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ABSTRACT

This report discusses the development of the Science Careers Program (SCP), describes the final product, presents the results of an evaluation study of the program, and discusses plans for dissemination. SCP is aimed at increasing the career relevance of science education for all students in grades 4-9, while at the same time particularly encouraging female and minority students to consider careers in science and engineering. Materials developed for classroom use include a series of posters of "typical" scientists, a number of transparencies, and a series of student activities, worksheets, and puzzles. Additional resource materials developed for the teacher include a "dictionary" of science and engineering fields, an annotated bibliography of science careers materials, a compendium of information about famous women and minority scientists, and data about the current status of women and minorities in the labor force. The program (tried out in several hundred classrooms during the 1982-83 school year) was extremely well received by the participating teachers in terms of their ratings of the 12 classroom activities and the effectiveness of the program's in-service component. In addition, the posters of scientists were used effectively with junior high school, senior high school, and college students. (JN)

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DEVELOPMENT AND EVALUATION OF THE SCIENCE CAREERS PROGRAM

Final Report

Iris R. Weiss

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I. INTRODUCTION

Early adolescence has been identified as a key period in the education of students in mathematics and science. Students who find science and mathematics instruction boring or irrelevant in their junior high school years tend not to continue in these subjects as soon as they are given the choice, typically in early high school. As a result, many students are not obtaining the knowledge and skills necessary for functioning in a technological society, and they are closing off many of their career options without realizing that they are doing so. The situation is most serious in the case of women and minorities, where the numbers pursuing training in science and mathematics are very small compared to white males.

In recent years there have been a number of attempts to increase the participation of women and minorities in science and technology careers. These have involved a diversity of types of interventions, including workshops, special courses, visits to schools, and the distribution of various printed materials and media products. The target audiences have ranged from elementary school children to graduate students, parents, and teachers; and the program sponsors have included a variety of private companies, colleges and universities, and federal agencies. For example, films about women in science have been produced by Bell Telephone, the Massachusetts Institute of Technology, Sandia Laboratories and the Mills College WEEAP project; and a slide-tape presentation prepared under an NSF g[redacted]is being distributed by the National Science Teachers Association. Among the many special pamphlets which have been distributed are the American College Testing Program's "Women in Science and Technology," the American Chemical Society's "Careers in Chemistry--Opportunities for Minorities," and the Harvard University Center for Astrophysics' "Space for Women." Science career workshops for women and minority students have been conducted at a large number of colleges and universities, and many of these have also offered special remedial and/or enrichment courses in science and mathematics for women and minority students. A number of other programs have had scientists visit schools to give students an opportunity to see and interact with appropriate role models. These include NSF's Visiting Women Scientists Program, a program sponsored by the Pennsylvania Department of Education, and one coordinated by the Lawrence Hall of Science at the University of California, Berkeley.

To date, most efforts have focused on high school and college students. However, there is a growing feeling that earlier intervention is necessary. While many students will not make definite career decisions prior to college, a number of the influencing factors (such as role stereotyping) which limit access to science careers will have had their effects well before that time.

The purpose of the Science Careers Program is to increase the career relevance of science education for all students in grades 4-9 while at the same time particularly encouraging female and minority students to consider careers in science and engineering. The project focuses on: (1) helping teachers to become knowledgeable about science career opportunities; (2) fostering the idea that teachers should encourage female and minority students to consider these careers; and (3) providing activities for use in the classroom, including a number of materials to show students that the "white male in lab coat" 'mad scientist'" stereotype of a scientist is inaccurate.

The activities developed for use in the classroom are designed to be appropriate for both males and females and for students of all race and ethnic backgrounds. This has a number of major advantages: (1) teachers can plan to use the activities with the entire class rather than with special instructional groups; (2) all students will learn that science careers are appropriate pursuits for women and minority students as well as for white males; and (3) the same materials and activities attend to career relevance goals for all students and career access goals for special populations, thus reducing the burden on teachers and providing increased cost effectiveness.

This report discusses the development of the Science Careers Program, describes the final product, presents the results of an evaluation study of the program, and discusses plans for dissemination.

II. DEVELOPMENT OF THE SCIENCE CAREERS PROGRAM

The Science Careers Program was developed in two phases. During Phase I, a draft of the program was developed and tested in the field with a small group of teachers. The results of the field trials were promising, and led RTI to propose to NSF that further development work be undertaken. The purpose of Phase II would be to complete the development of the Science Careers Program, including revising Phase I materials, developing additional materials, carrying out a summative evaluation of the program, and documenting and disseminating the results.

The Phase I budget did not allow computer analysis of the student field trial pretests and posttests. An initial activity of Phase II was to create a computer file of student pretest and posttest data and to analyze these data by sex and race, and by teacher. These results, along with the teacher test results and subjective evaluations by the field trial teachers and RTI staff, were used to modify the program objectives. The student results were also analyzed to help in revising the tests themselves, for example, in showing which items needed to be eliminated because they were answered correctly by most students on the pretest.

Once the final program objectives had been specified, RTI worked with a small group of teachers in revising those Phase I materials that had been problematical or ineffective, developing new materials, and field testing both the revised and the newly developed materials. Formative evaluations were conducted on a continuous basis and the results used to make the activities both easier to use and more effective.

The slide presentation developed in Phase I had deliberately been accompanied by a written script rather than by an audiotape. The intent had been to eliminate the unnecessary costs associated with professional recording of a script that would almost certainly need revision. During Phase II the slide presentation was revised, tried out, and then put in final form: a filmstrip accompanied by an audiocassette tape.

Since development of scientist posters is quite an expensive process, RTI decided to conduct an evaluation of the Phase I posters before proceeding with the development of additional posters. This would enable us to use teacher and student feedback to design the most effective series of posters possible within the available resource constraints.

An announcement was sent to State Science Supervisors advertising the availability of a set of 20 scientist posters free of charge while supplies lasted to grade 4-9 teachers who were willing to help evaluate them. Poster sets, along with ideas for using the posters and an evaluation questionnaire, were sent to the first 200 of the more than 400 teachers who requested them. Wile the results were overwhelmingly positive (94 percent rated the posters either excellent or good), there were a number of suggestions for improving the series. The most frequent recommendation was for more color, with many teachers commenting that beige paper was too dull. Many teachers expressed a need for more posters covering other science fields. Also, while many teachers commented that they liked the information about the scientists' personal lives because it made the scientists seem like "real people"; many others said they would have liked more science content and less on life style.

The results of the poster evaluations were used in designing the Phase II posters. While printing the posters in full color would have been prohibitively expensive, it was possible to have the posters printed on a variety of paper colors rather than all beige and to use more vibrant ink colors. Scientists were selected to complement the fields already represented on the first set of posters, and the new posters focused more on the actual jobs of the scientists and less on their life styles. In this way, the entire series would include some posters with each type of focus.

III. DESCRIPTION OF THE SCIENCE CAREERS PROGRAM

The final version of the Science Careers Program consists of a set of class activities, including a filmstrip/cassette presentation and a series of posters; a book of resource materials for teachers; and guidelines for conducting in-service programs based on these materials. The contents of the Science Careers Program are described below.

A. Class Activities

The Science Careers Program includes a series of 12 class activities. Each of them addresses one or more of the following major points:

1. There is a diversity of science and technology careers requiring different kinds of skills and different levels of training and education.

2. One does not need to be a genius to success in a career in science and technology.

3. The ability to be a successful scientist is not restricted to any one race or sex.

4. Successful science careers can be combined with full personal lives; women need not give up marriage and motherhood to pursue these careers.

5. In the past, women and minorities faced many barriers to their participation in science careers; these included early role stereotyping and outright discrimination.

6. Students need not decide on a particular career at this stage but should begin thinking about various alternatives.

7. There are a variety of resources available for learning more about specific science and technology careers.

8. It is especially important for students to keep their options open by getting a good background in science and mathematics.

The 12 activities included in the Science Careers Program are decribed below.

Activity 1: Investigating Students' Images of Scientists

To many students, the word scientist evokes an image of a white male who wears a white coat and works in a laboratory, an unattractive genius who has no time to enjoy life, in fact, sort of a weird person.

The purpose of the first activity is to give students an opportunity to examine their own "images" of scientists by completing the sentence, "When I think of a scientist, I think of ...", and by drawing or describing the person they had in mind. This activity sets the stage for the remainder of the program where students will learn that the traditional stereotyped image of science and scientists is no longer accurate.

Activity 2: Sex Role Stereotyping in Home and Class Chores

Activity 2 makes students aware of sex role stereotyping on the part of parents and teachers. The class is asked to list chores young people are often asked to do and then to categorize them as performed mainly by males or mainly by females. Students then discuss how they may have gotten the idea that certain tasks are appropriate for only one sex. Two articles on sex stereotyping are included in the Resource Materials for Teachers to give teachers additional background information for this discussion.

Activity 3: People at Work

In this activity students indicate whether they think each of a number of jobs is done mostly by men, mostly by women, or about equally by both. Similarly, students are asked which of a number of occupations have a lot of minority workers. The major point here is to help students realize that women and minority workers have traditionally been concentrated in low-paying, dead-end jobs. Additional facts about women and minorities in the labor force are provided in the Resource Materials for Teachers to assist teachers in discussing both the current status and recent trends.

Activity 4: Predictions for Your Future

The idea that a young girl will grow up, get married, and be taken care of financially for the rest of her life is a myth, but many students are not aware of this. Activity 4 involves students in making predictions about their futures, and at the same time acquaints them with some of the facts: most women will work; many families today depend on two incomes to make ends meet; and many women have to support themselves because they are single or because they become widowed or divorced.

Activity 5: Detecting Sex and Race Bias in Language

The purpose of Activity 5 is to help students recognize sex and race bias in textbooks and other written mterials as well as in spoken language. Students are told of the results of a number of studies of textbooks--for example, word problems in arithmetic books had boys doing a wide variety of activities and girls almost always cooking and sewing. They are then asked to complete a worksheet, indicating if each of a number of statements shows sex or race bias and how it can be revised to eliminate bias.

Activity 6: Famous Women and Minority Scientists

The purpose of Activity 6 is to make students aware of the very significant contributions women and minority students have made despite the barriers

they faced. To help reinforce the information they are given, students are asked to complete a "Scrambled Scientists" worksheet and a "Famous Women and Minority Scientists Crossword Puzzle." But the vast majority of scientists are not, and never will be, Nobel Prize winners. A series of posters of scientists is included in this program to show students that most scientists are people much like themselves. Each poster presents a brief profile of a "typical" scientist along with one or more pictures of the scientist. The posters provide role models for students as well as illustrating a number of important points. For example, the common misconception among students that one has to be a genius to become a scientist is disputed by providing information about a scientist's experience with poor grades in college. Other posters illustrate that successful science careers can be combined with full personal lives and that handicapped persons can successfully pursue science careers.

Activity 7: Filmstrip Presentation

The sound filmstrip presentation "Exploring Careers in Science and Engineering" attempts to show students that there are a diversity of science and engineering careers available and that a wide variety of people are pursuing these careers. There is a copy of the script in the student activities booklet.

Activity 8: Branches of Science and Engineering

This activity expands upon the filmstrip presentation by having the students learn about specific science and engineering fields. A transparency is used to show the major branches within science and engineering, and the students are asked to complete a matching exercise on definitions of science and engineering careers. A number of optional parts of this activity allow teachers to treat this topic in more depth if desired.

Activity 9: Skills and Interests Needed for a Science Career

The major purpose of Activity 9 is to show students that many of them already have skills and interests that are appropriate for science and engineering careers. Students complete a science interest inventory. (Sample questions: Have you ever collected leaves or flowers or insects? Would you like to look at the moon through a telescope?) The class then discusses some of the characteristics that might indicate that a person is well-suited for a science career--for example, curiosity and creativity. Teachers are provided with examples from the posters that can be mentioned in these discussions. Finally, a transparency is provided to help make the point that students will severely limit their career choices if they do not get an adequate background in mathematics in high school.

Activity 10: Learning More About Science and Engineering Careers

In this activity students learn about the resources available for learning about science and engineering careers and are then assigned to find out about a particular occupation and report to the class. Questions to help students focus their research are provided, as are a number of suggestions for presentation formats (for example, role-playing a scientist, giving a demonstration of an activity related to the occupation, or writing a profile of an interviewed scientist).

Activity 11: Employment Outlook for Scientists and Engineers

The purpose of Activity 11 is to give students one tool for learning about employment opportunities by teaching them how to read classified advertisements. Optional parts of this activity involve students in learning about the employment outlook in their local area as well as salaries offered in various fields.

Activity 12: Planning for a Career

The final activity talks about planning for a career. Regardless of the career a student eventually decides to pursue, there are certain steps that all of them should follow. A transparency showing some of these steps is provided, as well as some points that can be discussed within each step.

B. Resource Materials for Teachers

Each of the 12 class activities described above includes a brief "Background Information for Teachers" section as well as guidelines for use of the activity. In addition, teachers were provided with a separate book of resource materials. The contents of the Resource Materials for Teachers book are described below.

First the project objectives are listed under three major headings: Women and Minorities in the Labor Force, Knowledge of Science Careers, and Overcoming Barriers to the Participation of Women and Minorities in Science.

The second section focuses on sex, race, and handicap role stereotyping. A number of aids for detecting stereotyping are provided as background information for the program's activities on sex and race stereotyping. They can also be used by teachers in evaluating instructional materials for possible purchase.

Section 3 in the Resource Materials for Teachers is a compilation of facts about women and minorities in the labor force. Some of these facts are communicated to students as part of the class activities (e.g., that 9 out of 10 women will work outside their homes at some point in their lives). Others can be introduced by teachers at appropriate points in the class discussions.

The provision of women and minority scientist role models is a central theme of this program. To assist teachers, Section 4 of the Resource Materials includes a compendium of information about famous women and minority scientists, a li[redacted]these scientists keyed to science curriculum topics, and sample ide[redacted]using the scientist posters.

Section 5 in the Resource Materials for Teachers provides a wealth of information about science and engineering careers, including how many people

are employed in each field, where they are employed, average starting salaries, and employment outlook. A list of definitions of many science and engineering careers is included as a handy reference for teachers. Section 5 also includes a discussion of the participation of women and minorities in science, starting from attitudes and performance as youngsters, and continuing on to career aspirations, course enrollments, and employment.

The final section in the Resource Materials for Teachers describes ways that teachers and students can learn more about science and engineering careers. Guidelines for arranging to have scientists visit classes are provided, including handouts to be given to the scientists to help them prepare for their visits. Finally, an extensive annotated bibliography of print and audio-visual materials related to the topics in this program is provided.

C. Workshop Coordinator Notebook

[redacted] districts which agreed to conduct Science Careers Program Workshops were provided with Workshop Coordinator Notebooks that described fully their responsibilities in implementing and evaluating the Science Careers Program. The Workshop Coordinator Notebook contains detailed guidelines for conducting a 2-hour in-service program, and it includes overhead transparencies that describe the topics covered in the Science Careers Program, the Class Activities, and the Resource Materials for Teachers.

Those districts which elected to conduct an extended in-service program in which the teachers received renewal credits were able to utilize detailed guidelines for an 8-meeting in-service program. This extended format was designed to give teachers an opportunity to discuss the program topics and the class activities as they were used. The workshop coordinator's guidelines included a list of the materials and equipment needed for each meeting and worksheets and other assignments for the teachers to do between meetings. The final meeting would be devoted to evaluating the program and providing recommendations for improvements.

IV. DATA COLLECTION

While the Phase I materials were being revised and new ones being developed, RTI began the process of locating teachers who would use the materials and assist in their evaluation. The research design proposed for this project included evaluating the Science Careers Program with and without an accompanying in-service program. A number of districts were given the opportunity to participate in the Science Careers Program by agreeing to send a workshop coordinator to a training session, and later to conduct a Science Careers In-Service Program in their district using the guidelines provided by RTI.

Workshop coordinators from 15 districts in 10 states (North Carolina, Tennessee, Kentucky, Florida, Maryland, New York, Massachusetts, Michigan, Iowa, and California) participated in a 2-day training session in North Carolina in August, 1982. Typically, the district science supervisor was chosen as workshop coordinator, but the group of 15 also included guidance and career counselors, teachers, and a principal. Participants paid for their own transportation; housing, meals, and program materials were provided with project funds.

After the training session, workshop coordinators were asked to identify up to 20 teachers of grades 4-9 science in their district who wanted to participate in the Science Careers Program. Depending on the size and structure of the school system, some districts chose to conduct the program at a single grade level while others identified teachers throughout the 4-9 grade range. Each of these teachers was given a packet of pretest materials including a letter from RTI, a teacher pretest, and a set of student pretests. The workshop coordinator was responsible for collecting the completed forms and forwarding them to RTI.

Once the pretests were received at RTI, teachers within each district were randomly assigned to experimental and control groups. The experimental group was to participate in an in-service program and use the Science Careers Program materials in the fall; both the experimental and control group teachers and their students would be posttested at the end of the fall semester. Additional copies of the Science Careers Program materials were provided to each district so the control group teachers would be able to use the program in the spring if they wished.

While the districts which would provide in-service programs for teachers were being identified, RTI was also identifying individual teachers who would use the Science Careers Program materials in their classes without participating in an in-service program. Those teachers who had requested poster sets after the original supply had been exhausted were sent letters indicating that the posters were no longer available but could be obtained free of charge during the 1982-83 school year by those teachers who agreed to use the entire program in their classes and help evaluate it. Interested teachers were sent pretest packets; upon receipt of the completed pretests RTI randomly assigned teachers to experimental and control groups and notified them whether they would be receiving the materials in the fall or spring. In either case, students and teachers would be posttested at the end of the fall semester.

There was some attrition from both the "workshop" teachers group and the "individual" teachers group. A few teachers began the program but later decided they could not devote the necessary class time to complete it. Other teachers did not return the completed posttests and/or evaluation forms despite repeated requests. At the conclusion of the data collection phase of the program, usable data had been obtained from 176 experimental teachers (127 workshop and 49 individual) and 140 control group teachers (108 workshop and 32 individual). Seventy-five percent of the participating teachers were white, 24 percent black, and 1 percent other races. Two-thirds of the teachers were female. Usable pretests and posttests were received from 3884 students in the experimental group and 3082 in the control group. Approximately half of the students were female, and approximately 72 percent of each group were white and 28 percent were black.

V. EVALUATION RESULTS

Summative evaluation of the Science Careers Program was based on teacher ratings of the program and teacher and student gains as compared to those of the control groups. Teacher ratings of the various components of the program and teacher and student achievement data are presented in the following sections.

A. Teacher Ratings of the Class Activities

Teachers were asked to fill out a "Record of Class Activities" form as the class completed each activity. The form asked for ratings of the adequacy of the guidelines for teachers, the appropriateness of the activity for that grade, and its effectiveness in meeting the program's objectives. Teachers were also asked to indicate which, if any, optional parts of the activity they had used, how much class time had been spent on the activity, and whether or not they intended to use the activity with other classes in the future. Finally, teachers were asked to provide recommendations for improving each activity.

The percentages of teachers rating each activity excellent, good, fair, and poor are shown in Table 1. Most of the activities were highly rated by the teachers; percentages rating the activity excellent or good ranged from a low of 77 percent for "Planning a Career" to a high of 92 percent for "Famous Women and Minority Scientists." In rating the class activities "overall," 88 percent of the teachers indicated they were either excellent or good. Table 1 also includes separate ratings of the scientist posters and the filmstrip presentations. The scientist posters were particularly well received, with 94 percent of the teachers rating them either excellent or good.

Interestingly, teachers who had used the program on their own reacted more favorably to the materials than those who had participated in an in-service workshop. For example, while 61 percent of the "individual" teachers rated the filmstrip excellent, only 41 percent of the workshop teachers did so. Similarly, teachers working individually were more apt to judge the class activities as excellent. (Forty-nine percent of the "individual" teachers rated the class activities overall as excellent, compared to 31 percent of the "workshop" teachers.) It is not clear whether these figures indicate that the workshops had a negative impact on the teachers' perceptions of the program or whether those who had actively sought out the program on their own were more highly motivated to begin with.

Table 1

Teacher Ratings of the Class Activities

Activity	Percent of Teachers Rating the Materials			
	Excellent	Good	Fair	Poor
1. Images of Scientists	40	51	9	0
2. Sex Role Stereotyping	34	47	15	4
3. People at Work	35	55	10	1
4. Predictions for Your Future	27	53	19	0
5. Detecting Sex and Race Bias in Language	46	35	16	3
6. Famous Women and Minority Scientists	51	41	8	0
7. Career Opportunities in Science	50	38	12	1
8. Branches of Science and Engineering	38	51	11	0
9. Skills and Interests Needed	39	42	16	2
10. Learning More About Science Careers	34	48	17	1
11. Employment Outlook	32	53	14	1
12. Planning for a Career	35	42	21	3
Class Activities Overall	36	52	10	2
Filmstrip Presentation	46	38	12	3
Scientist Posters	63	31	6	0

The teachers were generally quite pleased with the guidelines for using the activities, with between 86 percent and 95 percent of the teachers rating each activity's guidelines excellent or good. There was somewhat more variability in teacher ratings of the appropriateness and effectiveness of the individual activities with certain groups of students. Interestingly, as can be seen in Table 2, the effectiveness ratings were often a good deal higher than those for appropriateness. Apparently in many cases teachers who had concerns about the appropriateness of a particular activity for their classes' age and ability levels still considered that the activity had been effective in meeting its objectives. The overwhelming majority (93 percent) of the teachers plan to use at least one of the class activities with other classes in the future, and 65 percent plan to use half or more of the activities.

Table 2

Teacher Ratings of the Appropriateness and Effectiveness of the Class Activities

Activity	Percent of Teachers Rating the Activity Excellent or Good: Appropriateness for that Grade and Students	Effectiveness in Meeting Objectives
1. Images of Scientists	85	90
2. Sex Role Stereotyping	81	82
3. People at Work	84	91
4. Predictions for Your Future	74	82
5. Detecting Sex and Race Bias in Language	78	80
6. Famous Women and Minority Scientists	84	90
7. Career Opportunities in Science	86	88
8. Branches of Science and Engineering	85	91
9. Skills and Interests Needed	81	84
10. Learning More About Science Careers	72	84
11. Employment Outlook	74	85
12. Planning for a Career	71	78

There were a number of suggestions for improving the program as a whole as well as recommendations for changes in particular activities. Some teachers felt that there was too great an emphasis on sex and race stereotyping and that the program should either omit those activities or shorten them. The activities that focused on science and scientists tended to be the most highly rated, and some teachers felt that these should receive even greater emphasis. Suggestions for strengthening this aspect of the program included providing a 16mm film, filmstrips on specific careers, and a filmstrip on famous women and minority scientists. Other teachers would like to have hands-on activities so students could explore the kinds of experiments carried out in the various fields.

There was some concern that the Science Careers Program was unfair to white male students, and a number of teachers asked for more statistics on employment of white males, examples of famous white male scientists, and more

white males depicted on the posters. Other teachers expressed the need for materials on races other than blacks in both the employment statistics and the information on famous scientists. (Unfortunately, such information is not readily available from the Department of Labor or elsewhere.)

While teachers generally liked the format of the materials (pages to be inserted in a 3-ring notebook), there were a number of recommendations for making the materials easier to use. Suggestions included providing the actual transparencies (as opposed to transparency masters), providing student booklets containing the various worksheets and information sheets, and including a test for each unit.

B. Teacher Ratings of the Effectiveness of the In-Service Component of the Program

At the completion of the program, each teacher was asked to complete an evaluation form. First, teachers were asked how valuable the program had been to them in terms of their own learning about science and engineering careers, knowledge of the current status of women and minorities in the labor force, and awareness of sex and race stereotyping. In addition, they were asked if the program had helped them learn how to obtain additional resources for learning about science careers. As shown in Table 3, teachers generally perceived the Science Careers Program as quite helpful in their own learning. Interestingly, teacher ratings of the value of the program to them did not vary much based on whether or not they had participated in workshops about the use of these materials.

Table 3

Utility of the Science Careers Program to Teachers

	Percent of Teachers Rating the Program					
	Very Valuable		Somewhat Valuable		Not Valuable	
Topic	Individual	Workshop	Individual	Workshop	Individual	Workshop
a. Science and Engineering Careers	55	62	45	33	0	5
b. Women and Minorities in the Labor Force	60	68	40	29	0	3
c. Sex and Race Stereotyping	47	48	45	40	9	12
d. Obtaining Additional Resources	64	58	34	36	2	7

As was described in an earlier section, teachers had been provided with an extensive collection of resource materials including articles about sex and race stereotyping, a compendium of women and minority scientists, and information about science and engineering careers. As can be seen in Table 4, each part of the Teacher Resource Materials was rated somewhat or very valuable by more than 80 percent of the teachers. The most highly valued resource materials were the facts about women and minorities in the labor force, the definitions of science and engineering fields, and the compilation of information about science and engineering careers (including employment outlook, salary information, etc.); in each case, 98 or 99 percent of the teachers indicated that the materials were somewhat or very useful.

Table 4

Teacher Ratings of Resource Materials for Teachers

	Percent of Teachers Rating the Material		
	Very Valuable	Somewhat Valuable	Not Valuable
a. Articles on sex and race role stereotyping	47	44	9
b. Facts about women and minorities in the labor force	62	37	1
c. Compendium of women and minority scientists and engineers	54	40	5
d. Women and minority scientists keyed to science curriculum topics	52	42	6
e. Copies of the text portions of the posters	56	34	10
f. Supplemental biographical information on poster scientists	52	41	7
g. Information about science and engineering careers	67	31	2
h. Definitions of selected science and engineering fields	67	31	2
i. Guidelines for arranging visits with scientists and engineers	31	51	19
j. Science Careers Program annotated bibliography	36	53	11

C. Teacher Achievement Data

Each teacher who participated in the Science Careers Program was asked to complete a pretest at the start of the program and a posttest at its conclusion. Table 5 reports the pretest and posttest results for the two experimental groups--those teachers who participated in in-service workshops and those who used the Science Career materials on their own--and the control group for each. Note that the teachers who participated in workshops related to the Science Career Program made somewhat larger gains than those who used the materials without attending a workshop. Control group scores remained virtually unchanged from pretest to posttest, and the difference between each experimental group and its control was significant beyond the .01 level.

Teacher results on individual objectives were also examined to find out the areas in which the program was most and least effective. The results shown in Table 6 indicate that while the Science Careers Program was effective in each of the three major program objectives, gains were largest in the area of overcoming barriers to the participation of women and minorities in science. Teachers, particularly those who had attended workshops related to this program, learned to recognize sex and race role stereotyping and indicated changes in both their attitudes and their classroom behaviors. Within Objective II, the largest teacher gains were in realizing the importance of adequate high school mathematics preparation for students' future careers and in learning about the contributions of women and minorities in science; once again, teachers who attended workshops made greater gains than those who did not.

D. Student Achievement Data

As was the case with the teachers, each student who participated in the Science Careers Program, either in the experimental or control classes, was asked to complete a pretest prior to the program and a posttest at the conclusion of the program. In order to obtain data on a large number of items without consuming an inordinate amount of class time, two different student forms were used, each containing approximately half of the items. Students were randomly assigned to complete either Form A or Form B in both the pretest and the posttest, and student IDs were used to match the forms. Since entire classes rather than individual students had been randomly assigned to experimental and control groups, the class was the appropriate unit of analysis for the evaluation studies. Therefore, the responses of all students in a given

Table 5

Teacher Total Scores on Pretests and Posttests

	Percent Correct			Standard Error of the	
	Pretest	Posttest	Difference	Difference	t
1. Teachers participated in workshop					
a. Experimental (N=127)	60	78	18	1.01	11.86*
b. Control (N=108)	61	62	1	.97	
2. Teachers used materials on their own					
a. Experimental (N=49)	62	75	13	1.72	5.83*
b. Control (N=32)	60	61	1	1.27	

* Significant beyond the .01 level.

Table 6

Teacher Pretest-Posttest Differences on Major Program Objectives

	Workshop Teachers		Individual Teachers	
	Experimental	Control	Experimental	Control
Objective I--Women and Minorities in the Labor Force (7 items)	17	0	16	1
Objective II--Knowledge of Science Careers (33 items)	16	0	11	1
Objective III--Barriers to Women and Minorities (10 items)	24	2	19	3

class were aggregated to provide a class score for each objective and for the total score. Results are provided separately for those classes whose teachers participated in a workshop related to the Science Careers Program, and those whose teachers used the materials on their own. Results are also reported for the classes randomly selected as a control group for each of these.

Table 7 shows the class results for total score. Note that the control groups made almost no gains from pretest to posttest, while each of the experimental groups showed a fairly substantial gain. The difference between each experimental group and its control was significant beyond the .01 level.

Table 7

Class Total Scores on Pretest and Posttest

	Percent Correct			Standard Error of the	
	Pretest	Posttest	Difference	Difference	t
1. Teachers participated in workshop					
a. Experimental (N=127)	51	63	12	.75	11.13*
b. Control (N=108)	50	51	1	.42	
2. Teachers used materials on their own					
a. Experimental (N=49)	51	62	11	1.11	5.81*
b. Control (N=32)	50	52	2	.71	

* Significant beyond the .01 level.

Class results on individual objectives were also examined to determine the areas in which the program was most effective and those where it had relatively little impact. Table 8 shows the pretest-posttest differences for the two experimental groups and the two control groups on the major program objectives. Note that the control groups gained very little from pretest to posttest and that the most substantial gain for each of the two experimental groups was in their knowledge of science careers.

Table 8

Class Pretest-Posttest Differences
on Major Program Objectives

	Workshop Teachers		Individual Teachers	
	Experimental	Control	Experimental	Control
Objective I--Women and Minorities in the Labor Force, (6 items)	4	-1	4	0
Objective II--Knowledge of Science Careers (22 items)	16	3	15	2
Objective III--Barriers to Women and Minorities (15 items)	8	3	7	3

There were only small gains in student knowledge about women and minorities in the labor force. A look at the results for individual items revealed that the Science Careers Program was effective in showing students that women and minority workers tend to be concentrated in fields that pay relatively little. The program did not succeed in getting across the message that most women work out of necessity rather than for "extras," nor did students learn that women comprise such a substantial proportion of the labor force (40 percent).

The largest student gains were in knowledge of science careers. Gains were particularly great in learning about the types of work done in various science and engineering fields and about the contributions of famous women and minority scientists. The Science Careers Program was effective in breaking down some of the myths students held about scientists, but others were more resistant to change. Students learned that being blind or using a wheelchair does not prevent a person from being a scientist, that not all scientists spend a lot of time in laboratories, and that you don't have to be a genius to be a scientist. On the other hand, the program did not markedly affect the perceptions of those students (about one-third of the group on both pretest and posttest) who consider science too dull to choose as a career or the almost 20 percent who think scientists don't have time to enjoy life.

Objective III included several subobjectives: sex and race role stereotyping; recognition that persons should not be restricted to roles based on race or sex; and recognition that science careers are compatible with full

personal lives. In addition, one of the program subobjectives included in Objective III was that increased numbers of female and minority students indicate an interest in science careers.

The program was quite effective in teaching students to detect sexist and racist language. Interestingly, while students came to realize that science and engineering were appropriate pursuits for women, they did not generalize this attitude to other careers; at the conclusion of the program many students still labeled carpenter and astronaut as men's jobs and librarian and nurse as women's jobs.

Table 9 shows the percentages of students classified by race and sex who indicated they want to know more about science careers and those who said they are planning a science career. In each sex/race category, a larger percentage of students who participated in the Science Careers Program than those in the control group indicated an interest in science careers. Note also that while males still demonstrate a somewhat greater interest in pursuing science careers, participation in the Science Careers Program has narrowed the gender gap.

Table 9

Student Interest in Science Careers

	Percentage of Students Who					
	Want to Know More About a Science Career			Are Planning a Science Career		
	Experimental	Control	Difference	Experimental	Control	Difference
White female	44	39	5	19	11	8
Minority female	52	41	11	20	12	8
White male	46	43	3	22	16	6
Minority male	56	49	7	24	20	4

VI. DISSEMINATION PLANS

The Science Careers Program is being distributed by the Research Triangle Institute, P.O. Box 12194, Research Triangle Park, N.C. 27709. Teachers or other interested persons can purchase the entire program or any of its components--the posters, filmstrip/cassette presentation, class activities, and teacher resource materials--at cost. Announcements of the availability of these materials were sent to all State Science Supervisors and Career Education Specialists, as well as to professional societies and a number of sex/race equity groups. This report is being submitted to ERIC and to the National Technical Information Service for entry into their report dissemination systems. Plans are also under way to have some of the scientist posters published in the National Science Teachers' Association new journal, Scope. Finally, the American Association for the Advancement of Science is considering the feasibility of distributing parts of the Science Careers Program as part of its large "Science Resources for Schools" project.