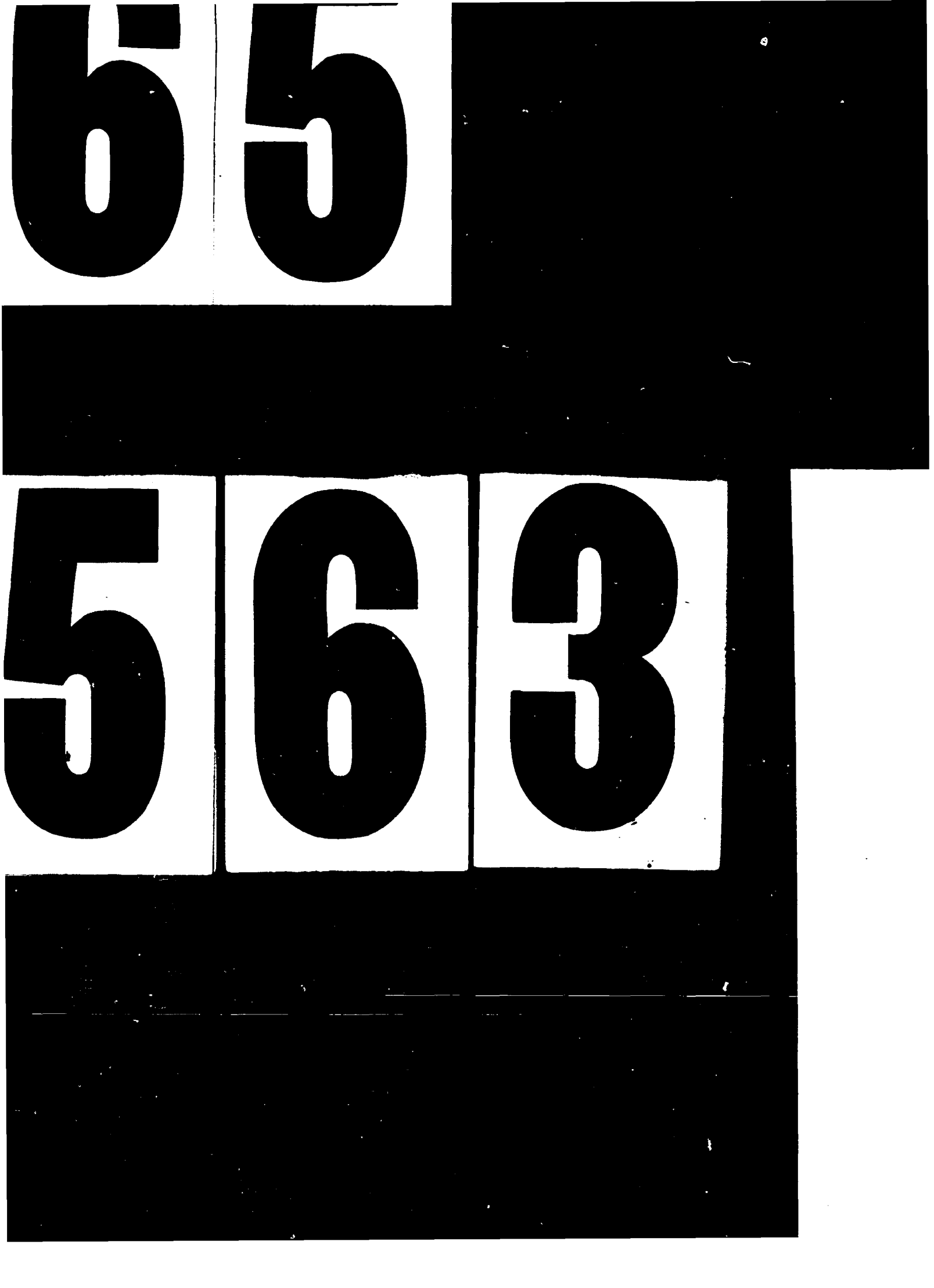
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A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF EDUCATION

BY

CHARLES HARRISON DOUGLAS, JR.

Norman, Oklahoma

1965

COMPARISONS AMONG THE COLLEGE CAREERS OF STUDENTS WHO HAVE PARTICIPATED IN THE SIR ALEXANDER FLEMING AWARDS, THE OKLAHOMA HIGH SCHOOL INSTITUTES, THE OKLAHOMA CITY SCIENCE FAIRS, AND SELECTED OKLAHOMA CITY PHYSICS CLASSES FOR THE YEARS OF 1956-1962.

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CHAPTER I

DESCRIPTION OF THE STUDY

Introduction

The need to encourage high school students to continue in science and engineering fields has been recognized for a long time. Great emphasis has been placed on these areas by both professional scientists and educators since about 1950. This need has been the result of natural changes in our society toward a more scientifically oriented culture as well as the result of technological advances and conflicting ideologies between the United States of America and the Union of Soviet Socialistic Republics.

Dr. James G. Harlow, Executive Vice-President of Frontiers of Science Foundation of Oklahoma, Inc. reports science in the following manner, "Science is the product of an extraordinary creative act--- the action of relatively unfettered intelligence, constructing logically consistent, aesthetically satisfying intellectual structures which by suitable manipulation can be made to encompass present knowledge and

to direct us to new knowledge."[1]

Different approaches have been utilized to increase interest in these fields. Basically the approaches have been to improve the subject matter competencies of the secondary teachers, and to supplement the regular classroom activities with materials and programs not readily available in most secondary schools.

Many private and governmental organizations are active in improving the classroom competencies of science and mathematics teachers. These organizations include the National Science Foundation, the General Electric Company, the du Pont Company, the Shell Company Foundation, and the Westinghouse Educational Foundation. This approach has included Academic Year Institutes, Summer Institutes, Week-end Institutes, Special Lecture-demonstration Programs, and talent searches.

Other methods of encouraging interest in high school science and mathematics courses include career guidance materials, the use of television in science teaching, personal contacts among teachers, students and professional society members, the use of science and mathematics counselors, travelling science exhibits, junior academies of science, science fairs, science clubs, and special science programs.

In these special areas, some of the more significant developments have been the introduction of science fairs, the Sir Alexander Fleming Awards, and the Oklahoma High School Institutes. These are no substitute for sound teaching but they can be exceedingly valuable supplements and powerful stimuli to students.

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[1]James G. Harlow, "Science Programs and the Development of Scientists," Teachers College Record, Vol. 60, No. 6, p. 307.

Background of the Problem

Perhaps the most alarming element in the present American situation is the low degree of understanding and appreciation of the role of science, engineering, and technology in society.[1]

There is an increasing need for scientists, and yet a decreasing number of young people are embarking on scientific careers. Projection of this contrast into the future makes clear that additional scientists must be trained. The place to begin, if effective action is to be taken in the high school and lower grades.

Dr. Glenn W. Giddings, consultant in educational relations for the General Electric Foundation told Oklahoma City University's fall faculty workshop:

> "Publicity of the need for scientists has somehow backfired. Despite all the advertising and urging and special pleadings, the number of students going into science and engineering has declined. The only science where enrollment has risen is biology and mathematics while chemistry and physics have remained constant in the number of students enrolled and geology and earth science have steadily declined. The "hoop-la" over science and engineering may have frightened some would-be students. They are afraid they won't get grades good enough for scholarships. Likewise guidance counseling programs in high schools may be poor. Counselors may not have taken the trouble to find out the requirements for engineering."[2]

Because there is some truth in these statements, the present emphasis in educational programming at the secondary level is in the upgrading of offerings, especially in the science, mathematics, and

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[1]American Museum of Atomic Energy, Science Fair Handbook for Teachers, Educational Section, P. O. Box 117, Oakridge, Tennessee, p. 1.

[2]The Daily Oklahoman, September 10, 1963.

foreign language areas and in all academic subjects in general.

Teachers are urged to demand more of the students and improve their own instructional procedures, as well as to keep up with new ideas and discoveries in their subject matter fields.

Administrators, teachers, and the lay public are questioning anew the educational value of many practices involved in school activities, including the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, and the Oklahoma City Science Fairs. The over-all value of these activities is not being denied; rather, a study is needed to point out just how well these programs are doing what they purport to do.

Statement of the Problem

The problem was to describe, report, and compare the college careers of students who had participated in the Sir Alexander Fleming Awards, the Oklahoma City Science Fairs, the Oklahoma High School Institutes, and selected Oklahoma City Physics Classes during the years 1956-1962 and to see if there were any significant differences among their choices of college careers.

This study's concern is not especially whether a person goes into science or engineering but whether he continues in one or the other. As W. L. Everitt, Dean of Engineering at the University of Illinois, and Past President of the Engineer's Council for Professional Development said, "It is easier to distinguish between the scientific function and the engineering function than to distinguish between the man who should be called a scientist and the man who should be termed an engineer."[1]

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[1]Oklahoma City Times, November 20, 1963.

CHAPTER II

REVIEW OF THE LITERATURE AND RELATED RESEARCH

Extracurricular student activities of various types are as old as education itself. These activities have been traced back to the universities of ancient Greece. Wilds reports, however, that it was practically impossible to find anything in the literature about extracurricular activities in American high schools prior to 1910 and at the writing of his book they were still in infancy. His work deserves special consideration because he reported numerous studies, some of which he conducted himself, concerning extracurricular activities. In summarizing them he said, "These studies also confirm the common opinion that activities of an athletic nature are emphasized far more than any other type of activity. One of our outstanding problems is to build up a proper sense of the proportionate value of the various types of activities, so that each type may be stressed according to its relative value."[1]

Mullins found, in a 1961 analysis of the activity programs of 496 public senior high schools in Oklahoma, that the same conclusion was true. His questionnaire contained a question about subject-centered clubs

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[1]Elmer Harrison Wilds, Extra Curricular Activities (New York: The Century Company, 1926), p. 5.

which would include science clubs and their availability for students. He found the frequency varied from 80 per cent in the largest schools to eight per cent in the smallest schools.[1]

Christopher and Howard found, in a survey of two hundred schools in Indiana that approximately 90 per cent of the activities had been added to the curriculum since 1922, and that between 39 per cent and 50 per cent had been added since 1942, indicating a steady increase in school activities.[2]

Writing for the Fifty-second Yearbook of the National Society for the Study of Education, Trump identified the most significant problems in relation to activities as: securing participating of all youth; maintaining a reasonable balance in the activity program; minimizing pressure for elaborate exhibitions and winning contests; and providing more systematic evaluation in relation to youth needs. Among the needed changes recognized were: reaching a consensus regarding purposes; clarifying policy-making and administrative relationships; and devising evaluation procedures.[3]

Suber conducted a study of current practices and opinions of high school principals of three hundred ninety four tax-supported, coeducational senior high schools having enrollments from 1000 to 2500.

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[1]Jesse Dale Mullins, "An Analysis of the Activity Programs in the Public Senior High Schools of Oklahoma." (unpublished doctoral dissertation, University of Oklahoma, Norman, 1961).

[2]A. Z. Christopher and W. L. Howard, "Cocurricular Activities in Two Hundred Indiana High Schools", School Activities, XXV (October, 1953), pp. 43-45.

[3]J. Lloyd Trump, "Extra-Class Activities and the Needs of Youth", National Society for the Study of Education, Fifty-second Yearbook, Part I (Chicago: The University of Chicago Press, 1953), pp. 160-179.

Practices used by the principals were, for the most part, considered to be very good. However, techniques for evaluating the outcomes of the activities seemed to be relatively underdeveloped, and current practices in gathering evaluative information were largely based on personal opinion.[1]

Hundreds of other articles concerning activities are to be found throughout the periodical materials and text books used in graduate and undergraduate courses in colleges and universities. These articles deal primarily with activities other than science activities. Only those articles most directly associated with the problem under study are contained in the review of the literature.

As has been previously stated, no studies were found that related directly to the problem under study of college career selection of the participants of the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and Selected Oklahoma City Physics Classes for the years 1956-1962. Several studies of related programs have been published and an even greater number of surveys has been conducted either touching on other facets of science programs or touching the fringes of the problem under study.

Tnere have been no published studies or surveys of the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Physics Classes, or the Oklahoma City Science Fairs. There have been studies of other high school institutes, physics classes, and

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[1]James Whitley Suber, "The Role of the High School Principal in the Extracurricular Activities Program", (unpublished doctoral dissertation, The George Washington University, 1955).

science fairs. These studies generally were searching for information other than the type of information sought in this study.

The surveys of the high school institutes have been evaluations of the material being presented in the programs rather than the study of future activities of the students who have participated in the programs. The physics classes of the United States have been studied and surveyed for many years, but no study was found that compared the participants of the physics programs with participants in selected extracurricular science programs.

The science fair programs have received intensive study since about 1950. A number of articles have described various facets of these programs. Most of these articles are very subjective in nature and based on the personal opinion of the respective authors. All of the studies related to the problem were examined and those considered most relevant are included in the review. A few investigators have examined either science fair programs or science fair participants. These are also included in this paper.

M. H. Ahrendt studied the records of the 1953 and 1956 winners in the Annual National Honor Society Program. All of these students ranked above the 99.9 percentile on a national general aptitude test; he found that 55 per cent of the 1953 winners indicated that they planned to prepare for work in science or engineering, or technical fields for which extensive training in mathematics and science was a prerequisite. The 1956 group expressed vocational preferences for scientific fields at the 60 per cent level.[1]

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[1]M. H. Ahrendt, "Mathematics and Science Are Our Topnotch Highschool Students Studying These Subjects?" NEA Journal, February, 1957, 109-111.

The Science Achievement Awards for Students (SAAS) was reported by Fisk in an evaluation study covering the years 1952-1958. This nation-wide program is supported financially by the American Society for Metals and is administered by the Future Scientists of America Foundation of the National Science Teachers Association. In this study, an attempt was made to contact every regional and national winner, plus a 10 per cent stratified sample by year, grade, and geographical area of the honorable mention students. Five hundred seventy one students replied, for a return of approximately 77 per cent. The student projects were 44 per cent in the biological sciences, 40 per cent in the physical sciences, 9 per cent in the earth sciences, 5 per cent in mathematics, and 2 per cent not in these categories. Among the various proposed and actual college majors, physics was the most common choice while chemistry, electrical engineering, and medicine ranked high. Teaching as a career ranked low. The number of these students who planned to continue in college for the winners and honorable mention was from 70 per cent to 80 per cent in science and related fields. The purposes of the SAAS Program are very similar to the purposes of the programs under study.

1. To stimulate and increase interest in science.
2. To stimulate and increase interest in science experimentation.
3. To encourage project work in science.
4. To increase science enrollments.
5. To help students choose scientific vocations.[1]

One reason for the growing student interest in science and technology during the past decade is the exciting advance which science has made and is projecting. Coupled with this is the awareness of educators,

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[1]Franklin G. Fisk, "The Science Achievement Awards," The Science Teacher, Vol. 26, Number 5, September, 1959, 323-327.

from kindergarten through the university, that genuine interest is sparked at a very early age, often before the first year of school. Scientific and technical socities, cognizant of the tremendous shortage of skilled scientists and technicians, are encouraging science fair programs for the purpose of recognizing potentials early and because through them additional motivation becomes more easily possible. More than 4 million people saw 3/4 of a million science exhibits made by students and shown at science fairs leading to the National Science Fair in 1960. The average affiliated fair showed 345 exhibits. A follow-up study shows that up to 90 per cent of the finalists of the National Science Fair actually go on to make science, education, or engineering their career. The growth of the National Science Fair has been as follows:

Year	Place	Area Fairs	Finalists
1950	Philadelphia, Pa.	13	30
1955	Cleveland, Ohio	71	136
1960	Indianapolis, Ind.	193	356[1]

Jones reports, "In recent years, with an ever-increasing need for talent in the field of science, an early start in the development of our young people along scientific lines of thinking is essential. One of the best ways of interesting pupils is through displays (projects, exhibits, etc.) where they can combine both mind and manual dexterity. Science fairs tend (1) to focus attention not only of pupils but also of the entire community on science; (2) to encourage and inspire in youth

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[1]Science Clubs of America Sponsor Handbook, Science Fairs National and Local, 1719 N. Street, N. W., Washington 6, D. C.

the desire for scientific experimentation; (3) to recognize talented youth without exploiting them; and (4) to encourage further work in the field of science in college and industry. Another outstanding value of the science fair is the educational salesmanship to the community."[1] Clingerman found that competition on local, regional, and national science fair levels have encouraged many to choose careers in science.[2]

The annual Science Talent Search began in 1942, as an activity of the Science Clubs of America and of Science Service, Inc., a non-profit educational institution which sponsors Science Clubs of America. From its inception, co-operation and financial aid have been given by the Westinghouse Educational Foundation of the Westinghouse Electric Corporation. The purposes of the Science Talent Search are to interest and encourage high school students toward a scientific career, to bring to public attention the valuable research potential in the youth of our country, and to create greater interest in science among young people through Science Clubs of America.

Continued effective administration of a program of this magnitude obviously calls for follow-up studies of results achieved. One survey included 1,550 high school seniors who had previously participated in the program. The questionnaires were returned in the following percentages:

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[1]N. R. D. Jones, "Science Fairs--Science Education in the Community," National Association of Secondary School Principals Bulletin, #191, Vol. 37 January, 1953), pp. 165-169.

[2]Kermit G. Clingerman, "Science Fairs Are They Worth the Time and Effort?" The Clearing House, No. 3, Vol. 37, (November, 1962).

Winners	74 per cent
Honorable Mentions	64 per cent
Others	28 per cent
total	31 per cent

The study indicated 92 per cent of the males who continued to college majored in science or science related fields and 85 per cent of the females who continued to college majored in science or science related fields.[1]

Teen-age boys are deeply interested in careers involving science and technology. More than one out of three boys indicate engineering, science, or medicine as a first choice for a lifetime career. Teen-age girls, too, indicate medicine (including nursing) as a first career choice. Teaching is second and office work is third in a list of first choices among teen-age girls. These are the results of a poll of 5,297 teen-age students survey by the Institute of Student Opinion in 1963. (The Institute of Student Opinion is an independent undertaking sponsored by Scholastic Magazines, Inc., and has conducted nationwide surveys of teenagers since 1943). This sampling of 5,297 students included boys and girls in grades 7-12 in junior and senior high schools, and in public, private, and parochial schools. Three years ago the Institute of Student Opinion made nationwide headlines with the report that 63 per cent of American teen-age students expected to go to college. This year a similar study indicated that 72 per cent of teen-agers now

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[1]Harold A. Edgerton, "Science Talent Its Early Identification and Continuing Development," Science Service, Inc., Washington 6, D. C., 1961.

say that they expect to attend college.[1]

Finkel found that several factors affect the high school student's choice of a science career. His first objective was to discover why students at the high school level choose to enter fields of endeavor other than science. It was believed that students had been exposed to certain conditions in the school which were of influence in their final choice of a career; some of these factors may have been: (a) the interest in science shown by the teachers; (b) the guidance received by the student; (c) the provisions made by the school for science facilities and the use of the science laboratory as an instrument of learning; (d) the availability to the students of supplementary science activities; (e) the presentation by the school of the courses in science and mathematics necessary to provide students with the fundamentals in those areas. He sent questionnaires to a group of secondary schools of various sizes and locations. His conclusion was that most young people in their formative years find things related to science of interest. Somewhere along their school career, this interest often wanes and may even be extinguished. The cause for this lies somewhere in the school, in the preparation of teachers, in their psychology of teaching, in the facilities of the school plant, and in the guidance and motivation received by the students.[2]

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[1]Science Teachers World, "News and Views in Science Education, Science Careers Score High Among Teen-age Students," Science World, Vol. 13, No. 6, April, 1963) p. 2T.

[2]Maurice Finkel, "Factors Affecting The High School Student's Choice Regarding a Science Career," Science Education, Vol. 45, No. 2, (March, 1961), pp. 153-157.

Renner reports the understandings held by secondary school students of the occupations of the scientist, technician and engineer. Probably the most critical of the present and possible future manpower shortages is the one in engineering. One of the factors which influence a young person's decision to enter a particular profession is undoubtedly his understanding of the duties and the activities of that profession. Renner concluded that if more students are to be attracted into engineering as a profession, a conscious effort must be made to deepen this understanding during the senior high years.[1]

Brandwein, who studied the gifted student as a future scientist, based a portion of his work on the following hypothesis:

1. Future contributors to science may be identified on the school level.

2. Science "talent", better called high level ability or developed ability in science, is not a specific factor, but emerges out of general intelligence.

    a. High level ability in science is a combination of intellectual abilities, inherited and developed.
    b. The expression of high level ability in science is directly related to the early opportunities available for involvement in science.

3. The number of scientists in supply for future scientific operations is significantly related to the number involved in school science.

    a. Youngsters who like school science, and are successful in it on the school level, tend to make science a life work.
    b. The supply of a great number of future scientists for our greatly increased needs does not primarily depend

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[1]John W. Renner, "A Study of the Understandings Held by Secondary School Students of the Occupations of the Scientist, Technician and Engineer" The Frontiers of Science Foundation of Oklahoma, Inc., Oklahoma City, Oklahoma, 1962.

on efforts by the colleges but on the efforts on the school level.[1]

Roe found several distinct patterns in the life histories of scientists. Her study revolved about 64 of the country's leading scientists. She found:

1. About one-half of them had fathers who were professional men.
2. None had fathers who were unskilled.
3. None was from a Catholic home.
4. What seems to be important in the home background is knowledge of learning, and the value placed on it for its own sake, in terms of the enrichment of life, and not just for economic and social rewards.
5. Other factors:
   a. Lost a parent
   b. Serious physical problem
   c. Many were eldest sons
   d. Intense interest shared by few friends.
   e. Inverterate readers.
   f. Most enjoyed school and studying.
   g. The physical scientist involved in gadgeterring.
   h. The biologist involved in natural history.
6. Very high IQ -- Median 166[2]

Cole relates certain characteristics of scientists. These are:

1. Strong Curiosity
2. Persistent Industriousness
3. Imagination
4. Patience
5. A love for prolonged periods of intellectual endeavor.

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[1]Paul F. Brandwein, The Gifted Student as Future Scientist, (New York: Harcourt, Brace and Company, 1955) pp. 25-26.

[2]Anne Roe, The Making of a Scientist, (New York: Dodd, Mead & Company, 1952), pp. 230-236.

6. Introversion

7. Willingness to challenge opinion.[1]

Daily indicated that as a group, scientists tend to do quite well on common types of tests of intelligence and to do correspondingly well in their school work. He also found that one of the most important problems in obtaining more competent scientists is that of obtaining more able youngsters who have high degrees of motivation for types of activities involved in various types of scientific careers.[2]

Cline, Richards, and Needham listed 17 traits or characteristics in the life history background of students who achieve in science:

1. Ideas are more important to them than people or money.
2. Psychological independence.
3. Choose study over athletics and social activities.
4. Frequently prefer books to people.
5. Television minimum.
6. Constructively dissatisfied with themselves and are frequently self critical.
7. Analyze own work and progress.
8. Often have a reading or speaking knowledge of a foreign language.
9. Interest in chess.
10. Family associations with people in the academic and scientific world.
11. Able to express and develop talents is more important than emotional or financial security.

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[1]Charles C. Cole, Jr., Encouraging Scientific Talent, (New York: College Entrance Examination Board, 1956), p. 10.

[2]John T. Daily, "Motivation For Science Careers," Science Education, Vol. 46, No. 3, (April, 1962), pp. 255-257.

12. Great use of the library.

13. Very critical of science teachers and think science teaching a poor job.

14. Great "question askers".

15. Not overprotected by parents especially in books and movies.

16. Family functional as a unit.

17. Only child -- if mother over 20.[1]

Vineyard concluded after studying the choices of science or non-science majors as related to ability and interest test scores that quantitative reasoning ability and choice of a science or non-science major are not independent of each other. Science is drawing in a greater proportion of the students and interest remains as a potent factor influencing the choice of a field.[2]

Conclusions

This review of the research related to school activities and primarily science activities has, of necessity been limited to those studies which seemed to be of major importance and which were particularly revelant to this study. It is interesting to note the similarities among the findings and conclusions. This indicates that, for the most part, the problems of encouraging students to major in science are still prevalent. Some of the most common general findings

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[1]Victor B. Cline, James M. Richards, and Walter Needham, "The Life History Background of Students Who Achieve in Science," Science Education, Vol. 46, No. 3, (April, 1962), pp. 258-261.

[2]Edwin E. Vineyard, "An Independence Study of Choice of Science or Non-science Major as Related to Ability and Interest Test Scores," Science Education, Vol. 43, No. 2, (March, 1959), pp. 125-129.

are listed below.

1. There has been an increase in all school activities, including science activities, both in numbers of activities as well as numbers of students who have participated in these activities.

2. A good program for evaluating the activity programs including science activities is generally lacking.

3. Purposes of the activities programs, including science activities frequently are either not stated or very loosely defined.

4. There is a correlation between high-level ability in school work and a student's continuing in science if there are early opportunities available for involvement in science.

5. Interest remains one of the primary factors in a student's selection of a career either for a science or non-science career.

6. The students who were successful in science studies or activities generally continued to college and majored in science.

7. The supply of future scientists is more dependent on efforts of secondary school science programs than on the college programs.

8. Activities of an athletic nature are emphasized far more than any other type of activity in most schools.

CHAPTER III

DESIGN OF THE STUDY

Within the State of Oklahoma several different approaches have been tried to encourage students to enter scientific fields. These approaches can best be described as being both curricular and extra-curricular. The curricular approaches have attempted improvement of instruction in the high school science and mathematics programs. Extra-curricular approaches have developed research programs for students working with scientists in their laboratories; students studying during the summer on a university campus with competent authorities in the fields of mathematics, science, and engineering; and students building projects with the help of their teachers and local scientists. All of these programs have contributed to an interest in science but it is unknown whether one of these programs was more productive in the development of science interest than the others.

The principal activities, at least the most highly publicized activities in Oklahoma, have been The Sir Alexander Fleming Awards, the Oklahoma High School Institutes, and the Oklahoma City Science Fairs Programs. Adequate records exist for identification and location of the participants in these activities for the past several years.

The general question of this study is simply whether or not these

special science programs deliver a larger fraction of their participants as scientists than do the elective classes in secondary school science. A control group was selected for a comparative study; the control selected was high school physics classes, because this is normally the most advanced science course offered in most secondary schools in Oklahoma.

A questionnaire was selected as the best data gathering device because of the large numbers involved and the distances of the participants from Oklahoma City. The participants were asked only objective questions concerning their present statuses as related to their college majors.

The questionnaire was designed so that the chi-square test could be applied to the data collected. In order to test the significance of observed differences among the different groups, their responses were compared by means of the chi-square method as described by Guilford.[1]

A brief description of each special science program and what it purports to do was obtained from the program directors, newspaper releases, and official brochures released to the students by the director of each program. A description of each program follows:

The Sir Alexander Fleming Awards

The Fleming Awards competition, which started in 1956, was named in memory of Dr. Alexander Fleming, British scientist who discovered penicillin. Dr. Fleming presided at the dedication of the

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[1]J. P. Guilford, Fundamental Statistics in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1956).

Foundation's hospital and research center in 1949.[1]

The Fleming Awards project was originated by the Volunteer Women's Service Corps of the Medical Research Foundation. All of the details of the competition up to the time of selection are handled by the Frontiers of Science Foundation of Oklahoma, Inc.[2]

The purpose of the program is to stimulate interest in science and to provide an opportunity for both boys and girls in the state of Oklahoma to participate in a research program. An understanding of the basic facts about living things is essential to the forward progress of man's efforts to combat human disease and suffering. Continued research progress is, however, dependent upon an adequate number of qualified and trained medical scientists and technicians.

> "Each fellowship will be tenable in the laboratories of the Oklahoma Medical Research Foundation during the months of June and July. The stipend will be $400.00 for this period. The student will work in the laboratories of the Foundation under the direct supervision of a member of the Foundation staff. The research program of the Foundation includes work in the following special fields: biochemistry, biophysics, bacteriology, physiology, endocrinology, organic chemistry, pharmacology, analytical chemistry and oncology. Applications will be accepted from residents of the State of Oklahoma. Students must have completed the junior year in high school prior to June, and must plan to graduate in June of the following year. They must present evidence of having completed at least two years of mathematics and two years of science in high school prior to assuming the fellowship. High scholastic standing and aptitude in science are essential qualifications. Students must be nominated by a science teacher who is well acquainted with their qualifications and by their high school principal. Students must also have the approval of their parents or guardian."[3]

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[1]Oklahoma City Times, April 12, 1957.

[2]Oklahoma City Times, May 10, 1962.

[3]Announcement Poster 1964, Oklahoma Medical Research Foundation and Frontiers of Science Foundation of Oklahoma Inc.

"The final selection of the students is based on accomplishments in science, enterprise, originality, intellectual ability, self-expression, maturity and poise."[1]

The Oklahoma High School Institutes

The Oklahoma State University has, for the past nine years, conducted a summer science program for secondary school students.

Classes have been conducted in the morning and afternoons five days per week and one-half day on Saturday as an experience intended not only to aid students in their senior science and mathematics courses in high school but also to help them discover and develop a better understanding of their major fields of interest. This understanding has been promoted through classroom work, laboratory demonstrations, discussion sessions, and by field trips to industrial organizations. Evening meetings have been devoted to subjects closely related to engineering, discussions of the civic and social responsibilities of the technically trained man, and the effect of industrialization upon the American way of life.

Through 1958 the program was partially financed by a small registration fee, plus a room and board charge; however, the University absorbed the major portion of the expense including all faculty time, administrative costs, facilities, secretarial assistance, and health service fees. The small registration fee approximately covered the direct non-salaried costs of the Institute.

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[1]Statement by Dr. Leonard Eliel, personal interview. Director of The Sir Alexander Fleming Awards Program.

During the summers of 1959, 1960, and 1961 the Institute was supported by the National Science Foundation. With this support 80 outstanding boys and girls were able to attend each year. In 1962 the National Science Foundation supported 40 students in a physical science and engineering program.

The objectives of the program are:

1. To provide an academic atmosphere which will foster individual development and promote scholarly achievement.

2. To increase cooperation with high schools by:

   a. Demonstrating the need for science and mathematics courses in preparation for enrollment in a university.

   b. Encouraging students to take such courses during their senior year.

   c. Creating an educational experience which will inspire participants to advise fellow students in their high school of the importance of mathematics and science for engineering and science careers.

   d. Familiarizing the student with a large multi-purpose university with strong emphasis on basic applied science and with the university lecture system, laboratory work and library study.[1]

The course work covers three principal fields of concentration: concepts in mathematics and their use, concepts in physical sciences and their relation to engineering, and the nature of several fields of engineering.

> . . "The requirements for admission to the institute is by application supported by a high school transcript of grades and two character recommendations. These will be reviewed by an admissions committee. The committee reserves the right to select only those who meet the high standards set by the faculty. The applicant should be a member of the junior class (11th grade)

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[1] Statement by Professor L. F. Sheerar, Director of the Oklahoma High School Institute.

> in high school and display a proficiency in mathematics and English, and a very definite interest in the fields of science and/or engineering. He should have high standards of character, dependability, intelligence, and be in good physical health."[1]

The Oklahoma City Science Fairs

In 1928 the American Institute proposed an experiment in science education. In that year the Institute organized the first Children's Fair to be held in New York City. At this event six main classes of projects were suggested: (1) backyard garden exhibits; (2) original notebooks on various topics in the field of plant and animal life; (3) conservation exhibits; (4) insects; (5) homemade animal cages; and (6) biological principles. From this beginning, science fairs have grown in size and popularity.[2]

A science fair is a competitive exhibition of scientific work developed and displayed by students under the direction of teachers and other interested persons. It provides an opportunity for students with imagination and initiative to display their ideas, research, and handiwork in science and mathematics. Essentially, a science fair is a collection of exhibits, each of which is designed to show a scientific principle, a laboratory procedure, or an industrial development. Science fairs vary in magnitude, content, and scope. The science fair is a means of intensifying interest in science and focusing

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[1]Announcement Poster 1957, Oklahoma High School Institute, Oklahoma A & M College, Stillwater, Oklahoma.

[2]Projects Today---Careers Tomorrow, A Student Guide to Science Fair Projects. American Petroleum Institute 1271 Avenue of the Americas, New York 20, New York.

attention upon scientific accomplishments. At the same time, the science fair expands and extends scientific knowledge and accomplishment.

Science fairs may be placed in at least three geographical categories. Local science fairs are fairs held for one school or school system. District, regional, and state fairs are made up of exhibits representing several schools or school systems. The final category is the National Science Fair.

The general aim of science fairs is to encourage interest, understanding, and appreciation in science and mathematics. More specifically, the purpose of the science fairs is fourfold:

1. To encourage students to take a more active interest in science and mathematics and thus enlarge the number of scientifically and technically trained people.
2. To afford opportunities for teachers and students to exchange ideas.
3. To arouse the interest of the public in the abilities of students and teachers.
4. To provide science education for the community.[1]

The Oklahoma City Science Fair was one of the earliest of the science fairs in the United States. It had its beginning in 1950 under the very able direction of the late Mr. Howard E. Brown. The Oklahoma City Science Fair has been jointly sponsored by the Oklahoma City Public Schools, the Oklahoma City Chamber of Commerce, and the Oklahoma Publishing Company.

Any boy or girl who attends a public, private, or parochial school

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[1]A Manual for Science Fairs. Educational Section, American Museum of Atomic Energy, P. O. Box 117, Oak Ridge, Tennessee, p. 3.

and who resides in the Oklahoma City School District may enter the science fair. These students must be in grades 7-12. These grade levels are sub-divided into Junior High Exhibits (grades 7-9) and Senior High Exhibits (grades 10-12). The basic categories of exhibits are biological, physical, and earth sciences. These are further sub-divided into individual and group projects. Each project then competes only against those projects within a given category. Thus a senior high school (individual) biological project competes only with other senior high (individual) biological projects.

There are five criteria used by the science fair judges.

1. Scientific thought: Completeness of observation, controlled experimentation, etc.

2. Creative ability: Originality in plan and execution; demonstration of new or improved ways of expressing scientific ideas.

3. Thoroughness: Exhibit tells a complete, concise story about project, emphasizing important items.

4. Clarity and dramatic value: Exhibit catches and focuses visitor's attention; labels large, neat, and easy to read.

5. Technical skills: Exhibit sound and durably constructed; good craftsmanship shown.

The science fair judges are selected because of their ability as scientific and technical experts. Their decisions are based on the merit of the exhibits being judged.[1]

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[1]Program and catalog of exhibits, conducted by the Oklahoma City Public School Teachers, 1957.

Selected Oklahoma City Physics Classes

The Oklahoma City Public Schools Physics Classes were selected as the control group because this is normally the most advanced science course taken before entering college. A Science Seminar is offered during the senior year in the Oklahoma City Schools but it has been offered only the last few years and has had an extremely small enrollment in comparison to the physics classes. A student is usually not permitted to enroll in physics unless he has had at least three years of mathematics, grades 9, 10, and 11. It is also generally recommended that he have biology and chemistry. The comparison of the Oklahoma City Physics Classes and the special science programs might indicate significant differences in the number of participants who go into science careers.

The problem was to describe and compare the college careers of students who had participated in the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and selected Oklahoma City Physics Classes during the years 1956-1962 and to see whether there were significant differences among the choices of their college careers. This general problem can readily be broken into the following null hypotheses:

1. There is no statistically significant difference between the number of males in the Sir Alexander Fleming Awards Program who continued in science and the number of males in the Oklahoma High School Institutes program who continued in science.

2. There is no statistically significant difference between the number of males in the Sir Alexander Fleming Awards Program who continued in science and the number of males in the Oklahoma City Science Fairs Program who continued in science.

3. There is no statistically significant difference between the number of males in the Sir Alexander Fleming Awards Program who continued in science and the number of males in the Oklahoma City Physics Classes Program who continued in science.

4. There is no statistically significant difference between the number of males in the Oklahoma High School Institutes Program who continued in science and the number of males in the Oklahoma City Science Fairs Program who continued in science.

5. There is no statistically significant difference between the number of males in the Oklahoma High School Institutes Program who continued in science and the number of males in the Oklahoma City Physics Classes Program who continued in science.

6. There is no statistically significant difference between the number of males in the Oklahoma City Science Fairs Program who continued in science and the number of males in the Oklahoma City Physics Classes Program who continued in science.

7. There is no statistically significant difference between the number of females in the Sir Alexander Fleming Awards Program who continued in science and the number in females of the Oklahoma High School Institutes Program who continued in science.

8. There is no statistically significant difference between the number of females in the Sir Alexander Fleming Awards Program who continued in science and the number of females in the Oklahoma City Science Fairs Program who continued in science.

9. There is no statistically significant difference between the number of females in the Sir Alexander Fleming Awards Program who continued in science and the number of females in the Oklahoma City Physics Classes Program who continued in science.

10. There is no statistically significant difference between the number of females in the Oklahoma High School Institutes Program who continued in science and the number of females in the Oklahoma City Science Fairs who continued in science.

11. There is no statistically significant difference between the number of females in the Oklahoma High

School Institutes Program who continued in science and the number of females in the Oklahoma City Physics Classes Program who continued in science.

12. There is no statistically significant difference between the number of females in the Oklahoma City Science Fairs Programs who continued in science and the number of females in the Oklahoma City Physics Classes Program who continued in science.

13. There are no statistically significant differences among the grade averages of the participants in the four programs.

Answers were also obtained for the following questions. The numbers of answers to these questions were not subjected to statistical tests of significance, but they were compared with each other in terms of percentages.

1. Do more students who have participated in one of the four programs enter the science fields than enter the engineering fields?

2. Do more students who have participated in one of the four programs enter the fields of science teaching than from other programs?

3. Do the grade averages of the four programs differ with respect to the sex of the participants?

4. Do the program participants exhibit differences among the numbers in each program who receive their bachelors, masters or doctors degree?

5. Are there differences among the numbers of participants who continued to college from the four programs?

6. Are there differences among the numbers of males who continued to college and the numbers of females in the four programs?

7. Are there differences among the numbers of males who continued in science and the numbers of females who continued in science?

8. What is the field of highest interest among the students who selected engineering as a career?

9. What is the field of highest interest among the students who selected science as a career?

10. What is the field of lowest interest among the students who selected engineering as a career?

11. What is the field of lowest interest among the students who selected science as a career?

12. Do more males than females select science careers?

13. What are the high school honors and activities of the participants?

14. What are the college honors and activities of the participants?

The Questionnaire

The questionnaire was developed primarily for the purpose of determining the present status of the students who had participated in one of the science programs in the secondary schools. These questions asked each participant to report his areas of activities since graduation from high school. All of these questions were objective in nature and could be answered by a simple check beside the question.

The cover letter stated that no school or individual would be identified in the study and that it was not necessary for any of the participants to sign the questionnaire. However, a place was provided for the signature. Only three of the participants failed to sign the questionnaire.

After the questionnaire had been designed and before it had been sent to the participants, it was administered to a number of college students and college graduates in order to determine whether or not the directions and questions could be followed and understood. On the

basis of the information gathered during the tryout period, parts of the questionnaire were redesigned and some of the directions and questions rewritten. The basic content of the questionnaire, however, was not changed.

The specific questions and hypotheses presented, pages 27, 28, 29, and 30, served as the basis for individual items in the questionnaire. The format of the questionnaire and the wording of the items were developed and grew out of a study of questionnaires, consultation with colleagues, the doctoral committee, and members of the Oklahoma City Public Schools Research Department. The final questionnaire consisted of 28 objective items. It and the covering letter are presented on pages 32, 33, 34, 35 and 36.

Letter of Transmittal

April 1, 1964

I am Charles Douglas, a graduate student at the University of Oklahoma studying the Oklahoma City Science Fair, the Oklahoma State University High School Institute Program, the Sir Alexander Fleming Fellowship Competition, and students who were in one of the physics classes of the Oklahoma City Public Schools as my doctoral dissertation problem under the direction of Dr. James G. Harlow. Certain kinds of information which I hope to obtain, will be of vital interest to the work of these three groups and the agencies which sponsor them.

Please co-operate by completing the enclosed questionnaire and return it as soon as possible in the enclosed self-addressed envelope. No school or individual will be identified in the study.

I know that you are very busy but I believe that you will agree that information needs to be gathered which can form the basis for careful analysis and development of recommendations to the Oklahoma City Public Schools, the Oklahoma State University High School Institute Program, the Fleming Fellowship Competition and the sponsoring agencies.

The information which you will provide me by returning the enclosed questionnaire will provide the basis for an objective and comprehensive analysis of this problem. Many thanks for your prompt return of the questionnaire.

Sincerely,

Charles H. Douglas

Charles H. Douglas
600 North Oakview Drive
Oklahoma City, Oklahoma

Questionnaire

We're trying to learn about the future careers of participants of certain selected science programs.

1. Would you tell us about yourself by checking the appropriate squares?

I was---

A winner or received honorable mention in the Okla. City Science Fair..(1)☐

A winner, alternate, or finalist in the Fleming Fellowship Competition.(2)☐

A participant in one of the OSU High School Institutes.....(3)☐

A member of an Oklahoma City Physics Class.....(4)☐

None of these listed.....(5)☐

2. Have you attended college?.....(1) Yes ☐ (2) No ☐
If YES, please answer all remaining questions.
If NO, please answer questions 24,25,26,27,28,29 and return questionnaire.

Please check the appropriate college you are, or were enrolled in.

3. Arts and Sciences..... ☐

4. Business Administration..... ☐

5. Education..... ☐

6. Engineering..... ☐

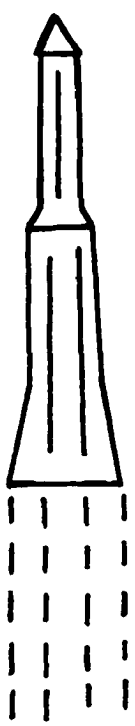
7. Fine Arts..... ☐

8. Pharmacy..... ☐

9. None of these listed..... ☐

If you majored or minored in science or engineering, please check your undergraduate major and minor.

	10-11 Major	12-13 Minor
Engineering		
Aeronautical and Space	(1) ☐	(1) ☐
Agricultural	(2) ☐	(2) ☐
Architectural	(3) ☐	(3) ☐
Chemical	(4) ☐	(4) ☐
Civil	(5) ☐	(5) ☐
Electrical	(6) ☐	(6) ☐
Engineering Physics	(7) ☐	(7) ☐
General	(8) ☐	(8) ☐
Geological	(9) ☐	(9) ☐
Industrial Management	(10) ☐	(10) ☐
Mechanical	(11) ☐	(11) ☐
Metallurgical	(12) ☐	(12) ☐
Petroleum	(13) ☐	(13) ☐
Othering Engineering	(14) ☐	(14) ☐
Science		
Astronomy	(15) ☐	(15) ☐
Bacteriology	(16) ☐	(16) ☐
Botany	(17) ☐	(17) ☐
Chemistry	(18) ☐	(18) ☐
Dentistry	(19) ☐	(19) ☐
Geology	(20) ☐	(20) ☐
Mathematics	(21) ☐	(21) ☐
Medicine	(22) ☐	(22) ☐
Physics	(23) ☐	(23) ☐
Zoology	(24) ☐	(24) ☐
Other Sciences	(25) ☐	(25) ☐



14. What is your classification by semester hour earned?

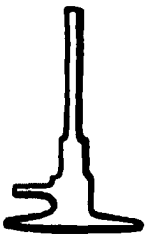
0 to 29.....(1) ☐

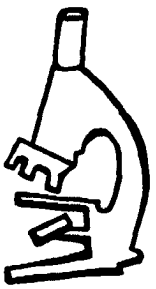
30 to 59.....(2) ☐

60 to 89.....(3) ☐

90 to 119.....(4) ☐

120 and over...(5) ☐





How many semester hours have you now completed in?...

15. astronomy _____

16. botany _____

17. chemistry _____

18. geology _____

19. mathematics _____

20. physics _____

21. zoology _____

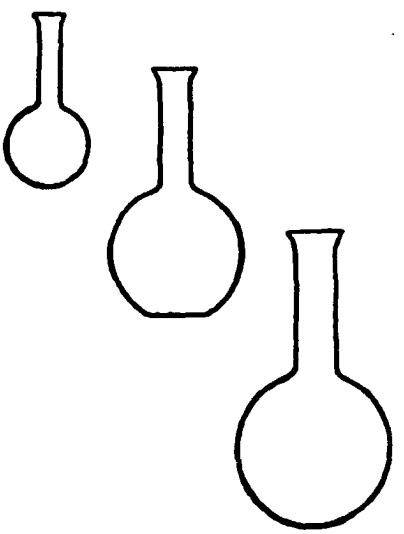
22. What is the highest degree that you have?

None.....(1) ☐

Bachelors.....(2) ☐

Masters.....(3) ☐

Doctors.....(4) ☐



Please check the appropriate boxes for your college honors and activities.

23

Athletics.....(1) ☐

Dean's or President's Honor Roll.....(2) ☐

Departmental Clubs.....(3) ☐

Professional Fraternity or Sorority..(4) ☐

Student Government.....(5) ☐

Other.....(6) ☐

Please check the appropriate boxes for your high school honors and activities.

24

Athletics.....(1) ☐

Fine Arts Clubs.....(2) ☐

National Honor Society..(3) ☐

Mathematics Club.....(4) ☐

Pep Club.....(5) ☐

Science Club.....(6) ☐

Student Council.....(7) ☐

School Class Officer....(8) ☐

Other.....(9) ☐

Please check your appropriate high school grade average.
A= 4.0

25

Over 3.5....(1) ☐

3.0 to 3.5..(2) ☐

2.5 to 2.9..(3) ☐

under 2.5...(4) ☐

26 Are your married?.....(1) Yes ☐ (2) No ☐

27 If married---Before entering college..(1) ☐

While in college.....(2) ☐

After completing college.(3) ☐

28 What is your sex?..Male (1) ☐ Female (2) ☐

29 Would you please sign here?

_____

Procedures and Organization

Gathering the Data---The names of the participants in the science programs were obtained from the sponsoring agencies. All of the winners from 1956-1962 in three of the programs were used in the study. These were the participants in the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, and the Oklahoma City Science Fairs. The participants in the Oklahoma City Physics classes were selected at random from the Oklahoma City Physics Classes for the years 1956-1962, and were screened to exclude participants in any of the three special science programs.

The names and addresses of the Sir Alexander Fleming Awards Participants were obtained from the Oklahoma Medical Research Foundation. In a few instances it was necessary to write the high school that the participant had attended to obtain the participant's mailing address because only the participant's name and high school address was available from the Foundation.

The Oklahoma High School Institutes participants' names and addresses were obtained from Mr. Glenn Rucker of the Division of Engineering and Industrial Extension of Oklahoma State University. Every name and address was available from this source.

The names of the Oklahoma City Science Fair Winners were obtained from Mr. Howard E. Brown and Mr. Otis E. Lawrence of the Oklahoma City Public Schools. The names of the high schools and students were available. The addresses of the students were obtained from the registrars of the respective high schools.

The names and addresses of the members of the Oklahoma City

Physics Classes were obtained from the respective high school registrars.

Participants in each category were asked to complete a copy of the questionnaire. The questionnaire was mailed on March 27, 1964. This resulted in a return from the Sir Alexander Fleming Awards group of 72 per cent, the Oklahoma High School Institutes of 73 per cent, the Oklahoma City Science Fairs of 77 per cent, and the Oklahoma City Physics Classes of 55 per cent.

Treatment of the Data

The summary---The returned questionnaires were divided into four classes: The Oklahoma City Science Fairs, the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, and the Oklahoma City Physics Classes. These four classes were further subdivided by sex and the responses to each item were tabulated.

Analysis of the data---Answers to the questions presented following the statement of the problem were formulated by examining the data concerned with each question.

Definition of Terms

The following definitions are necessary for clarification and interpretation of the study.

1. Senior High School includes grades 10, 11, and 12. It does not, under any conditions, include grades 7, 8, and 9.

2. Regular classes (or courses) are those classes or courses for which the State Department of Education approves credit toward graduation.

3. Special science programs include the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, and the Oklahoma City Science Fairs.

4. Oklahoma High School Institutes includes only those students who attended the courses offered at Oklahoma State University during the years 1956-1962.

5. Oklahoma City Physics Classes include only those students who took physics in the Oklahoma City Public Schools. It does not include physics classes offered by the Oklahoma City Public Schools over television to schools outside the Oklahoma City School District.

6. Oklahoma City Science Fairs includes only those students who won awards during their 10, 11 and 12 grades during the years 1956-1962.

7. Continue in Science includes only those students who checked items 10-11 of the questionnaire (Page 34) which requested the student to check the appropriate box if he majored either in engineering or in science.

8. The Sir Alexander Fleming Awards Participants in general will be referred to as the Fleming Participants.

9. The Oklahoma High School Institutes Participants in general will be referred to as the Institute Participants.

10. The Oklahoma City Science Fairs Participants in general will be referred to as the Science Fair Participants.

11. The Oklahoma City Physics Classes Participants in general will be referred to as Physics Classes Participants.

CHAPTER IV

ANALYSIS OF THE DATA

The information obtained by tabulating the returns to the questionnaire is reported and analyzed in this chapter. Summaries of the replies to each item of the questionnaire were prepared in tabular form. Those tables which were related to the more important aspects of the study are included in this chapter. The remaining tables related to the questionnaire are included in the Appendix.

The reporting of the findings is in terms of the hypotheses and questions listed in Chapter III.[1] The tables which apply to each of these hypotheses and questions are therefore referred to in reporting answers to the hypotheses and questions. The tables in the Appendix are not necessarily referred to in sequential order because they follow the order of the items of the questionnaire. The format of the questionnaire and the placement of the items in it were based upon logical order, simplicity of completion, and conservation of space. It was necessary, therefore, occasionally to present an item in another place in the questionnaire in the interest of observing the last two criteria.

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[1] Supra, pp. 27, 28, and 29.

General Information

Table 1 presents the numbers who were included in the study, both male and female. It also includes those who did not continue to college. The greatest number of replies came from the Oklahoma High School Institutes participants. The questionnaires were received from more than 70 per cent of the participants of the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, and the Oklahoma City Science Fairs. The number of questionnaires received from the Oklahoma City Physics Classes participants was slightly more than 50 per cent.[1]

Table 1

TOTAL NUMBER OF QUESTIONNAIRES USED IN THE STUDY IN EACH OF THE FOUR PROGRAMS.[a]

Fleming	Institute	Science Fair	Physics
98	268	131	213

[a]Questionnaire Item 1.

Table 2 reports the numbers who were included in the study by sex. It is to be noted that a significantly greater number of males participated in three of the programs. The Sir Alexander Fleming Awards Programs had almost equal numbers of males and females. The predominance of males in the three programs was the primary reason that most of the tables and computations were segregated by sex for each program.

[1]Supra, p. 38.

Table 2

TOTAL NUMBER OF QUESTIONNAIRES USED IN THE STUDY BY SEX IN EACH OF THE FOUR PROGRAMS.[a]

Program	Male	Female	Total
Fleming	54	44	98
Institute	223	45	268
Science Fair	90	41	131
Physics	183	30	213

[a]Questionnaire Item 28.

Table 3 reports the percentage distribution by sex of the participants of the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes. As has been previously indicated, the Sir Alexander Fleming Awards Programs had almost equal numbers of males and females participating while the other three programs were dominantly male.

Table 3

PER CENT OF PARTICIPANTS IN EACH OF THE FOUR PROGRAMS BY SEX.[a]

Programs	Male %	Female %	Total %
Fleming	55	45	100
Institute	83	17	100
Science Fair	69	31	100
Physics	86	14	100

[a]Questionnaire Item 28.

To What Extent Have the Participants in the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes Programs Continued to College?

The data in Table 4 show that 99 per cent of the Sir Alexander Fleming Awards Winners and the Oklahoma High School Institutes respondents continued to college. The corresponding values for the Oklahoma City Physics Classes were 96 per cent and for the Oklahoma City Science Fairs 95 per cent. Clearly, there is very little difference in the per cent of respondents for each program who continued to college. All of the participants of the four programs continued to college at a very high level. Incidentally, it has been estimated that between 50 and 60 per cent of all Oklahoma high school seniors continue to college.[1] This fraction is approximately equal to the national average.[2]

Table 4

PER CENT OF RESPONDENTS IN THE FOUR PROGRAMS WHO CONTINUED TO COLLEGE.[a]

Program	%
Fleming	99
Institute	99
Science Fair	95
Physics	96

[a]Questionnaire Item 2.

[1]Statement by Dan Hobbs, State Regents for Higher Education, Okla.

[2]Supra p. 12.

Table 5 reveals the number who either did or did not attend college. In two of the programs every female who responded continued to college. These are the Sir Alexander Fleming Awards and the Oklahoma High School Institutes programs. The number of males as compared to the number of females who did not continue is approximately the same ratio as the total number of males as compared to the total number of females in all four programs.

Table 5

PARTICIPANTS IN THE FOUR PROGRAMS WHO EITHER DID OR DID NOT GO TO COLLEGE BY SEX.[a]

Program	Went to College		Did not go to College	
	Male	Female	Male	Female
Fleming	53	44	1	0
Institute	220	45	3	0
Science Fair	86	39	4	2
Physics	177	28	6	2

[a]Questionnaire Item 2.

Is There a Difference Between the Number of Males and Females in Each Program Who Continued in Science?

Table 6 indicates a pronounced sex difference in the numbers who continued in science. This difference necessitated generally for most tabulations and computations the separation of each program by sex. As

expected, the males continued in science a much higher rate than the females. Seventy four per cent of the males continued in science as contrasted with 55 per cent of the females for all of the four programs combined.

The males and females of the Sir Alexander Fleming Awards Programs continued in science at almost the same rate. The males of the other three programs continued in science at a much higher rate than the females of the same programs.

Table 6

PARTICIPANTS WHO DID OR DID NOT CONTINUE IN SCIENCE BY SEX.[a]

Programs	Continued in Science		Did Not Continue	
	Male	Female	Male	Female
Fleming	45	34	6	9
Institute	177	22	43	23
Science Fair	58	15	28	24
Physics	116	14	61	14

[a]Questionnaire Items 10-13.

Table 7 shows no significant difference in the number of males who continued in science between the Fleming and the Institutes Programs. Both programs are doing what they purport to do, delivering significant numbers of students to science related careers. The fraction that they are delivering is approximately equal to the fraction delivered by other science programs sponsored on a national level.[1]

[1]Supra pp. 9, 10, 11.

Table 7

CONTINUATION OF MALES IN SCIENCE.[a]

Hypotheses* No. 1-6 (Page 27)	Program Delivery to Science Majors	Differences
1.	Fleming vs. Institute	No Significant Difference
2.	Fleming vs. Science Fair	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
3.	Fleming vs. Physics	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
4.	Institute vs. Science Fair	Significant Difference in Favor of the Oklahoma High School Institutes Programs
5.	Institute vs. Physics	Significant Difference in Favor of the Oklahoma High School Institutes Programs
6.	Science Fair vs. Physics	No Significant Difference

[a]Questionnaire Items 10-11.

*Detailed tables in Appendix, pp. 92-99.

There is a significant difference in favor of the Fleming and Institutes Programs when compared with the Science Fairs and Physics Classes Programs. This difference is probably due to a number of factors. Two factors readily identified are the nature of the program offered and

the method of selection of the students to participate.

One of the criteria for participation in the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs is high scholastic attainment. This is not one of the criteria for admission to a science fair and is not rigorously adhered to for admission to a physics class. Another one of the criteria which is common to all four programs is recommendation by a science teacher. This criterion seems to be rather closely followed by the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs but is followed to a lesser degree by the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Programs. The Oklahoma City Science Fairs Programs had little screening or recommendations by science teachers for entrance to the fair during the period under study from 1956-1962, but this fair more recently has began a screening of the projects by the teachers primarily because of lack of room for the projects plus an attempt to develop a better quality of project displayed. The recommendations for entrance into a physics class vary somewhat from school to school with each school screening the students to some degree.

A third criterion for the Sir Alexander Fleming Awards and the Oklahoma High School Institutes programs is proficiency in mathematics and English. The other two programs have no English stipulation and the Oklahoma City Physics Classes generally expect the enrollees to have taken or to be taking trigonometry; but even this varies from school to school.

A fourth criterion is a definite accomplishment or interest in science. All four programs attract students interested in science while usually only the Sir Alexander Fleming and the Oklahoma High School

Institutes Programs limit participation to those who have shown a definite accomplishment in science. In the science fairs, most students are entering for the first time, and they generally have not shown other types of accomplishments in science. Very few of the physics participants have entered a science fair or have tried to participate in one of the other science programs.

A fifth criterion is a student's previous high school work; his transcript has been reviewed by an admissions committee in both the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs. Generally all students who want to be are enrolled in physics and the same is true for the students who want to participate in the science fair.

A sixth criterion is that the students in the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs are doing their work away from home while the other two programs are conducted in the student's school and his own home environment. Studies of the traits or characteristics in the life history background of students who achieve in science indicate that they have psychological independence.[1] These two programs which have the students away from home may be attracting students who are more psychologically independent than the students who participate in the programs in their own local environment.

A seventh criterion is that the students of the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs are

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[1]Supra p. 16.

placed in direct contact with "authorities" in the field of science, whereas, the students in the other two programs may have limited contact with authorities in the field. Another trait or characteristic of the life histories of students who achieve in science is association with people in the academic and scientific world.[1]

This study did not develop data which could finally explain the smaller science major yield of science fairs and the physics classes. Possible factors are presented below as speculations which may be of use to other investigators.

1. Some high school science teachers base a portion of the student's grade on a science fair project.

2. Some high school science teachers require every student in class to have a science fair project. This is most noted in the so called "accelerated" classes.

3. A science fair project may or may not be the student's own work.

4. The science fair judge although extremely competent in his own field may not be familar with the work of students.

5. The Oklahoma City Science Fair has categories in which several students work together on a project. It is very possible that in such projects, one member of the group might have a greater interest in science and do most of the work.

6. The Oklahoma City Science Fair has an Earth Science Division and the opportunities in these areas for careers have steadily declined since 1950.

7. The greater number of science fair projects come from grade 10 when most high school students are taking a course in biology. This is a required subject and not an elective course.

8. The physics classes are open to every student who wants to take this course. There are minimum requirements but in some schools these requirements are not rigorously followed.

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[1] Supra p. 16.

Table 8

CONTINUATION OF FEMALES IN SCIENCE.[a]

Hypotheses* No. 7-12 (Page 28)	Program Delivery to Science Majors	Differences
7.	Fleming vs. Institute	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
8.	Fleming vs. Science Fair	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
9.	Fleming vs. Physics Classes	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
10.	Institute vs. Science Fair	No Significant Difference
11.	Institute vs. Physics	No Significant Difference
12.	Science Fair vs. Physics	No Significant Difference

[a]Questionnaire Items 10-11.

*Detailed tables in Appendix, pp. 100-107.

Table 8 shows significant differences between the numbers of females who continued in science from the Fleming Programs and those who participated in the Institutes, Science Fairs, and Physics Classes Programs. The basic factors are probably essentially the same as those

listed for the males.[1]

However, the primary reason why more of the females of the Fleming Programs continued in science may possibly be found in the difference among the programs offered to all of the females of the four groups. The research program for the Sir Alexander Fleming Awards Participants included work in the following special fields: biochemistry, biophysics, bacteriology, psychology, endocrinology, organic chemistry, pharmacology, analytical chemistry, and oncology. The Fleming participants are also thrown into direct contact with many young ladies who are employed at the Oklahoma Medical Research Foundation in various facets of scientific research. The other three programs are somewhat barren in the number of female contacts for their female participants.

Three of the programs had significantly more males in each of the programs than females.[2] It is quite possible that these programs could be more male-oriented because of the large number of male participants. Since the Sir Alexander Fleming Awards Programs include nearly equal numbers of males and females, they may have a better balanced program in regard to the science desires of young males and females.

The differences noted among the various programs might be attributed to differences within the programs or they could be due to differences among the participants selected for the programs. The

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[1] Supra pp. 46, 47, and 48.

[2] Supra p. 42.

respondents were asked through questionnaire item 25 about their high school grade averages. This information was checked by asking the respondents to check their high school honors and activities. One of these activities was the National Honor Society. Their responses to both of these questions were consistent.

The statistically significant differences noted among the numbers who continued in science from the different programs suggested that the grade averages of the respondents should be examined to determine whether the differences could have been related to the differences among the abilities of the participants in each of the four programs.

Are there Significant Differences Among the Grade Averages of the Males and Females Who Continued in Science from the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes?*

Table 9

HIGH SCHOOL GRADE AVERAGES OF THE PARTICIPANTS OF THE FOUR PROGRAMS.[a]

Grade Average	Fleming		Institute		Science Fair		Physics	
	M	F	M	F	M	F	M	F
Over 3.5	41	37	148	37	30	20	52	15
3.0 - 3.5	9	5	62	7	26	17	66	9
2.5 - 2.9	2	1	8	1	27	2	49	4
Under 2.5	0	0	2	0	2	0	9	0

[a]Questionnaire Item 25; numbers are raw counts.

*Detailed tables in Appendix, pp. 107-121.

Table 9 shows the Sir Alexander Fleming Awards participants with the highest grade averages of the four programs. The fraction of this group with averages over 3.5 was 86 per cent for the females and 79 per cent for the males. The Oklahoma High School Institute participants had the next highest grade averages with 82 per cent for the females and 67 per cent for the males presenting grade averages over 3.5. The remaining two programs had much lower grade averages. The Oklahoma City Science Fairs had about 36 per cent for the males and 51 per cent for the females with grade averages above 3.5. The Oklahoma City Physics Classes had about the same grade averages as the Oklahoma City Science Fairs.

This indicates that more participants should have continued to college from the Sir Alexander Fleming Awards and the Oklahoma High School Institutes than the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Programs. This was not borne out by this study because over 95 per cent of all of the respondents started to college.[1] In general students with the higher grade averages in Oklahoma continue to college in greater numbers than students who have poorer grades.[2]

This is possibly another one of the reasons why more of the students of the Sir Alexander Fleming Awards and the Oklahoma High School Institutes continued in science in greater numbers when compared with the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Programs. In general, students with higher grade averages

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[1]Supra p. 43.

[2]John J. Coffelt and Dan S. Hobbs, "In and Out of College," Oklahoma State Regents for Higher Education, October, 1964, p. 19.

major more frequently in science than in other areas.[1]

The grade average difference does not account for the difference between the numbers of females of the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs who continued in science. This difference probably lies within the programs themselves.

Table 10

THE GRADE AVERAGES OF THE MALES IN THE FOUR PROGRAMS.[a]

Hypotheses* No. (Page 28)	Programs	Difference
13.	Fleming vs. Institute	No Significant Difference
14.	Fleming vs. Science Fair	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
15.	Fleming vs. Physics	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs.
16.	Institute vs. Science Fair	Significant Difference in Favor of the Oklahoma High School Institutes Programs
17.	Institute vs. Physics	Significant Difference in Favor of the Oklahoma High School Institutes Programs.
18.	Science Fair vs. Physics	No Significant Difference

[a]Questionnaire Item 25.

*Detailed tables in Appendix, pp. 107-118.

[1]Ibid., p. 71.

Table 10 shows no significant differences between the grade average of the males in the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs. This finding is consistent with the findings of no significant differences between the males in the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs in continuation in science. The selectivity of the candidates for scholastic attainment in both programs is equally high.

There are significant differences between the grade averages of the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Participants males when compared with the males of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Programs in favor of the first two programs mentioned. This finding was somewhat expected in light of the fact that more of the Fleming and Institutes Participants continued in science than did the Science Fairs and the Physics Classes Participants, because in general the more able students continues in science at a higher frequency than the less able students.

The Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs are clearly attracting more scholastically capable students than are the other two programs.

There is no significant difference between the grade averages of the males of the Oklahoma City Science Fairs and the males of the Oklahoma City Physics Classes. This is consistent with the findings of no significant difference between the continuation in science of the males of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes. This strongly indicates that the Oklahoma City

Science Fair has no more value in encouraging students to begin careers in science than do physics classes in the Oklahoma City Public Schools. The value of the Oklahoma City Science Fair must be found in other purposes of science fairs.[1]

Table 11

THE GRADE AVERAGES OF THE FEMALES IN THE FOUR PROGRAMS.[a]

Hypotheses* No. (Page 28)	Programs	Differences
19.	Fleming vs. Institute	No Significant Difference
20.	Fleming vs. Science Fair	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
21.	Fleming vs. Physics	Significant Difference in Favor of the Sir Alexander Fleming Awards Programs
22.	Institute vs. Science Fair	Significant Difference in Favor of the Oklahoma High School Institutes Programs
23.	Institute vs. Physics	Significant Difference in Favor of the Oklahoma High School Institutes Programs
24.	Science Fair vs. Physics	No Significant Difference

[a]Questionnaire Item 25.

*Detailed tables in Appendix, pp. 115-121.

[1]Supra p. 25.

Table 11 shows that there is no statistically significant difference between the grade averages of the females in the Sir Alexander Fleming Awards Programs and the Oklahoma High School Institutes Programs. This is not consistent with the previous findings between the two programs with respect to continuation in science. Apparently the difference lies in the programs because both programs appeal to the student who has demonstrated accomplishments in science as well as an expressed interest in science. It is very possible that the activities of the Medical Research Foundation are more geared to the needs of the females with their emphasis being placed on research and having more women involved in this sort of work at the Foundation.

There was found to be a significant difference between the grade averages of the females in the Sir Alexander Fleming Awards and the grade averages of the females in the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Programs. This is consistent with the findings of a significant difference between the numbers continuing in science from these programs, because in general the more capable the student the more frequently he will major in science. Also it will be remembered that the Sir Alexander Fleming Awards Programs expose their female participants to more women at work in science than do the other programs.

A significant difference was found between the grade averages of the females in the Oklahoma High School Institutes and the grade averages of the females in the Oklahoma City Science Fairs and the Oklahoma City Physics Classes. It would have been expected that a larger fraction of the females of the Oklahoma High School Institutes

Programs would have continued in science because of their better grade averages, and in general the more capable students continue in science careers in greater numbers than do the less capable students.[1] This implies that the Oklahoma High School Institutes Programs with more capable female participants is not doing any better in encouraging females to continue in science than are the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Programs.

No significant difference was found between the grade averages of the females of the Oklahoma City Science Fairs and the grade averages of the females of the Oklahoma City Physics Classes Program. This finding is consistent with the findings of no difference in the numbers continuing in science. Both programs attract girls of about equal ability and neither program is superior to the other as far as the number who continue in science.

How Does the Choice of the College Major Vary With the Program of the Respondents?

Table 12 indicates some dissimilarities between the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs. All previous information indicated that the two programs had much in common. Table 12 shows the college that the student was enrolled in at the time of his attendance in college.

One of the big differences between the Fleming and the Institutes Participants was in their selection of colleges. The Fleming male participants selected predominatly colleges of Arts and Sciences. Very few of the male or female Fleming Participants selected the Colleges

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[1]Coffelt and Hobbs, op. cit. p. 71

of Engineering. Sixty seven per cent of the males from the Sir Alexander Fleming Awards Program were enrolled in colleges of Arts and Sciences at the time of this study. The Oklahoma High School Institutes Participants were more equally divided between the Colleges of Arts and Science and the Colleges of Engineering. Forty nine per cent of the Institutes' male participants were enrolled in Colleges of Arts and Sciences and 31 per cent in the Colleges of Engineering.

The Oklahoma City Science Fairs Participants more closely emulated the Sir Alexander Fleming Awards participants in their selection of colleges. The Oklahoma City Physics Classes Participants more closely followed the selections of colleges of the Oklahoma High School Institutes. Sixty-four per cent of the males from the Oklahoma City Science Fairs Programs were enrolled in the Colleges of Arts and Sciences and twelve per cent were enrolled in the Colleges of Engineering. Forty-seven per cent of the males of the Oklahoma City Physics Classes Programs were enrolled in the Colleges of Arts and Sciences and twenty-eight per cent were enrolled in the Colleges of Engineering.

Little difference could be noted among the four programs for selection of other colleges. Not a single Sir Alexander Flemings Awards participant enrolled in the Colleges of Business Administration. Fewer than ten per cent of the students in all four of the programs matriculated in Colleges of Education.

Table 12

COLLEGES OF ALL RESPONDENTS.[a]

Colleges	Participants							
	Fleming		Institute		Science Fair		Physics	
	M	F	M	F	M	F	M	F
Arts and Sciences	40	24	105	25	52	28	77	19
Business Administration	0	0	19	3	12	3	30	1
Education	3	5	11	13	2	7	5	8
Engineering	8	1	83	0	15	0	58	0
Fine Arts	0	2	1	1	3	4	4	1
Pharmacy	1	0	1	0	1	0	3	0
None of these listed	4	3	13	6	7	2	5	1

[a]Questionnaire Items 3-9.

Table 13 shows that more of the Sir Alexander Fleming Awards respondents continued in science as contrasted with engineering than any of the other programs. This is probably due to at least two factors. These factors are (1) the nature of the Sir Alexander Fleming Awards Program, and (2) the higher percentage of females in this program.

More of the Institutes participants continued in science than in engineering, but the ratio was about 3 to 2; whereas, the ratio for

the Fleming participants was about 9 to 1 in favor of science. The Oklahoma City Science Fairs Program had 80 per cent of their participants in science and 20 per cent in engineering. This strongly suggests that the science fairs have greater appeal for the student who is interested in the sciences as contrasted with engineering.

Table 13

PER CENT OF RESPONDENTS WHO CONTINUE TO COLLEGE AND MAJORED EITHER IN SCIENCE OR ENGINEERING.[a]

Program	Science %	Engineering %
Fleming	89	11
Institute	60	40
Science Fair	80	20
Physics	57	43

[a]Questionnaire Items 10-11.

As in the other three programs, the Physics Classes participants continued in sciences more than in the fields of engineering. However, the members of this group did continue in engineering more frequently than any of the other three groups. This indicates that either students interested in engineering take high school physics or that some of the facets of the high school physics courses encourage more of them to go into engineering.

What is the Most Popular Field in Engineering?

The engineering field was almost exclusively for the males in each program (Table 14). The Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes participants selected electrical engineering in the greatest numbers. Chemical engineering was selected next by the most respondents but mostly by members of the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs. The third and fourth selections by all of the four program participants were mechanical engineering and space and aeronautical engineering. These were followed in order by architectural, civil, general, engineering physics, industrial management, and agricultural engineering.

Three of the engineering fields were almost completely ignored by the participants of the four programs. These engineering fields were metallurigical, petroleum, and geological engineering fields. This is in keeping with the current national trend of fewer individuals entering these fields.

Table 14

NUMBER IN EACH PROGRAM WHO MAJORED IN ENGINEERING[a]

	Fleming	Institute	S. Fair	Physics
Aeronautical and Space	1	6	2	9
Agricultural	0	3	0	0
Architectural	0	3	3	7
Chemical	4	19	0	4
Civil	1	3	1	6
Electrical	2	23	4	13
Engineering Physics	1	0	2	4
General	0	3	0	0
Geological	0	1	0	1
Industrial Management	0	6	0	2
Mechanical	0	9	1	9
Metallurgical	0	0	0	0
Petroleum	0	1	0	0
Other Engineering	0	7	2	1

[a]Questionnaire Items 10-11, parts 1-14.

What is the most Popular Field in Science?

The choice of the selections of the careers in science closely parallels recent national studies of the selections of careers by science interested students.[1] Mathematics was clearly the first selection of the

[1]Supra pp. 3 and 7.

Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes. This may be a reflection of the trend of mathematics teaching. It was about 1956 when "new" mathematics courses were introduced to the students of Oklahoma and new courses have been added almost yearly.

Chemistry was the second selection by most of the participants of three of the four programs. Chemistry was the first selection of the Fleming participants. This is a strong suggestion that the research program offered to the Sir Alexander Fleming Awards participants is a chemistry oriented program.

Zoology was the third selection of all of the programs. More females of the Sir Alexander Fleming Awards and the Oklahoma High School Institutes selected this area than did the males of the same programs. The males from the other two programs majored in zoology in greater numbers than did the females of the same two programs.

The fourth choice was physics with slightly over three times as many males taking physics as females.

A single individual in the Oklahoma High School Institutes Programs selected astronomy as his major. The field of geology also closely followed the national trend with very few students majoring in this area.[1]

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[1]Supra p. 3

Table 15

NUMBER IN EACH PROGRAM WHO MAJORED IN SCIENCE[a]

Science	Fleming		Institute		S. Fair		Physics	
	M	F	M	F	M	F	M	F
Astronomy	0	0	1	0	0	0	0	0
Bacteriology	0	0	2	0	3	0	2	1
Botany	0	0	1	0	1	0	0	0
Chemistry	17	19	26	2	5	0	7	2
Dentistry	0	0	3	0	0	0	2	0
Geology	0	0	0	0	1	1	1	1
Mathematics	6	6	29	8	11	4	18	5
Medicine	6	3	7	1	6	2	9	0
Physics	3	1	13	0	6	2	10	2
Zoology	2	6	6	11	7	4	7	2
Other Science	4	3	6	8	4	2	3	1

[a]Questionnaire Items 10-11, parts 15-25.

How Many Hours in Each Science Field Have the Sir Alexander Fleming Awards Participants Completed?

An analysis of Table 16 reveals that the Sir Alexander Fleming Awards Participants not only took mathematics and chemistry in the greatest numbers for their science courses but also took them in greater depth. Astronomy was taken by 5 per cent of the group, but none of this group majored in astronomy. Botany was taken by 34 per cent and again none of these students majored in this area. Chemistry was selected in greater depth by more of the Fleming participants, with 85 per cent

taking at least one course and 42 per cent majoring in chemistry. The Sir Alexander Fleming Awards program is either doing a very good job of selecting students who are interested in careers in chemistry, or some of the various facets of the Sir Alexander Fleming Awards Program are definitely chemistry oriented. More of the Fleming participants took mathematics than any other area but only about 14 per cent of the group majored in this area. Physics was taken by 61 per cent of the group with about 5 per cent making this their major. Zoology was taken by about 43 per cent of the Fleming participants with about 9 per cent majoring in this area and these were mostly females.

Table 16

NUMBER OF SEMESTER HOURS COMPLETED BY THE SIR ALEXANDER FLEMING AWARDS PARTICIPANTS IN EACH SCIENCE FIELD.[a]

Science	0-9	10-19	20-29	30-39	40-49	50-59	Over 60
Astronomy	4	1	0	0	0	0	0
Botany	29	4	0	0	0	0	0
Chemistry	35	22	12	4	5	1	3
Geology	12	0	0	0	0	0	0
Mathematics	49	22	12	2	0	3	2
Physics	27	28	3	1	0	0	0
Zoology	22	12	2	1	4	0	1

[a]Questionnaire Items 15-21.

How Many Hours in Each Science Field Have the Oklahoma High School Institutes Participants Completed?

Table 17 indicates that the Oklahoma High School Institutes participants, like the Sir Alexander Fleming Awards participants, not only took mathematics and chemistry in the greatest numbers but also in greater depth. This was the only group of the four that produced a major in astronomy, though fewer than one per cent took any courses in astronomy. About this same per cent majored in botany but 21 per cent took at least an introductory course. Almost as large a percentage of this group took chemistry as did the Sir Alexander Fleming Participants. The similarity ends in the number who majored in chemistry with slightly over three times as many of the Fleming participants as Institutes Participants majoring in chemistry. There was a single participant who majored in geology and 21 per cent took an introductory course. Mathematics was taken by a higher fraction of the Institutes participants than by those involved in the other programs but only the Fleming Program had fewer majors in this field. There were 6 per cent physics majors and 67 per cent taking at least one course. Zoology had 8 per cent majors with 30 per cent taking at least one course.

Table 17

NUMBER OF SEMESTER HOURS COMPLETED BY THE OKLAHOMA HIGH SCHOOL INSTITUTES PARTICIPANTS IN EACH SCIENCE FIELD.[a]

Science	0-9	10-19	20-29	30-39	40-49	50-59	60+
Astronomy	12	0	0	0	0	1	0
Botany	52	4	1	0	0	0	0
Chemistry	130	56	9	9	2	2	3
Geology	49	0	0	0	0	0	1
Mathematics	89	86	42	18	10	9	3
Physics	90	73	9	2	0	2	1
Zoology	63	13	3	1	0	0	0

[a]Questionnaire Items 15-21.

How Many Hours in Each Science Field Have the Oklahoma City Science Fairs Participants Completed?

An analysis of Table 18 shows that the Oklahoma City Science Fairs participants took mathematics in the greatest numbers and in greater depth than any of the other subjects.

Introductory course were taken by 5 per cent of this group in astronomy. One per cent of this group majored in botany with 16 per cent taking at least one course. Chemistry was selected by the next largest per cent with about 7 per cent majoring in chemistry and 60 per cent taking at least an introductory course. This was the smallest fraction taking chemistry although just as many majored as did from the Physics Classes Programs. Mathematics was taken by 76 per cent of the

respondents with 21 per cent majoring in mathematics. Physics was taken by 50 per cent of the group with 11 per cent majoring in this area. This is the same percentage as was obtained for the students who took physics in high school. Only the Fleming participants took zoology in greater numbers than the Science Fair Participants and yet more Science Fair participants majored in zoology than did the Fleming participants. Geology was taken by a percentage of the Science Fair Participants higher than that of those participating in the other three programs, also, more majored in geology. This is a strong indication that high school students who are exposed to earth science activities more frequently will select this as their college major. The Science Fairs are probably the only ones of these four programs that expose students to much in the way of earth science activities.

Table 18

NUMBER OF SEMESTER HOURS COMPLETED BY THE OKLAHOMA CITY SCIENCE FAIRS PARTICIPANTS IN EACH SCIENCE FIELD.[a]

Science	0-9	10-19	20-29	30-39	40-49	50-59	60-69
Astronomy	6	0	0	0	0	0	0
Botany	17	1	0	0	1	1	0
Chemistry	40	22	8	4	0	0	0
Geology	28	0	2	0	0	0	0
Mathematics	50	21	10	9	3	2	0
Physics	30	19	6	2	2	3	0
Zoology	29	9	5	1	1	0	1

[a]Questionnaire Items 15-21.

How Many Hours in Each Science Field Have the Oklahoma City Physics Classes Participants Completed?

Table 19 shows that the Oklahoma City Physics Classes participants like the participants of the three other groups took mathematics in the greatest numbers as well as in greater depth. Astronomy was taken by four per cent. One per cent majored in botany with 14 per cent taking at least one course in botany. Chemistry as with the other programs was taken by a very high percentage of the group. Sixty nine per cent took chemistry with seven per cent making it their major field. Only the Science Fair participants took geology in greater numbers than did the Physics participants. Mathematics was taken in greatest numbers by this group as well as the highest percent majoring in this subject. Zoology was taken by 27 per cent of this group with seven per cent majoring in this subject. Physics was taken by 50 per cent of the group with 11 per cent majoring in physics. All of the other three programs had as many or more students taking college physics courses as did the Oklahoma City Physics Classes Program, and the Oklahoma City Science Fairs Programs had as many majoring in physics. Apparently the taking of physics in high school does not greatly increase the number of students who major in this subject in college.

Table 19

NUMBER OF SEMESTER HOURS COMPLETED BY THE OKLAHOMA CITY PHYSICS CLASSES PARTICIPANTS IN EACH SCIENCE FIELD.[a]

Science	0-9	10-19	20-29	30-39	40-49	50-59	60-69
Astronomy	9	0	0	0	0	0	0
Botany	26	1	1	0	0	0	0
Chemistry	83	41	12	5	0	0	0
Geology	42	0	2	1	0	0	0
Mathematics	76	53	28	7	6	1	1
Physics	29	56	8	4	1	2	2
Zoology	37	11	4	4	0	0	0

[a]Questionnaire Items 15-21.

What are the Degrees Possessed by the Participants?

There was very little observable difference among the numbers of the participants of each program who had degrees. Most of the participants for the years of 1956-1962 are still in college.

The four programs had the greatest similarities in bachelors degrees and began to differ slightly in the masters degrees with the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes participants having the greatest numbers of masters degrees. Little could be told about the doctors' degrees because of the lack of time since high school graduation but from the returns four males who had participated in the Sir Alexander Fleming Awards Programs had received doctors' degrees. These four degrees were in medicine. One male in the Oklahoma City Physics Classes

also received a medical degree. Four others in different programs indicated that they were now in medical school but had not received bachelors degrees prior to going to medical school.

Only one student volunteered the information that he was going to get a PhD and he was a student who did not plan to continue in science.

Table 20

DEGREES POSSESSED BY PARTICIPANTS[a]

Program	None		Bachelors		Masters		Doctors	
	M	F	M	F	M	F	M	F
Fleming	37	28	11	15	1	0	4	0
Institute	156	33	53	12	11	0	0	0
Science Fair	57	22	22	16	7	1	0	0
Physics	114	21	52	7	10	0	1	0

[a]Questionnaire Item 22.

How Many Respondents Are in Each Program by College Semester Hours Earned?

This was questionnaire item 14 and the data are found in Table 21. These data suggest that the participants in each program are progressing regularly through their college programs with no indication for any program that a substantial number of participants have left school.

The largest number of participants checked the "120 and over" semester hours column. This was what was expected for the participants who have completed high school in 1956, 1957, and 1958. These groups have now had time to complete at least 120 semester hours.

Table 21

NUMBER IN EACH PROGRAM BY SEMESTER HOUR[a]

Program	0-29	30-59	60-89	90-119	120 and over
Fleming	10	17	14	11	34
Institute	23	49	57	47	91
Science Fair	12	25	19	16	51
Physics	18	35	46	26	80

[a]Questionnaire Item 14.

What Were the High School Honors and Activities For The Participants in Each of the Four Programs?

Table 22 indicates that the National Honor Society was the activity most frequently reported by students in each program. The Sir Alexander Fleming Awards and the Oklahoma High School Institutes participants belonged to the National Honor Society at level of 65 and 68 per cent respectively. The Oklahoma City Science Fairs participants belonged to the National Honor Society at an approximately 10 per cent lower level than the Fleming and Institutes participants. The Oklahoma City Physics Classes participants were another 10 per cent lower than the Science Fair participants. This again supports the idea that Fleming and Institutes participants are academically superior students when compared with the other two programs.

The next most popular activity was the science club. More of the Science Fair participants participated in this activity than any of the other groups. The Fleming and Institutes participants belonged

to the science clubs at about a 10 per cent lower level than did the Science Fair Participants. The participants of the Oklahoma City Science Fairs belonged to science clubs almost two to one when compared with the physics classes participants. Participation in science clubs did not seem to be a critical area as far as this study was able to determine. Factors other than participation in a science club seemed to be more important, because the Science Fair participants and the Physics Classes participants should have had almost equal opportunities to belong to this organization. No differences were observed between these two in continuation in science and so it must be concluded that factors other than participation in a science club are dominant in career selection.

The student council was the next most frequently checked activity of the participants of the four programs. Little difference was noted among the participants of the four groups in participation in this area. The only observable difference was that the Science Fairs participants were 10 per cent below the other groups in total participation in student council activities.

Athletics, which has generally been considered to occupy too great a portion of the activities programs, was check by about one-half of the Institutes and Physics Classes participants and by about one-fourth of the other participants.

The next most frequently checked activity was participation as a class officer. The Institutes groups held the highest percentages of class offices. The Fleming participants held about 10 per cent fewer class offices, and the Science Fairs and the Physics Classes

participants had even fewer holding class offices.

The sixth most frequently checked activity was participation in a mathematics club. Few differences were noted among the numbers from each program who belonged to a mathematics club. It was anticipated that more students from all of the groups would have belonged to the mathematics club because mathematics was the first selection as a career with the Institutes, Science Fairs, and Physics Classes participants and a second choice with the Fleming Participants. Mathematics clubs are generally available to students in all but the smallest schools in Oklahoma. The large numbers going into mathematics must then be attributed to improvements in the mathematics curriculum or the increased need for mathematicians.

About one-third of the participants from the three of the programs belonged to pep clubs. The Institutes participants belonged to pep clubs at about the 16 per cent level. This is attributed to the fact that more of the institutes participants were active in athletics, and this probably interfered with their participation in a pep club.

More of the Oklahoma City Science Fairs participants checked the fine arts clubs than any of the other groups. Almost as many of the Fleming participants belonged to fine arts clubs as did the Science Fair participants. The other two groups had 10 per cent fewer belonging to the fine arts clubs.

Table 22

HIGH SCHOOL HONORS AND ACTIVITIES FOR PARTICIPANTS WHO CONTINUED TO COLLEGE[a]

	Fleming		Institute		Science Fair		Physics	
	M	F	M	F	M	F	M	F
Athletics	20	8	123	7	31	4	86	3
Fine Arts Club	10	9	42	12	15	14	12	9
National Honor Society	34	31	146	35	37	33	76	19
Mathematics Club	18	18	66	9	26	17	46	12
Pep Club	4	28	12	31	30	26	51	21
Science Club	31	22	111	21	56	23	70	10
Student Council	24	16	102	24	33	12	53	6
School Class Officer	20	12	99	14	20	10	42	6
Other	29	32	105	35	39	22	63	15

[a]Questionnaire Item 24.

What Were the College Honors and Activities for Each of the Programs?

Table 23 indicates that the dominant honor or activity in college for the groups under study was the same as in high school, scholastic excellence. It is interesting to note that although the percentage of students who were either on the Dean's or President's Honor Roll remained the same as the per cent who were on the high school National Honor Society Roll, there was a change in the sex ratio of the participants involved. In three of the programs the

males made the honor roll in college in greater numbers than they did in high school. These three programs are the Sir Alexander Fleming Awards, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes Programs. Only in the Oklahoma High School Institutes Programs was there a slight decline in the number of males who made their college honor rolls when compared with their high school records. This decline was very small, about three per cent, from their high school records.

The Oklahoma City Science Fairs participants continued to participate more in departmental clubs as they had in high school. Little difference could be noted in the participation of the Fleming participants and the Institutes participants; they continued at about the same rate as they had in high school. The Physics Classes participants made the most striking change. They had participated on a very low level while in high school but in college they are participating at the levels of the Fleming Institutes participants.

More of the Oklahoma High School Institutes participants belonged to professional fraternities and sororities than any of the other programs. The other three programs participated on about the same level, about 10 per cent lower than for the Institutes participants.

Athletics was checked by 50 per cent fewer of the participants of the Oklahoma High School Institutes and the Oklahoma City Physics Classes Programs when compared with the numbers of these two programs during their senior high school programs. The percentages participating in high school and college remained fairly constant for the other two programs.

All of the participants of the four programs participated less in college student government than they had in high school. This was perhaps due to less opportunity and lack of time to participate.

Table 23

COLLEGE HONORS AND ACTIVITIES OF ALL PARTICIPANTS.[a]

Honors and Activities	Fleming		Institute		S. Fair		Physics	
	M	F	M	F	M	F	M	F
Athletics	9	7	41	4	23	2	36	3
Dean's or President's Honor Roll	39	30	139	33	40	28	91	18
Departmental Clubs	23	21	90	22	44	23	75	16
Professional Fraternity or Sorority	18	15	78	12	32	12	51	9
Student Government	16	9	38	8	14	3	21	3
Other	24	24	102	23	35	22	63	11

[a]Questionnaire Item 23.

What Are the Minor Fields of All Participants?

Table 24 shows that the minor fields of the participants closely paralleled the choices of the major fields. Mathematics was clearly the most frequently selected field for all participants. Chemistry was selected second as a minor field followed by physics and zoology. None of the participants selected geology as a minor. Astronomy was selected by a single Oklahoma City Physics Classes participant.

Eighty-eight participants of all four programs selected mathematics as a minor field. The Fleming Awards and the Oklahoma High School Institutes participants minored in mathematics more than in any other field. The Oklahoma City Physics Classes delivered equal numbers to minor in mathematics and chemistry. The Oklahoma City Science Fairs participants minored more in chemistry than in mathematics. The Fleming Awards participants minored in mathematics and chemistry in almost equal numbers. The Oklahoma High School Institutes participants had almost twice as many minoring in mathematics as in chemistry.

The Fleming Awards, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes Programs produced almost twice as many minoring in mathematics as in physics.

Twice as many Fleming participants minored in mathematics as in zoology. All of the other programs had very few of their participants minoring in zoology.

Table 24

NUMBER IN EACH PROGRAM WHO MINORED IN SCIENCE[a]

Science	Fleming	Institute	S. Fair	Physics
Astronomy	0	0	0	1
Bacteriology	0	1	1	1
Botany	1	0	2	1
Chemistry	14	19	16	24
Geology	0	0	0	0
Mathematics	16	37	11	24
Physics	6	18	6	10
Zoology	7	5	4	2
Other Sciences	2	12	2	2

[a]Questionnaire Items 12-13, parts 15-25.

How Many Are Married in Each Program?

Table 25 shows the number from each program who married. About 20 per cent of all of the participants married before graduation from college. Marriage apparently was not a major factor in the decision of these students to continue in college.

Table 26 shows a more complete analysis of the marriage pattern of the participants of the four programs. This shows that very few of these participants married before starting to college, though females of the Sir Alexander Fleming Awards Program had approximately 25 per cent of their group marrying before starting to college.

Table 25

MARRIAGES IN THE FOUR PROGRAMS.

Fleming		Institute		Science Fair		Physics		Total
M	F	M	F	M	F	M	F	
14	12	53	21	27	12	66	10	215

[a]Questionnaire Item 26.

Table 26

MARRIAGES IN THE FOUR PROGRAMS BEFORE, WHILE IN, OR AFTER COLLEGE.[a]

	Fleming		Institute		Science Fair		Physics	
	M	F	M	F	M	F	M	F
Before College	0	10	1	1	3	1	2	0
While in College	9	0	39	17	19	5	48	5
After College	5	2	12	3	5	6	16	5

[a]Questionnaire Item 27.

The Non-College Fleming, Institute, Science Fair and Physics Respondents

Little could be learned about the non-college group because of the very high per cent of the respondents who continued to college. Each program enrolled students who did not continue to college. The study indicates that marriage was possibly a factor for the girls that did not continue. Marriage and military service were possible factors for the boys who did not go on to college.

Table 27

RESPONDENTS OF ALL PROGRAMS WHO DID NOT CONTINUE TO COLLEGE[a]

Fleming		Institute		Science Fair		Physics	
M	F	M	F	M	F	M	F
1	0	3	0	4	2	6	2

[a]Questionnaire Items 2 and 28.

Table 27 shows that one per cent of the Fleming and Institute respondents did not continue to college. The Science Fair and Physics respondents yielded five per cent and four per cent respectively not continuing to college.

Table 28

NUMBER IN EACH PROGRAM MARRIED BUT DID NOT CONTINUE TO COLLEGE[a]

Fleming		Institute		Science Fair		Physics	
M	F	M	F	M	F	M	F
0	0	0	0	1	2	5	2

[a]Questionnaire Item 26.

Table 28 shows that every girl who replied and did not continue to college was married. Only eight per cent of the girls who continued to college married before they started to college and 25 per cent married either before college or during college.

A higher per cent of the males who did not continue to college were married than those who continued to college. The figures are 36 per cent for the non-college male and less than one per cent for the college male who married before college. About 25 per cent of the non-college males went directly into service from high school. Tables 29 and 30 show the grade average and high school honors of the non-college students. Little inference can be drawn from these tables because of the few individuals involved.

Table 29

HIGH SCHOOL GRADE AVERAGE OF NON-COLLEGE RESPONDENTS.[a]

Grade Average	Fleming	Institute	Science Fair	Physics
Over 3.5	1	2	1	2
3.0 to 3.5	0	1	2	5
2.5 to 2.9	0	0	2	1
Under 2.5	0	0	1	0

[a]Questionnaire Item 25.

Table 30

HIGH SCHOOL HONORS AND ACTIVITIES OF THE NON-COLLEGE RESPONDENTS.[a]

Honors and Activities	Fleming	Institute	Science Fair	Physics
Athletics	0	2	1	3
Fine Arts Clubs	0	0	1	1
Honor Society	1	1	1	0
Mathematics Club	0	2	1	2
Pep Club	0	0	2	3
Science Club	1	2	1	0
Student Council	0	2	1	1
School Class Officer	0	0	0	3
Other	0	1	2	1

[a]Questionnaire Item 24.

It should be remembered that these data must be considered as tenative only, since they cannot readily be subjected to statistical test.

The foregoing analysis of the data involved consideration of each of the questions formulated at the beginning of the study. It revealed provocative information about each program under study, including some differences as well as similarities among the programs not otherwise suspected.

More information in regard to each of the questions could probably have been obtained, but it was felt a more detailed questionnaire would

lower the returns. The information provided by the analysis of the data seemed adequate for the purposes of the study.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to compare the college careers of students who have participated in the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and Selected Oklahoma City Physics Classes Programs to see if there were any significant differences in the choices of college careers. General information concerning their activities since leaving high school was obtained. A questionnaire was developed to obtain this information. The individual items of the questionnaire were developed to obtain responses to specific questions directly related to the acquisition of information concerning the problem.

Copies of the questionnaire were sent to the participants in the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and Selected Oklahoma City Physics Classes Programs for the years 1956-1962. The returned questionnaires were tallied and summarized in terms of percentages based on the number of respondents to the questionnaires. The summaries are included in Chapters IV, and the Appendix. The data were analyzed in terms of the specific hypotheses and questions which served as the basis for the items of the questionnaire (Chapter IV).

This study has aggregated kinds of data, one of these is relatively firm since it has been tested for replicability with the Chi Square technique. The other is raw data. This is set out in Chapter IV. This section melds both blocks of data with conclusions that might guide these programs and others who are interested in science programs for secondary school students. This chapter will contain items statistical, inferential, and conjectural.

Conclusions

The following conclusions were drawn after a careful analysis of the data:

1. Little difference exists between the numbers of students in each program who responded to the questionnaire who continued to college.

2. More males from all of the programs continued in science when compared with the females from all of the programs.

3. The Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs were by far the most successful of the four programs in the delivery of males to science related careers.

4. The Sir Alexander Fleming Awards Program was by far the most successful of all of the programs in the delivery of females to science related careers.

5. The males and females of the Sir Alexander Fleming Awards and the Oklahoma High School Institutes Programs had significantly higher grade averages than the males and females in the other two programs.

6. A higher percentage of the Sir Alexander Fleming Awards and Oklahoma City Science Fairs participants selected careers in science as contrasted with the frequency of selection of engineering by the Oklahoma High School Institutes and the Oklahoma City Physics Classes participants.

7. Each of the groups has fewer than 10 per cent who selected education as a career and even fewer who indicated that they planned to be science teachers.

8. There was very little difference in the numbers who had obtained degrees from each program.

9. The programs in engineering which drew the greatest numbers were, first, electrical engineering, and second, following closely, chemical engineering.

10. The programs in engineering which drew the least numbers were geological, petroleum, and metallurigical engineering.

11. The most frequent choice of a career field was mathematics. Mathematics was followed in order by chemistry, zoology, and physics.

12. Geology drew the smallest numbers of participants.

13. More respondents for all of the programs were eligible and participated in the honor society than any other high school honor or activity. This was followed by participation in science clubs, athletics, and student government.

Recommendations

The foregoing conclusions suggest the following actions, which if initiated might significantly improve the number and quality of students who plan on making science a career.

1. Each of the four programs should be continued.

The programs are all delivering potential scientists at markedly different rates and each program seems to have some merit but the contributions of each program will need to be evaluated more carefully. Many students who could possibly be excellent engineers or scientists are undecided about their major fields when they go to college. Participation in one of the programs in this study might encourage them to enter a science field. Careful study of the Sir Alexander Fleming Awards Program should be made by parties interested in encouraging females to go into science because the females of this program continued in science at a much higher rate than those involved in the other programs.

2. The Sir Alexander Fleming Awards Program should definitely be continued and expanded.

The Sir Alexander Fleming Awards Program should definitely be expanded because of the extremely high correlation of continuing in science of both its male and female participants. The Sir Alexander Fleming Awards Program was by far the most successful in the numbers of both males and females who continued in science as compared to the other programs under study and percentage wise compared favorably to national studies of the Science Talent Search, SAAS Winners, and National Science Fair Winners. This expansion of the Sir Alexander Fleming Awards Program might be accomplished in three ways.

1. Expansion of the regular summer program to include more participants.

2. Inclusion of a program during the regular school term for students in the greater Oklahoma City area. These students

could participate regularly on a half-day basis either during the morning or in the afternoon.

3. Inclusion of a Saturday program for the central Oklahoma area. This could be either a half-day program or a full day program.

3. The Oklahoma High School Institute should definitely be continued and expanded.

Like the Sir Alexander Fleming Awards Program, the Oklahoma High School Institutes should definitely be expanded because of the extremely high fraction of the males in the program who continue in science. This might be accomplished in several ways.

1. Have double sessions as were held in 1959-1961.

2. Increase the number in each session.

3. Start a Saturday program.

Other ways of increasing the number who continue in science or engineering from the Oklahoma High School Institutes would be either to eliminate the females from the program or to add activities to the Oklahoma High School Institutes which might be of greater value to the females as far as career selection is concerned.

4. The Oklahoma City Science Fair sponsors should carefully examine the purposes for holding this fair.

The Oklahoma City Science Fair should be continued but should emphasize values other than encouraging students to enter science careers, because students taking a regular school program go into science just as much as do the participants of the Oklahoma City Science Fair. The greatest values of the science fairs at the present time is making the public aware of some of the science activities in the

schools and giving large numbers of students an opportunity to display their work. An increased number of science fair students might be encouraged to go into science in the following ways.

1. Many science teachers although very excellent science teachers are not "gadgeteers". Each science teacher could be encouraged to have his own individual project and discuss and display it for his classes.

2. Science teachers can be encouraged not to require science projects but to encourage as many students as possible to make them.

3. Science teachers should encourage the students who are working on projects to consult with others in their area who are proficient in this field.

4. Science teachers should encourage their students at the very first of school to start on a project. Time should be spent carefully explaining the difference between a display and a research project.

5. Every student should be allowed to display his project. This exhibit can very well be in conjunction with the PTA open house. Only the best of the individual school exhibits should be entered in the Oklahoma City Science Fair.

6. Science teachers should be encouraged to have the students with prize winning exhibits visit their classes, discuss their projects and also their future plans.

7. A museum should be started to display the best of the science fair projects for use by other students.

5. The people and organizations in Oklahoma interested in science should be encouraged to provide the following.

    1. Guidance pamphlets on engineering and science careers should be on display in quantity at the state and other science teachers meetings.

    2. Speakers should be made available when the counselors meet. These speakers could then have the opportunity to discuss science careers and to make science career pamphlets available.

3. Speakers with extensive information should visit schools and discuss careers in science.

6. Additional studies should be made of science-oriented students in Oklahoma.

   1. The participants in this study should receive another questionnaire similar to the one used in this study to learn whether in five years they are still interested in pursuing a science career.

   2. This same study could be re-run in about five years covering the time period from 1962-1968 to learn whether the results would be the same. The physics course for the most part has already shifted over to the PSSC and some changes have occurred and will occur in the other programs under study.

   3. The science teachers of Oklahoma are not coming from the four programs under study in any large numbers. In view of the persisting shortage of competent science teachers, it might be helpful to study the backgrounds of the Oklahoma Science teachers since about 1950.

   4. All participants of the Oklahoma City Science Fair should receive a questionnaire similar to the one used in this study to see what the impact of winning has to do with the career selection as compared to a student who has entered a project but has not won an award.

APPENDIX

Are There any Statistically Significant Differences in The Numbers of Males and Females Who Continued in Science in the Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes?

Using the data contained in Table 6, the chi square test was applied to each program as compared to another program by sex, all differences significant at the .01 level or lower. The following 12 null hypotheses were tested:

1. There is no statistically significant difference in the number of males of the Fleming Awards who continued in science as compared to the males of the Oklahoma High School Institutes.

Table 1.1 A Comparison of Fleming Awards and Oklahoma High School Institutes Participants with Respect to Continuation in Science.

Continuation	Fleming	Institute	Both
Continued	47	177	224
Did not Continue	6	43	49
Total	53	220	273

Table 1.2 The Expected Numbers of Fleming Awards and Oklahoma High School Institutes Participants had There Been no Difference Between the Two.

Continuation	Fleming	Institute	Both
Continued	43.5	180.5	224
Did not Continue	9.5	39.5	49
Total	53	220	273

Table 1.3 Discrepancies Between Obtained and Expected Frequencies in Tables 1.1 and 1.2.

Continuation	Fleming	Institute
Continued	3	-3
Did not Continue	-3	3

Table 1.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Fleming	Institute	Both
Continued	.206	.005	.211
Did not Continue	.95	.228	1.178
Both	1.156	.233	1.389

Chi square in this case is 1.389 and is small enough so we accept the null hypothesis that there is no difference in the number of males of the Fleming Awards who continued in science as compared to the males of the Oklahoma High School Institutes.

2. There is no statistically significant difference in the number of males of the Fleming Awards who continued in science as compared to the males of the Oklahoma City Science Fairs.

Table 2.1 A Comparison of Fleming Awards and Oklahoma City Science Fairs Participants with Respect to Continuation in Science.

Continuation	Fleming	Science Fair	Both
Continued	47	58	105
Did not Continue	6	28	34
Total	53	86	139

Table 2.2 The Expected Numbers of Fleming Awards and Oklahoma City Science Fairs Participants Had There Been No Difference Between the Two.

Continuation	Fleming	Science Fair	Both
Continued	40	65	105
Did not Continue	13	21	34
Total	53	86	139

Table 2.3 Discrepancies Between Obtained and Expected Frequencies in Tables 2.1 and 2.2.

Continuation	Fleming	Science Fair
Continued	6.5	-6.5
Did not Continue	-6.5	6.5

Table 2.4 The Cell-square Contingencies For the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Fleming	Science Fair	Both
Continued	1.06	.650	1.71
Did not Continue	3.24	2.100	5.34
Total	4.30	2.750	7.05

Chi square in this case is 7.05 and is large enough to reject the hypothesis that there is no difference between the males of the Fleming Awards and the Oklahoma City Science Fairs.

3. There is no statistically significant difference in the number of males of the Fleming Awards who continued in science as compared to the number of males of the Oklahoma City Physics Classes.

Table 3.1 A Comparison of Fleming Awards and Oklahoma City Physics Classes Participants with Respect to Continuation in Science.

Continuation	Fleming	Physics	Both
Continued	47	116	163
Did not Continue	6	61	67
Total	53	177	230

Table 3.2 The Expected Numbers of Fleming Award and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Continuation	Fleming	Physics	Both
Continued	37.6	125.4	163
Did not Continue	15.4	51.6	67
Total	53.0	177.0	230

Table 3.3 Discrepancies Between Obtained and Expected Frequencies in Tables 3.1 and 3.2.

Continuation	Fleming	Physics
Continued	8.9	-8.9
Did not Continue	-8.9	8.9

Table 3.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Fleming	Physics	Both
Continued	2.10	.635	2.735
Did not Continue	5.15	1.53	6.68
Both	7.25	2.165	9.415

Chi square is 9.415 and is large enough to reject the hypothesis that there is no difference between the continuation in science of the males of the Fleming Awards and the Oklahoma City Physics Classes.

4. There is no statistically significant difference in the number of males of the Oklahoma High School Institutes who continued in science as compared to the males of the Oklahoma City Science Fairs.

Table 4.1 A Comparison of the Oklahoma High School Institutes and Oklahoma City Science Fairs Males with Respect to Continuation in Science.

Continuation	Institute	Science Fair	Both
Continued	177	58	235
Did not Continue	43	28	71
Total	220	86	306

Table 4.2 The Expected Numbers of Oklahoma High School Institutes and Oklahoma City Science Fairs Participants Had There Been no Difference Between the Two.

Continuation	Institute	Science Fair	Both
Continued	169	66	235
Did not Continue	51	20	71
Total	220	86	306

Table 4.3 Discrepancies Between Obtained and Expected Frequencies in Tables 4.1 and 4.2.

Continuation	Institute	Science Fair
Continued	8	-8
Did not Continue	-8	8

Table 4.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Institute	Science Fair	Both
Continued	.38	.97	1.35
Did not Continue	1.25	3.2	4.45
Total	1.63	4.17	5.80

The Chi square obtained is 5.80 and is large enough to reject the hypothesis that there is no difference between the continuation in science of the males of the Oklahoma High School Institutes and the Oklahoma City Science Fairs.

5. There is no statistically significant difference in the number of males of the Oklahoma High School Institutes who continued in science as compared to the males of the Oklahoma City Physics Classes.

Table 5.1 A Comparison of Oklahoma High School Institutes and Oklahoma City Physics Participants with Respect to Continuation in Science.

Continuation	Institute	Physics	Both
Continued	177	116	293
Did not Continue	43	61	104
Total	220	177	397

Table 5.2 The Expected Numbers of Oklahoma High School Institute and Oklahoma City Physics Classes Participants had There been no Difference between the Two.

Continuation	Institute	Physics	Both
Continued	162	131	293
Did not Continue	58	46	104
Total	220	177	397

Table 5.3 Discrepancies Between Obtained and Expected Frequencies in Tables 5.1 and 5.2.

Continuation	Institute	Physics
Continued	15	-15
Did not Continue	-15	15

Table 5.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Institute	Physics	Both
Continued	1.39	1.72	3.11
Did not Continue	3.88	4.80	8.68
Both	5.27	6.52	11.79

Chi square in this case is 11.79 and is sufficiently large to reject the hypothesis that there is no difference between the males of the Oklahoma High School Institutes and the Oklahoma City Physics Classes in the continuation in science.

6. There is no statistically significant difference in the number of males of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes who continued in science.

Table 6.1 A Comparison of Oklahoma City Science Fairs and Oklahoma City Physics Classes Participants with Respect to Continuation in Science.

Continuation	Science Fair	Physics	Both
Continued	58	116	174
Did not Continue	28	61	89
Total	86	177	263

Table 6.2 The Expected Numbers of Oklahoma City Science Fairs and Oklahoma City Physics Class Participants Had There Been no difference between the Two.

Continuation	Science Fair	Physics	Both
Continued	57	117	174
Did not Continue	29	60	89
Total	86	177	263

Table 6.3 Discrepancies Between Obtained and Expected Frequencies in Tables 6.1 and 6.2.

Continuation	Science Fair	Physics
Continued	1	-1
Did not Continue	-1	1

Table 6.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Science Fair	Physics	Both
Continued	.018	.035	.053
Did not Continue	.009	.017	.026
Both	.027	.052	.079

Chi square is .079 and is small enough to accept the hypothesis that there is no difference between the males who continued in science in the Oklahoma City Science Fairs and the Oklahoma City Physics Classes.

7. There is no statistically significant difference in the number of females of the Fleming Awards who continued in science as compared to the females of the Oklahoma High School Institutes.

Table 7.1 A Comparison of Fleming Awards and Oklahoma High School Institutes Participants with Respect to Continuation in Science.

Continuation	Fleming	Institute	Both
Continued	34	22	56
Did not Continue	9	23	32
Total	43	45	88

Table 7.2 The Expected Numbers of Fleming Awards and Oklahoma High School Institutes Participants Had There Been No Difference Between the Two.

Continuation	Fleming	Institute	Both
Continued	27.4	28.6	56
Did not Continue	15.6	16.4	32
Total	43	45	88

Table 7.3 Discrepancies Between Obtained and Expected Frequencies in Tables 7.1 and 7.2.

Continuation	Fleming	Institute
Continued	6.1	-6.1
Did not Continue	-6.1	6.1

Table 7.4 The Cell-square Contingencies for the Computation of Chi square Relative to the Study of Continuation in Science.

Continuation	Fleming	Institute	Both
Continued	1.30	1.32	2.62
Did not Continue	2.30	2.38	4.68
Both	3.60	3.70	7.30

Chi square in this case is 7.30 and is large enough to reject the hypothesis that there is no difference between the females of the Fleming Awards and the Oklahoma High School Institutes.

8. There is no statistically significant difference in the number of females of the Fleming Awards who continued in science as compared to the females of the Oklahoma City Science Fairs.

Table 8.1 A Comparison of Fleming Awards Participants and Oklahoma City Science Fair Participants with Respect to Continuation in Science.

Continuation	Fleming	Science Fair	Both
Continued	34	15	49
Did not Continue	9	24	33
Total	43	39	82

Table 8.2 The Expected Numbers of Fleming Awards and Oklahoma City Science Fair Participants had there been No Difference Between the Two.

Continuation	Fleming	Science Fair	Both
Continued	25.6	23.4	49
Did not Continue	17.4	15.6	33
Total	43	39	82

Table 8.3 Discrepancies Between Obtained and Expected Frequencies in Tables 8.1 and 8.2.

Continuation	Fleming	Science Fair
Continued	7.9	-7.9
Did not Continue	-7.9	7.9

Table 8.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Fleming	Science Fair	Both
Continued	2.44	2.64	5.08
Did not Continue	3.58	4.00	7.58
Both	6.02	6.64	12.66

Chi square in this case is 12.66 and is large enough to reject the hypothesis that there is no difference between the females of the Fleming Awards and the Oklahoma City Science Fairs.

9. There is no statistically significant difference in the number of females of the Fleming Awards who continued in science as compared to the females of the Oklahoma City Physics Classes.

Table 9.1 A Comparison of Fleming Awards Participants and Oklahoma City Physics Classes Participants with Respect to Continuation in Science.

Continuation	Fleming	Physics	Both
Continued	34	14	48
Did not Continue	9	14	23
Total	43	28	71

Table 9.2 The Expected Numbers of Fleming Awards and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Continuation	Fleming	Physics	Both
Continued	29	19	48
Did not Continue	14	9	23
Total	43	28	71

Table 9.3 Discrepancies Between Obtained and Expected Frequencies in Tables 9.1 and 9.2.

Continuation	Fleming	Physics
Continued	4.5	-4.5
Did not Continue	-4.5	4.5

Table 9.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Fleming	Physics	Both
Continued	.7	1.45	2.15
Did not Continue	1.67	2.25	3.92
Both	2.37	3.70	6.07

Chi square was found to be 6.07 and is large enough to reject the hypothesis that there is no difference between the females of the Fleming Awards and the Oklahoma City Physics Classes.

10. There is no statistically significant difference in the number of females of the Oklahoma High School Institutes who continued in science as compared to the females of the Oklahoma City Science Fairs.

Table 10.1 A Comparison of Oklahoma High School Institutes and Oklahoma City Science Fair Females with Respect to Continuation in Science.

Continuation	Institute	Science Fair	Both
Continued	22	15	37
Did not Continue	23	24	47
Total	45	39	84

Table 10.2 The Expected Numbers of Oklahoma High School Institutes and Oklahoma City Science Fairs Participants Had There Been No Difference Between the Two.

Continuation	Institute	Science Fair	Both
Continued	19.8	17.2	37
Did not Continue	25.2	21.8	47
Total	45.0	39.0	84

Table 10.3 Discrepancies Between Obtained and Expected Frequencies in Tables 10.1 and 10.2.

Continuation	Institute	Science Fair
Continued	2.2	-2.2
Did not Continue	-2.2	2.2

Table 10.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Institute	Science Fair	Both
Continued	.244	.280	.524
Did not Continue	.192	.222	.414
Both	.436	.502	.938

Chi square is .938 and is small enough to accept the hypothesis that there is no difference between the females who participated in the Oklahoma High School Institutes and the Oklahoma City Science Fairs Programs.

11. There is no statistically significant difference in the number of females of the Oklahoma High School Institutes who continued in science as compared to the females of the Oklahoma City Physics Classes.

Table 11.1 A Comparison of Oklahoma High School Institutes and Oklahoma City Physics Classes Participants with Respect to Continuation in Science.

Continuation	Institute	Physics	Both
Continued	22	14	36
Did not Continue	23	14	37
Total	45	28	73

Table 11.2 The Expected Numbers of Oklahoma High School Institutes and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Continuation	Institute	Physics	Both
Continued	22.2	13.8	36
Did not Continue	22.8	14.2	37
Total	45.0	28.0	73

Table 11.3 Discrepancies Between Obtained and Expected Frequencies in Tables 11.1 and 11.2.

Continuation	Institute	Physics
Continued	-.2	.2
Did not Continue	.2	-.2

Table 11.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Institute	Physics	Both
Continued	.002	.003	.005
Did not Continue	.002	.003	.005
Both	.004	.006	.010

Chi square is .010 and is small enough to accept the hypothesis that there is no difference between the females who participated in the Oklahoma High School Institutes and the Oklahoma City Physics Classes.

12. There is no statistically significant difference in the number of females of the Oklahoma City Science Fairs who continued in science as compared to the females of the Oklahoma City Physics Classes.

Table 12.1 A Comparison of Oklahoma City Science Fairs and Oklahoma City Physics Classes Participants with Respect to Continuation in Science.

Continuation	Science Fair	Physics	Both
Continued	15	14	29
Did not Continue	24	14	38
Total	39	28	67

Table 12.2 The Expected Numbers of Oklahoma City Science Fairs and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Continuation	Science Fair	Physics	Both
Continued	17	12	29
Did not Continue	22	16	38
Total	39	28	67

Table 12.3 Discrepancies Between Obtained and Expected Frequencies in Tables 12.1 and 12.2.

Continuation	Science Fair	Physics
Continued	-2	2
Did not Continue	2	-2

Table 12.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Continuation in Science.

Continuation	Science Fair	Physics	Both
Continued	.236	.332	.568
Did not Continue	.196	.250	.446
Both	.432	.582	1.014

Chi square is 1.014 and is small enough to accept the hypothesis that there is no difference between the females who participated in the Oklahoma City Science Fairs and the Oklahoma City Physics Classes.

Is There Any Statistically Significant Difference In The Grade Averages of the Males and Females of the Sir Alexander Fleming Awards, the Oklahoma High School Institutes, the Oklahoma City Science Fairs, and the Oklahoma City Physics Classes?

Using the data contained in Table 9, the chi square test was applied to each program as compared to another program by sex. A .01 significance level was used. The following 12 hypotheses were tested:

1. There is no statistically significant difference in the grade average of the males of the Fleming Awards as compared to the males of the Oklahoma High School Institutes.

Table 13.1 A Comparison of Fleming Awards and Oklahoma High School Institutes Participants with Respect to Grade Average.

Grade Average	Fleming	Institute	Both
Over 3.5	41	148	189
Under 3.5	11	72	83
Total	52	220	272

Table 13.2 The Expected Numbers of Fleming Awards and Oklahoma High School Institutes Participants Had There Been No Difference Between the Two.

Grade Average	Fleming	Institute	Both
Over 3.5	36	153	189
Under 3.5	16	67	83
Total	52	220	272

Table 13.3 Discrepancies Between Obtained and Expected Frequencies in Tables 13.1 and 13.2.

Grade Average	Fleming	Institute
Over 3.5	5	-5
Under 3.5	-5	5

Table 13.4 The Cell-square Contingencies For the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Averages	Fleming	Institute	Both
Over 3.5	.695	.163	.858
Under 3.5	1.580	.372	1.952
Both	2.275	.535	2.810

Chi square is 2.810 and is small enough to accept the hypothesis that there is no difference between the grade averages of the males of the Fleming Awards and the Oklahoma High School Institutes.

2. There is no statistically significant difference in the grade average of the males of the Fleming Awards as compared to the males of the Oklahoma City Science Fairs.

Table 14.1 A Comparison of Fleming Awards and Oklahoma City Science Fairs Participants with Respect to Grade Average.

Grade Average	Fleming	Science Fair	Both
Over 3.5	41	30	71
Under 3.5	11	55	66
Total	52	85	137

Table 14.2 The Expected Numbers of Fleming Awards and Oklahoma City Science Fairs Participants Had There Been No Difference Between the Two.

Grade Average	Fleming	Science Fair	Both
Over 3.5	27	44	71
Under 3.5	25	41	66
Total	52	85	137

Table 14.3 Discrepancies Between Obtained and Expected Frequencies in Tables 14.1 and 14.2.

Grade Average	Fleming	Science Fair
Over 3.5	14	-14
Under 3.5	-14	14

Table 14.4 The Cell-Square Contingencies For the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Average	Fleming	Science Fair	Both
Over 3.5	7.30	4.45	11.75
Under 3.5	7.85	4.80	12.65
Both	15.15	9.25	24.40

Chi square in this case is large enough to reject the hypothesis that there is no difference between the males of the Fleming Awards and the Oklahoma City Science Fairs with respect to grade averages.

3. There is no statistically significant difference in the grade averages of the males of the Fleming Awards and the Oklahoma City Physics Classes.

Table 15.1 A Comparison of Fleming Awards and Oklahoma City Physics Classes Participants with respect to Grade Average.

Grade Average	Fleming	Physics	Both
Over 3.5	41	52	93
Under 3.5	11	124	135
Total	52	176	228

Table 15.2 The Expected Numbers of Fleming Awards and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Grade Average	Fleming	Physics	Both
Over 3.5	21	72	93
Under 3.5	31	104	135
Total	52	176	228

Table 15.3 Discrepancies Between Obtained and Expected Frequencies in Tables 15.1 and 15.2.

Grade Average	Fleming	Physics
Over 3.5	20	-20
Under 3.5	-20	20

Table 15.4 The Cell-square Contingencies For the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Average	Fleming	Physics	Both
Over 3.5	19.0	3.8	22.8
Under 3.5	12.9	5.6	18.5
Both	31.9	9.4	41.3

Chi square was found to be 41.3 and is large enough to reject the hypothesis that there is no difference between the grade averages of the males of the Fleming Awards and the Oklahoma City Physics Classes.

4. There is no statistically significant difference in the grade averages of the males of the Oklahoma High School Institutes and the Oklahoma City Science Fairs.

Table 16.1 A Comparison of the Grade Averages of the Males of the Oklahoma High School Institutes and the Males of the Oklahoma City Science Fairs.

Grade Average	Institute	Science Fair	Both
Over 3.5	148	30	178
Under 3.5	72	55	127
Total	220	85	305

Table 16.2 The Expected Numbers of Oklahoma High School Institutes and Oklahoma City Science Fairs Participants Had There Been No Difference Between the Two.

Grade Average	Institute	Science Fair	Both
Over 3.5	128	50	178
Under 3.5	92	35	127
Total	220	85	305

Table 16.3 Discrepancies Between Obtained and Expected Frequencies in Tables 16.1 and 16.2.

Grade Average	Institute	Science Fair
Over 3.5	20	-20
Under 3.5	-20	20

Table 16.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Average	Institute	Science Fair	Both
Over 3.5	3.12	8.00	11.12
Under 3.5	4.35	11.40	15.75
Both	7.47	19.40	26.87

Chi square was found to be 26.87 and is large enough to reject the hypothesis that there is no difference in the grade averages of the Oklahoma High School Institutes and the Oklahoma City Science Fairs Participants.

5. There is no statistically significant difference in the grade averages of the participants of the Oklahoma High School Institutes and the Oklahoma City Physics Classes.

Table 17.1 A Comparison of the Grade Averages of the Oklahoma High School Institutes and the Oklahoma City Physics Classes Participants.

Grade Average	Institute	Physics	Both
Over 3.5	148	52	200
Under 3.5	72	124	196
Total	200	176	396

Table 17.2 The Expected Numbers of Oklahoma High School Institutes and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Grade Average	Institute	Physics	Both
Over 3.5	111	89	200
Under 3.5	109	87	196
Total	220	176	396

Table 17.3 Discrepancies Between Obtained and Expected Frequencies in Tables 17.1 and 17.2.

Grade Average	Institute	Physics
Over 3.5	37	-37
Under 3.5	-37	37

Table 17.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Averages	Institute	Physics	Both
Over 3.5	12.3	15.4	27.7
Under 3.5	12.6	15.7	28.3
Total	24.9	31.1	56.0

Chi square was found to be 56.0 and is large enough to reject the hypothesis that there is no difference in the grade averages of the Oklahoma High School Institutes and the Oklahoma City Physics Classes Participants.

6. There is no statistically significant difference in the grade averages of the males of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes.

Table 18.1 A Comparison of the Grade Averages of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Participants.

Grade Average	Science Fair	Physics	Both
Over 3.5	30	52	82
Under 3.5	55	124	179
Total	85	176	261

Table 18.2 The Expected Numbers of Oklahoma City Science Fairs and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Grade Average	Science Fair	Physics	Both
Over 3.5	27	55	82
Under 3.5	58	121	179
Total	85	176	261

Table 18.3 Discrepancies Between Obtained and Expected Frequencies in Tables 18.1 and 18.2.

Grade Average	Science Fair	Physics
Over 3.5	3	-3
Under 3.5	-3	3

Table 18.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Average	Science Fair	Physics	Both
Over 3.5	.333	.163	.496
Under 3.5	.155	.075	.230
Both	.488	.238	.726

Chi square is .726 and is small enough to accept the hypothesis that there is no difference between the grade averages of the males of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes.

7. There is no statistically significant difference in the grade average of the females of the Fleming Awards as compared to the females of the Oklahoma High School Institutes.

Table 19.1 A Comparison of the Fleming Awards and Oklahoma High School Institutes Participants with Respect to Grade Average.

Grade Average	Fleming	Institute	Both
Over 3.5	37	37	74
Under 3.5	6	8	14
Total	43	45	88

Table 19.2 The Expected Numbers of Fleming Awards and Oklahoma High School Institutes Participants Had There Been No Difference Between the Two.

Grade Average	Fleming	Institute	Both
Over 3.5	36	38	74
Under 3.5	7	7	14
Total	43	45	88

Table 19.3 Discrepancies Between Obtained and Expected Frequencies in Tables 19.1 and 19.2.

Grade Average	Fleming	Institute
Over 3.5	1	-1
Under 3.5	-1	1

Table 19.4 The Cell-square Contingencies For the Computations of Chi Square Relative to the Study of Grade Averages.

Grade Average	Fleming	Institute	Both
Over 3.5	.007	.007	.014
Under 3.5	.036	.036	.072
Both	.043	.043	.086

Chi square is .086 and is small enough to accept the hypothesis that there is no difference between the grade averages of the females of the Fleming Awards and the Oklahoma High School Institutes.

8. There is no statistically significant difference in the grade average of the females of the Fleming Awards as compared to the females of the Oklahoma City Science Fairs.

Table 20.1 A Comparison of Fleming Awards and Oklahoma City Science Fairs Participants With Respect to Grade Average.

Grade Average	Fleming	Science Fair	Both
Over 3.5	37	20	57
Under 3.5	6	19	25
Total	43	39	82

Table 20.2 The Expected Numbers of Fleming Awards and Oklahoma City Science Fair Participants Had There Been No Difference Between the Two.

Grade Average	Fleming	Science Fair	Both
Over 3.5	30	27	57
Under 3.5	13	12	25
Total	43	39	82

Table 20.3 Discrepancies Between Obtained and Expected Frequencies in Tables 20.1 and 20.2.

Grade Average	Fleming	Science Fair
Over 3.5	7	-7
Under 3.5	-7	7

Table 20.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Average	Fleming	Science Fair	Both
Over 3.5	1.40	1.55	2.95
Under 3.5	3.22	3.50	6.72
Both	4.62	5.05	9.67

Chi square was found to be 9.67 and is large enough to reject the hypothesis that there is no difference between the females of the Fleming Awards and the Oklahoma City Science Fairs with respect to grade average.

9. There is no statistically significant difference in the grade averages of the females of the Fleming Awards and the Oklahoma City Physics Classes.

Table 21.1 A Comparison of the Fleming Awards and Oklahoma City Physics Classes with Respect to Grade Average.

Grade Average	Fleming	Physics	Both
Over 3.5	37	15	52
Under 3.5	6	13	19
Total	43	28	71

Table 21.2 The Expected Numbers of Fleming Awards and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Grade Average	Fleming	Physics	Both
Over 3.5	31.5	20.5	52
Under 3.5	11.5	7.5	19
Total	43.0	28.0	71

Table 21.3 Discrepancies Between Obtained and Expected Frequencies in Tables 21.1 and 21.2.

Grade Average	Fleming	Physics
Over 3.5	5.5	-5.5
Under 3.5	-5.5	5.5

Table 21.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Averages	Fleming	Physics	Both
Over 3.5	.96	1.48	2.44
Under 3.5	2.61	4.50	7.11
Both	3.57	5.98	9.55

Chi square was found to be 9.55 and is large enough to reject the hypothesis that there is no difference between the grade averages of the females of the Fleming Awards and the Oklahoma City Physics Classes.

10. There is no statistically significant difference in the grade averages of the females of the Oklahoma High School Institutes and the Oklahoma City Science Fairs.

Table 22.1 A Comparison of the Grade Averages of the Females of the Oklahoma High School Institutes and the Females of the Oklahoma City Science Fairs.

Grade Average	Institute	Science Fairs	Both
Over 3.5	37	20	57
Under 3.5	8	19	27
Total	45	39	84

Table 22.2 The Expected Numbers of Oklahoma High School Institutes and Oklahoma City Science Fairs Participants Had There Been No Difference Between the Two.

Grade Average	Institute	Science Fair	Both
Over 3.5	30.5	26.5	57
Under 3.5	14.5	12.5	27
Total	45.0	39.0	84

Table 22.3 Discrepancies Between Obtained and Expected Frequencies in Tables 22.1 and 22.2.

Grade Average	Institute	Science Fair
Over 3.5	6.5	-6.5
Under 3.5	-6.5	6.5

Table 22.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Average	Institute	Science Fair	Both
Over 3.5	1.18	1.36	2.54
Under 3.5	2.48	2.86	5.34
Both	3.66	4.22	7.88

Chi square was found to be 7.88 and is large enough to reject the hypothesis that there is no difference in the grade averages of the females of the Oklahoma High School Institutes and the Oklahoma City Science Fairs.

11. There is no statistically significant difference in the grade averages of the females of the Oklahoma High School Institutes and the Oklahoma City Physics Classes.

Table 23.1 A Comparison of the Grade Averages of the Oklahoma High School Institutes and the Oklahoma City Physics Classes Participants.

Grade Average	Institute	Physics	Both
Over 3.5	37	15	52
Under 3.5	8	24	32
Total	45	39	84

Table 23.2 The Expected Numbers of Oklahoma High School Institutes and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Grade Average	Institute	Physics	Both
Over 3.5	28	24	52
Under 3.5	17	15	32
Total	45	39	84

Table 23.3 Discrepancies Between Obtained and Expected Frequencies in Tables 23.1 and 23.2.

Grade Average	Institute	Physics
Over 3.5	9	-9
Under 3.5	-9	9

Table 23.4 The Cell-square Contingencies for the Computation of Chi Square Relative to the Study of Grade Averages.

Grade Average	Institute	Physics	Both
Over 3.5	2.56	3.00	5.56
Under 3.5	4.23	4.80	9.03
Total	6.79	7.80	14.59

Chi Square was found to be 14.59 and is large enough to reject the hypothesis that there is no difference in the grade averages of the Oklahoma High School Institutes and the Oklahoma City Physics Class Participants.

12. There is no statistically significant difference in the grade averages of the females of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes.

Table 24.1 A Comparison of the Grade Averages of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes Participants.

Grade Average	Science Fair	Physics	Both
Over 3.5	20	15	35
Under 3.5	19	14	33
Total	39	29	68

Table 24.2 The Expected Numbers of Oklahoma City Science Fairs and Oklahoma City Physics Classes Participants Had There Been No Difference Between the Two.

Grade Average	Science Fair	Physics	Both
Over 3.5	20	15	35
Under 3.5	19	14	33
Total	39	29	68

There is no difference in the grade averages of the females of the Oklahoma City Science Fairs and the Oklahoma City Physics Classes.

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