1988-89 Group VIII | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | # | # | # | # | # | # | # | # | # |
| MALE | 12 | 13 | 5 | 12 | 10 | 5 | 9 | 5 | 71 |
| FEMALE | 8 | 1 | 4 | 7 | 6 | 3 | 6 | 9 | 44 |
| TOTAL: | 20 | 14 | 9 | 19 | 16 | 8 | 15 | 14 | 115 |

**Recruitment**

The multi-approach is used in recruiting students for the program. The approach utilizes science faculty, admission personnel, high school counselors, science and math teachers, alumni and the media.

Extensive use is also made of mailings to alumni, high schools, and other groups. During the Fall term, letters and materials are sent to all known alumni on the East Coast. The mailing describes the program and requests their support in identifying potential candidates. During the same time high school science and math teachers are also mailed similar materials seeking their help in recommending students for the program.

Limited media exposure is provided for the program on a few local radio stations and in several newspapers. Occasionally, the program is able to receive TV coverage on one of the local community service programs.

### Participant Selection

Each potential participant is required to complete both a program and university application, provide three (3) letters of recommendation, a high school transcript, and SAT scores.

Upon receipt of the LASER application and materials, the student is invited for an on-campus interview. The main purpose of the interview is to allow for a close review and evaluation of the student's abilities, academic potential, strengths and weaknesses. A team of 3 to 5 people spend from 45 to 90 minutes talking with each student. From the interview each student is rated on six items that are considered important to the student's success in the program.

Following the interview, students are required to complete the math placement test. This is an ETS test designed to evaluate the student's skills in algebra and pre-calculus. Based on their performance, students are placed in one of several math courses: algebra, pre-calculus or calculus. Normally, only those students testing into calculus are considered for the program. However, the final decision on selection is made by the director only after careful review of all the information available on a given student. Generally, with the exception of math background, no single item is the sole basis for selection.

### Faculty and Staff

The pertinent program staff consists of a director, secretary, and an advisory committee. In addition, one or more assistants to the director, counselors, parents, course instructors, student tutors, and resident advisors are utilized during the course of the program.

### Curriculum

The curriculum for this program is based on very specific requirements needed to complete technical programs in science and engineering. Most of these requirements have been worked out with participating science departments and engineering schools. The actual courses are in our science and pre-engineering curriculum.

The academic phase of the initial year of the program begins in the summer. During this period, students complete first year pre-engineering requirements in mathematics (calculus) and physics, as well as a survey course in engineering sciences taught by the project director and other engineers and scientists. At the conclusion of this summer trimester, students have earned approximately 18 credit hours. These students continue their studies in the fall.

## Student Outcomes

The overall goal of the LASER program is to improve students' interest in and ability to pursue a technically-oriented education that leads to a career (or at least a degree) in engineering or a related science field. Thus, the entire program has been designed and implemented to achieve that end. The significant accomplishments of the project are summarized under the headings listed below and in Table 2.

**Undergraduate Degrees Awarded**

The most significant results of this project is the number of technical graduates. The program has had 34 students complete degree programs. Of this total, over 70% completed degrees in one of several technical areas. Expected graduates for the 1988-89 academic year will include 8 physics majors, 8 chemistry majors, and 1 electrical engineer.

## TABLE 2
## LASER PARTICIPANTS STATUS (RETENTION/TRANSFERS/GRADUATION)

| | | Number of Students Retained With Years Since Entry | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | # | 1 | 2 | 3 | 4 | 5 | 6 | Trans | Eng | Tech | Non | Grad |
| 1981-82 | 20 | 20 (110%) | 17 (85%) | 9 (45%) | 6 (30%) | 1 (5%) | 0 | 6 (30%) | 5 (25%) | 14 (70%) | 3 (15%) | 5 (25%) |
| 1982-83 | 14 | 10 (71%) | 5 (36%) | 5 (36%) | 4 (29%) | 1 (7%) | 0 | 5 (36%) | 4 (29%) | 8 (57%) | 1 (7%) | 2 (14%) |
| 1983-84 | 9 | 9 (100%) | 8 (89%) | 6 (67%) | 4 (44%) | 3 (33%) | 0 | 1 (11%) | 1 (11%) | 7 (78%) | 0 | 0 |
| 1984-85 | 19 | 18 (95%) | 18 (95%) | 18 (95%) | 10 (53%) | 5 (26%) | | 3 (16%) | 2 (11%) | 14 (74%) | 0 | 6 (32%) |
| 1985-86 | 16 | 16 (100%) | 14 (88%) | 11 (69%) | 8 (50%) | | 6 (30%) | 4 (25%) | 5 (31%) | 1 (6%) | 0 | |
| 1986-87 | 8 | 8 (100%) | 8 (100%) | 7 (88%) | | | | | | | | |
| 1987-88 | 17 | 16 (94%) | 16 (94%) | | | | | | | | | |
| 1988-89 | 15 | 14 (93%) | | | | | | | | | | |

Trans represents the # of students that have transfered. Eng represents the # of students that are Engineering graduates or persisting. Tech represents the # of students that are Technical graduates or persisting. Non represents the # of students that are Non-technical graduates or persisting. Grad represents the # of students that are in graduate school.

The LASER concept is successfully adding to the number of minorities completing undergraduate degrees in science and engineering. By the close of the 1988-89 academic year, the program expects to have graduated 13 B.S. engineers; 28 B.S. physicists; 6 B.S. chemists and 8 M.S. level scientists and engineers.

**Graduate and Professional Programs**

Equally impressive has been the project's success in encouraging students to seek advanced degrees in a wide variety of areas. A total of 14 students have enrolled in some type of advanced studies. Of this total, 80% are completing degrees in one of several technical areas that include engineering, physics, and chemistry, or non-technical areas such as psychology.

During 1988, three (3) students were selected as recipients of national fellowships from the Office of Naval Research and Oakridge Associates. Yvette Bell and Octavia Blount received ONR Fellowships that year, while Lori Thomas and Yvette Bell received Oakridge Fellowships.

**Participants**

The program has over 40 participants this academic year. Ten (10) of these participants are currently completing degrees at other colleges. Eight (8) of the ten students are pursuing degrees in engineering. In addition to the above students, a large number of students will be completing their studies at Lincoln. Over 80% of the students are pursuing technical degree programs.