COMMON CHARACTERISTICS OF HIGH SCHOOL STUDENTS WITH
SUPERIOR RATED SCIENCE PROJECTS AT THE
CENTRAL OHIO DISTRICT SCIENCE DAY

A Thesis

Presented in Partial Fulfillment of the Requirements
for the Degree Master of Arts

by

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CHAPTER I
THE BACKGROUND OF THE STUDY

Introduction

The science project has been recognized by science educators in the past three or four decades as an important means of enriching regular class work in science, and as an instrument of motivating capable high school students toward further scientific inquiry. Science project exhibits were organized initially by state academies of science and educational institutions with the purpose of stimulating interest in science among high school students, especially the more capable.

The response of students to the early science project exhibit programs was enthusiastic. Science exhibits under the name Science Day, Science Fair, or Science Congress grew in size and number from the local to the state and national level. Science projects in such events are evaluated or judged by scientists and science educators, and certificates or other recognitions are given according to ratings based on common criteria.
As any other educational movement, the science day movement has drawn criticism and skeptical comments by those who have doubts about the educational and scientific value of science days. Even those who are sympathetic to the science day movement often state that improvements can be made in fulfilling the objectives of science day programs. The evaluation of science days and science fairs has been based largely on personal experience of the individuals associated with them. Research on science days is limited and consists primarily of opinion polls. Little factual information is available concerning the high school students who participate in the science day programs. Information is needed concerning the actual effect of science day experiences on the participating student. Such a comprehensive study would very likely start with a study of the background of students and would be completed by follow-up studies.

The present study is limited to the background of students participating in a science day program who received superior rating. Assuming that a superior rated project represents a worthwhile effort and a worthwhile achievement, one may further assume that this achievement is directly related to the student's native ability and his immediate
environment. An investigation of these assumptions would have implications on judging practices, which have often been criticized as being superficial and inconsistent.

The Ohio Academy of Science has pioneered the science day movement in Ohio through its Junior Division, often referred to as the Junior Academy of Science. The Junior Academy is responsible for the initiation and administration of the district Science Days, which lead to the State Science Day Program. Independent of the Science Day programs, Regional Science Fairs are also held in Ohio under the sponsorship of Science Service, and the Science Clubs of America. This study, however, is primarily concerned with the Science Day program and, in particular, the Central Ohio District Science Day of 1963. The students who received superior rating in that science day in Grades 9-12 are the subjects of this study.

The Problem

Many science teachers encourage and urge their students to enter science fairs and science days at the local, district, regional, state, and national level. There is a great deal of pride associated with superior ratings and other honors won. A competitive spirit often develops, which tends to overshadow the real significance of the
project activity. Indeed, one may wonder whether science fairs are anything more than a contest or a show. Several questions may be raised in relation to this. Some such questions are:

1. Is a superior project an indication of strong interest in science?

2. What is the value of a superior rated project to the student?

3. How consistent are the judges in applying the judging criteria?

4. What factors are conducive to superior projects?

5. Are science day projects and science day programs suitable for enriching regular class work in science?

6. Is science day activity suitable for creating, sustaining, and enhancing interest in science?

7. How are students who do not receive superior ratings affected?

These questions cannot be answered adequately without first knowing who are the students who received superior rating and what are they like. It is, therefore, the problem of this study to seek common characteristics among students who received superior rating at a particular science day. The Central Ohio District Science Day was chosen for
this purpose. This particular science day was chosen be-
cause of proximity, variety of types of schools and school
districts, and types of communities included in the seven
county area which it serves. Since this study is concerned
with gross characteristics, no control group was used. It
was thus made possible to study a broader spectrum of char-
acteristics on an exploratory basis.

The data for the study was obtained by means of ques-
tionnaires, and from records of the Central Ohio District
Science Day Committee. The search for common character-
istics centered around three main areas: 1) the student and
his family, 2) the school and the science teacher, and 3) the
school district and community. A more detailed description
of factors studied and procedures followed is given on
pp. 15-16 and in Chapter III.

Need for This Study

A study such as the present one is needed in order to
achieve the following objectives:

1. Identify the "typical" student who received superior
rating. The degree to which a student is identifiable would
help evaluate the consistency of Science Day judging.
2. Determine some of the characteristics in the student's background that are conducive to effective project work as defined by widely accepted criteria.

3. Draw implications as to the extent to which conditions favorable to effective project work are within the control of the science teacher and the school.

4. Find out how well the capable high school students are represented at the District and State Science Day Programs. Also, find out to what extent the Science Day Program can be used to motivate the less capable or the less achieving student.

These objectives can be fulfilled only in part in this study. More studies will be needed in order to evaluate better the effect on the high school student of the Science Day programs as they are currently conducted. The movement toward science exhibit programs has reached such dimensions that studies of this type are urgently needed. Whatever position a science educator may choose to take toward science days and science fairs should be based on factual information, rather than mere opinions or limited personal experience.
The Ohio Academy of Science: Its Role in the Science Day Movement in Ohio

The teaching of science in the public schools has been a major concern of the Ohio Academy of Science since its founding in 1891. A special committee on education was established in 1897. During its first three decades, the Academy's educational efforts centered around increasing the proportion of science instruction in the public schools. When this goal was partly achieved by the early 1920's, the emphasis shifted to developing better working relationships between the Academy and the high school teacher. Initial attempts by the Academy proved disappointing. In 1929 Dr. C. G. Shatzer was appointed to investigate ways by which interest in science might be encouraged among high school students. This led to the formation of the Committee on Junior Scientific Effort, which was the forerunner of the Junior Academy of Science.¹

The most significant accomplishment of the Committee was the District Scientific Conference held in Springfield in 1932, in which 94 student projects were displayed. High

school students were in charge of most of the Conference program. This pilot conference was so successful that recommendations were made to continue and enlarge the program. Lack of funds prevented this until 1940, when the Junior Academy of Science was established. A Science Day program was augmented and continued until 1944. War time conditions prevented the program from continuing during 1945 to 1948. The Junior Academy, however, remained in existence and was reactivated by 1949. Following the District Science Day programs that year, the First Annual State Science Day was held at Denison University, in which 78 students participated. A total of 600 science projects were exhibited in the District meetings the same year.²

By 1958, 44,434 projects were displayed in the District Science Days and 877 took part in the State Science Day. Beginning in 1959, it became necessary to limit the number of projects that could be shown at the State Science Day due to limitations in available space.³


³Dexter, op. cit., p. 241.
Rating Practices

History of Criteria for Judging.--Since the early days of the Science Day program in Ohio, judging of the exhibits was based on viewing the exhibit and discussing the project with the entrant. The judging team, which is composed of a college science instructor and a high school science teacher, interviews the entrant with the purpose of developing some insight into his understanding of his project, the field of science to which it is related, his interests, and his personality. This provides the judges with a background against which they can apply the criteria established by the Junior Academy more appropriately. It also provides the opportunity for the high school student to come in contact with college science instructors and scientists. The informality of this contact helps the student evaluate his own work and his interest in science. Seven criteria were initially developed for evaluating science projects in the District and State Science Day programs. These criteria were:

1. Scope of the project

2. Neatness

Ohio Academy of Science Newsletter, II, No. 3 (March, 1950), 1.
3. Clarity of explanation
4. Thoroughness
5. Knowledge achieved
6. Sustained interest
7. Originality

The judges were provided with a written explanation of the above criteria. To receive superior rating one would have to receive superior rating in at least five criteria, including knowledge achieved. The criteria were simplified and quantified in 1962. The new criteria in effect as of that year are:

1. Knowledge achieved
2. Use of scientific method
3. Clarity of expression
4. Originality and creativity

6. See Appendix A.
These criteria are defined and explained in special written instructions issued to the judges prior to the Science Day. Each one of the four criteria is allowed up to a maximum of ten judging points. A total of at least 34 points and 9 or 10 points in knowledge achieved are required for superior rating. The minimum number of points can be raised to meet quota requirements at the District science days.

Selection of Judges.-- The Central Ohio District Science Day Committee sends out requests to college science instructors, scientists, persons from science related professions, and high school science teachers. The prospective judges may choose the science areas in which they are to judge, and, whenever possible, they may choose more specialized fields within the broad areas. Judging is done in pairs, with a college science instructor or scientist and a high school science teacher in each pair.

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8 See Appendix A.

9 The author was a member of the Certification Committee of the Central Ohio District Science Day in 1963.
Judging Time.— The number of projects to be judged by each pair of judges is kept to a minimum, generally not more than five, in order to provide more time for each project. Judging is generally concluded within two hours. Most judges spend at least 20 minutes interviewing each entrant. They ask questions and discuss the project with the student in order to form as complete an idea as possible concerning his effort. After the judging is concluded, the judges discuss the project among themselves and rate it by using a special rating card. 10

Science Days vs. Science Fairs.— The judging system in science days sponsored by the Ohio Junior Academy of Science differs in both practice and philosophy from the system used in science fairs, which are affiliated with the National Science Fair-International sponsored by the Science Clubs of America. In science fairs affiliated with the National Science Fair-International judging is done in the absence of the exhibitor on the basis of the exhibit itself. Recognitions and awards are few but substantial. 11 These

10 See Appendix A.

practices, according to a study by Brennan leads to competition, and emphasis on the exhibit, rather than the project. The stiff competition leads to the encouragement of those that need no encouragement, and to the discouragement of many more. Many of the scientists and educators queried by Brennan are critical of these aspects of science fairs.\footnote{Ibid.} Insofar as these aspects are concerned, the judging practices in science days associated with the Ohio Junior Academy of Science appear to be more appropriate.

**Definition of Terms**

Some of the terms important to this study are defined below in order to clarify their meaning within the context of this study.

**Science Project.** A science project is a problem solving activity related to some field of science.

**Science Exhibit.** A science exhibit is an exhibit or display showing the methods and results of a problem solving activity.

**Judging.** Judging is the process of evaluating and rating a science project or science exhibit in a program designed for such purpose.
Science Day. Science day is a program in which science exhibits are displayed and judged. This term is generally used in connection with such programs affiliated with the Ohio Junior Academy of Science.

Science Fair. Science fair is synonymous with science day. This term is, however, more frequently connected with programs affiliated with the National Science Fair.

High Group. This term is used in connection with schools cooperating in this study with three or more students who received superior rating for their science projects at the Central Ohio District Science Day.

Low Group. This term is used to describe schools cooperating in this study that are not included in the above group.

Project, Student, School, Parent, Teacher. The primary subjects of this study are students who received superior rating for their science projects at the Central Ohio District Science Day. They are often referred to as merely students. Their science teacher is often referred to as teacher. Project is used to mean the particular science project which was rated superior at the District Science Day in 1963. School and parent are likewise used in connection with the primary subjects of this study.
Characteristics Studied

As stated earlier in this chapter, the background of the subjects of this study was investigated for common characteristics with respect to 1) the student himself and his family, 2) his school and his science teacher, and 3) community and geographic location of the school. The main types of characteristics to be investigated under each one of the three categories are listed below as follows:

I. The student and his family
   A. Characteristics of a general nature
   B. Characteristics of the student related to his interests and sources of influence
   C. Characteristics of the family
   D. Information related to the project
   E. Ability and achievement
   F. Extracurricular activities

II. The school, the teacher, and the community
   A. The school
      1. Size
      2. College orientation
      3. Local science exhibits
      4. Past performance at the District Science Day
B. The teacher

1. Fields of preparation
2. Experience
3. Graduate study
4. Professional memberships
5. Attitude toward science days

C. School district and location

1. Distribution by counties
2. Type of school district
3. Community resources

**Limitations of the Study**

The present study is limited geographically, since it is restricted to seven counties which are served by the Central Ohio District Science Day program. It covers a period of one year. It is limited as to the type of student, since only students with superior rated projects were considered. This limitation sets further limitations on the type of school and type of science teacher to be included in the study. Finally, this study is concerned only with Grades 9-12.

This was basically an exploratory study, and, in spite of the above limitations, much useful information was obtained.
Organization of the Thesis

Chapter II is devoted to a review of studies on science fairs, and other studies helpful in interpreting the results of this study. Chapter III deals with sources of information and procedures followed in obtaining the results. Chapter IV includes data related to the student and his family with brief discussion of results. The results related to the teacher, the school, and the school district are reported in Chapter V. A summary, conclusions, and recommendations are given in Chapter VI.
CHAPTER II

REVIEW OF RELATED STUDIES

Introduction

Chapter II is devoted to a review of other studies on science fairs, and studies that would be helpful in interpreting the results of this study. The former are primarily Master's theses on science fairs. The latter are studies on giftedness. These studies will be particularly helpful since no norms were established for the characteristics studied. Interpretation of common characteristics in the background of students who produced superior rated projects is facilitated through reference to these other related studies.

Studies on Science Fairs

Methods and Objectives.-- Brennan made a study of the appropriateness of prevailing science fair methods and objectives.¹ A group of high school teachers, college science instructors, and science teacher educators were queried.

¹Brennan, op. cit.
Many of them felt that science fair methods and practices, especially in science fairs affiliated with the National Science Fair, are in need of improvement. Judging practices, in particular, need revision.

**Science Fair Projects and Student Growth.**-- Bowers studied the value of science fairs to the high school student as judged by science teachers.\(^2\) The teachers' opinions were generally favorable toward science fairs. The study covered a twelve county area in the northeastern section of Indiana. The degree of participation of high school students in science fairs appeared to be related to the following factors:\(^3\)

1. The number of years of experience of the science teacher: Most of the teachers whose students took part in a science fair had 1-10 years of teaching experience. The most active teachers, however, were those with over twenty years of teaching experience.

2. The size of the school: The amount of participation in science fairs increased with the size of the school.

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\(^3\) Ibid., 45-53.
3. The teacher load: Schools with three or more science teachers showed greater participation. The number of different subjects taught by each science teacher in those schools was considerably smaller.

Two serious weaknesses of Bower's study were, first, that no students were directly involved in it; second, it was apparently assumed that teacher opinion provided adequate evidence for evaluating the contribution of science fairs.

Science Fair Participation and Achievement.-- Chappell studied the relation between science fair participation and student achievement in science in Wichita schools. According to the findings of the study, most science fair projects were produced by students with A or B grade average. These students, however, were a small fraction of all students with A or B average in the school district. Chappell infers from his findings that "science fair participants tended to make better grades."  

Effectiveness of Science Fairs According to Former Participants.-- Rogers made a follow up study of 735 First

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and Second Grant award winners in the Rhode Island Schools' Science Fairs from 1946 to 1951. More than half of them were engaged in science or science related occupations. Many of them, including those in non-science occupations, made enthusiastic comments regarding their science fair experience. In general, there was concensus among the respondents that science fairs

1. Promote interest in science
2. Enrich the school curricula in both general and specific areas of science education
3. Provide opportunities for science education and personal contacts beyond what is normally provided by the schools alone.

A number of the participants made suggestions regarding the improvement of judging practices. Others suggested that teachers take a more active part in science fairs.


6Ibid., 76.

7Ibid., 78.
Background of Science Talent Search Participants.--
Kell conducted a study of the background of 158 high school seniors who participated in the Texas Science Talent Search in 1957-1958. Factors in the background of those participants were studied in relation to the scores they received in the three criteria on which the Talent Search was based. These were the Science Aptitude Examination of the Science Clubs of America, a project paper, and data sheets prepared by the participants, their teachers, and school administrative personnel. Kell's findings may be summarized as follows:

1. Respondents identified some person, generally a teacher, as the main influence in their becoming interested in science.

2. The degree of success of the participants in the Talent Search was directly related to school size. Participants from larger schools generally scored higher.

3. The more successful participants appeared to be selective in their choice of extracurricular activities.

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4. Parental educational background and occupation showed some influence on the participants' performance in the Talent Search.

5. Most participants showed aspirations toward engineering, physical science, and medical vocations.  

*Characteristics of Potential Scientists, Engineers, and Professional People.*—MacCurdy conducted an extensive study of college freshmen and sophomores who won or received honorable mention in the National Talent Search of 1952-1953. He investigated their personalities, attitudes, interests, activities, sources of influence, family background, and science teachers in relation to their vocational choices. Because of the relevance of many of the findings of MacCurdy's study to the findings of the present study, references to specific parts of his study will be made in Chapter VI.

*Studies Related to Giftedness*

The conventional meaning of *giftedness* has been associated with high intelligence as measured by IQ tests or a

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highly developed specific ability. Recently, the term "gifted" tends to become synonymous with "high achiever." The term "mentally superior" is often used to describe persons with high IQ. The two terms are not, however, necessarily synonymous. This is because IQ is not always a reliable measure of mental ability. Intelligence test scores are often used as the main or sole criterion in identifying gifted students. Even in such cases there is lack of uniformity in the IQ or percentile limits used. Limits of IQ 135, 150, etc., are used. The problem of identification of gifted students becomes more complex if factors other than IQ are included (grades, achievement scores, aptitude scores, creativity test scores, etc.). The use of several criteria would tend to identify a greater fraction of those young people who possess general or specific abilities and skills in a degree considerably above average. It would be reasonable to expect that the students participating in this study possess a few or several characteristics associated with giftedness, especially giftedness related to

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12 Ibid.
scientific pursuits. Factors related to giftedness other than mental ability as measured by IQ tests are: 1) achievement, 2) creativity, 3) family background, and 4) motivation.

Achievement. -- Gowan in a study of high achieving students lists the following family characteristics which are generally associated with high achievement in school: 13

1) homes not broken by separation, divorce, or death, 2) higher educational level of parents, 3) consonance of values between parents and children, 4) parental concern over the child's progress, and some tension in task demands.

Concerning the characteristics of the high achieving student himself, he tends to have 1) clear educational and occupational objectives, 2) good use of time and money, 3) enthusiastic, socialized, activity oriented view of life, 4) positive character integration, 5) maturity, responsibility, and seriousness of interests, 6) dominance, permisiveness, and self confidence, and 7) awareness and concern for others. 14

---


14 Ibid.
The characteristics listed above indicate that high achievement is related to a healthy family situation and the development of desirable personal traits. Some degree of mental ability is most likely needed. Beyond that, achievement is a behavioral pattern associated with social factors. Anderson cites other studies which generally confirm Gowan's findings.15

Creativity.-- The traditional concept of intelligence associated with IQ test performance is inadequate, since it does not include factors associated with creative thinking. Terms such as "underachiever" and "overachiever" have been based on an incomplete picture of what is called intelligence. Tests that are used to identify students in the upper 20 per cent of IQ would miss about 70 per cent of those who score in the upper 20 per cent in creativity tests.16 Some minimum level of intelligence, possibly IQ 120, may be needed for outstanding success of a creative nature. A cut-off of IQ 135, however, which is commonly used is probably too high.


16 E. Paul Torrance, Creativity, (National Education Association, April, 1963), 8-9.
Creative thinking involves characteristics which are different from conventional intelligence. These are: 1) sensitivity to problems, 2) fluency, or the ability to produce many ideas, 3) flexibility, or the ability to use a variety of approaches, 4) elaboration, or the ability to fill in the details, and 5) redefinition. Tests for measuring creativity, as defined by these characteristics have been developed and are available for school use.¹⁷

Creative performance involves more than merely the presence of creative thinking ability. Andrews, in a study of the creative performance of working scientists, found that the following factors are related to creative performance: 1) creative ability, 2) presence of motivation to perform creatively and open avenues of communication with other scientists and sources of information, and 3) actual creative performance and recognition of his performance by others. Creative ability is required for creative performance, but it does not guarantee it.¹⁸

¹⁷ Ibid., 7-8.

Family Background.—Anderson cites a study by Chambers in which students with IQ 135 or above were studied over a 20-year period. It was found that parental background was more important in college going, occupational success, and community service than IQ.

... those students who transcended poor home environment were aided in this by the outside stimulation of a teacher or some other adult individual.¹⁹

Specific family characteristics which appear to be favorable were mentioned previously in this chapter.

Motivation.—Studies cited previously strongly suggest that the primary source of motivation of a young person is the home environment. This does not mean that the role of the school is not important in providing motivation. MacCurdy’s study shows that behind each potential scientist, engineer, and professional lies a favorable home environment, and a capable, dedicated science teacher.²⁰

Summary

Various studies on science fairs and on giftedness were reviewed in this chapter. The studies on science fairs dealt with the value of science fairs, appropriateness of

¹⁹Anderson, op. cit., 36.

²⁰MacCurdy, op. cit., 3-24.
science fair practices and objectives, and the background of Science Talent Search participants. The studies on giftedness dealt with criteria for identification of the gifted high school student, and factors that favor giftedness.
CHAPTER III

SOURCES OF INFORMATION AND PROCEDURE

The purpose of Chapter III is to enumerate and briefly describe the sources from which the data were obtained; to give an account of the procedures followed in obtaining the data; and finally, to explain briefly how the data were analyzed.

Preliminary Steps

Members of the Central Ohio District Science Day Committee were contacted and access to various records secured by the Fall of 1962. These records consisted mainly of lists of schools participating at the District Science Day in recent years and classification of projects by school, rating, and field of entry. These records were useful in guiding the planning of the procedure that was later followed.

As a member of the Certification Committee for the District Science Day, the author had the opportunity to observe the planning and the administration of the Science Day closely. When the results of the Science Day judging were
known on the evening of April 6, 1963, the judging cards for the superior rated projects were obtained and the study thus officially begun.

The Judging Cards.--- The judging cards for the superior rated projects contained the following information:

1. The name of the student
2. The name of the school
3. The title of the science project
4. The name of the sponsoring science teacher
5. The field of entry
6. The ratings

A list of students, teachers, and schools was initially developed from the information on those cards.¹

The Ohio School Directory.--- The directory, which is published by the State Department of Education, was used to obtain the following information:

1. School addresses
2. Names of the school principals
3. Names and addresses of superintendents
4. Enrollment in each school

¹ See Appendix A.
The Introductory Letter.-- A letter was sent to each one of twenty-three school superintendents and executive heads whose school district was represented in the group of students with superior projects. In this letter the nature of the study was briefly explained, and a request made for permission to enlist the cooperation of students and staff members involved in the study.\(^2\) Supporting letters from the Executive Secretary of the Ohio Junior Academy of Science, and from The Ohio State University were enclosed. An addressed, stamped envelope was also enclosed with a form for a positive or negative response. Twenty-two out of twenty-three superintendents and executive heads responded in the affirmative within a month. One superintendent did not respond.

The Questionnaires.-- The following questionnaires were constructed and used:

1. The student questionnaire, to be filled out by each one of the 88 students in Grades 9-12 who received a superior rating.

\(^2\)See Appendix B.

\(^3\)Samples of the questionnaires were included in the same letter.
2. The teacher questionnaire, to be filled out by each one of the science teachers sponsoring one or more of the above students.

3. The school information form (school questionnaire), to be filled out by the principal or his staff in each school participating in the study.

4. The transcript form, to be filled out for each student by some member of the principal's office staff.

All four questionnaires (the required number of each) were mailed to the principal of each high school after permission from the superintendent in that school was received. All materials were enclosed in a large Manila envelope. A return manila envelope with the author's address and sufficient postage was also included. The principal was asked in an accompanying letter to distribute the questionnaire to the proper persons and to mail them back together when completed. A checklist was attached to the principal's letter in order to avoid any omissions. ⁴

Within less than two months, 37 out of 38 schools that were sent sets of questionnaires returned all forms, with minor omissions. Two schools in the same city district were

⁴See Appendix B.
not sent questionnaires, since no permission was received.
Data for 80 out of 88 students were thus obtained from the
questionnaires. For the remaining eight students some data
were available from the judging cards and other Science Day
records. The response was generally encouraging in spite of
the time demands of the study on the students and educators
who cooperated.

Analysis of the Data

A great deal of information was available from the
questionnaires, transcripts, and other records. This made
it necessary to use some degree of selectivity in deciding
how this information would be classified, reported, and
analyzed. Over sixty factors were studied independently of
one another. In a few cases the correlation between two
factors was studied. However, no elaborate statistical
treatment of the data was attempted. It was decided that
the use of percentages and medians would be adequate in
identifying gross characteristics. Percentages are fre-
quently rounded off to the nearest one per cent. In items
where the questionnaires provided for a multiple response
the percentages add up to more than 100 per cent. The main
objectives of the analysis of the data were the following three points:

1. To identify the "typical" high school student who received superior rating.

2. To identify the "typical" school that tends to produce more superior projects.

3. To identify the "typical" science teacher who contributes to the production of more superior projects.

The results of the study are reported and analyzed in the next two chapters.
CHAPTER IV

THE STUDENT AND HIS FAMILY

The purpose of Chapter IV is to report and analyze the findings of the study that are related to the student who received superior rating, his family, his interests, his abilities, and his academic achievement. Most of the data for this chapter were obtained from the Student Questionnaires. Some data were obtained from the judging cards and other sources as indicated in the text.

Preliminary Information

Sex.-- Among the 88 students who received superior rating, boys outnumbered the girls by more than two to one. There were 62 boys and 26 girls. This information was obtained from the Student Questionnaires and from the judging cards.¹ Probable interpretations of this ratio of boys to girls are, first, that boys are more career minded than girls, especially toward professional, engineering, and

¹See Appendix A and Appendix B.
scientific careers; second, boys tend to have hobbies and interests of a scientific nature more than girls do.

**Grade Level.**—There were more superior projects from tenth grade students than any other grade, in grades 9-12. The distribution of superior projects according to grade level is shown in Table 1 below.

**TABLE 1. Distribution of superior projects by grade.** \(^a\)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td>10</td>
<td>31</td>
<td>37</td>
</tr>
<tr>
<td>11</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>12</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>84(^b)</td>
<td>100</td>
</tr>
</tbody>
</table>

\(^a\)Information obtained from the judging cards.

\(^b\)The actual number is 88, but this information was not available for the four remaining students.

**Science Course.**—Over two-fifths of the students were enrolled in biology. That was twice as many as the next highest, which was physics. The distribution of these students according to the science course in which they were enrolled in 1962-63 is shown in Table 2. It is interesting to note that there are almost twice as many students with superior projects enrolled in physics as there are in
chemistry. This is especially odd since the enrollment in chemistry is about twice the total enrollment in physics, as it will be shown later. Two possible interpretations of this are, first, that interest in chemistry among high school students is low; second, that no emphasis on project work is placed in high school chemistry classes. It cannot be decided, however, on the basis of available information whether either interpretation is valid.

**TABLE 2. Distribution of students with superior projects by science course in which they are enrolled.**

<table>
<thead>
<tr>
<th>Science Course</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Science</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Biology</td>
<td>34</td>
<td>43</td>
</tr>
<tr>
<td>Chemistry</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Physics</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>Earth Science</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

*a Information from school questionnaire, item 5, Appendix B, page 128.*

**Total Enrollment in Science Courses.—** Data on total enrollments by science course was available for 27 out of 37 schools cooperating in this study. It appears that this information was not readily available in several cases to the person filling out the school questionnaire. Table 3
shows the total enrollments for the most common science courses offered rounded off to the nearest ten. One may ask whether certain high school science courses tend to produce more superior rated projects than others. The number of superior projects for each science course and the total enrollment in the same subject are needed to evaluate this tendency.

**TABLE 3. Total enrollments in science courses (27 schools)**

<table>
<thead>
<tr>
<th>Science Course</th>
<th>Total Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>5,040</td>
</tr>
<tr>
<td>General Science</td>
<td>4,400</td>
</tr>
<tr>
<td>Chemistry</td>
<td>2,180</td>
</tr>
<tr>
<td>Physics</td>
<td>1,000</td>
</tr>
<tr>
<td>Physical Science</td>
<td>580</td>
</tr>
<tr>
<td>Earth Science</td>
<td>140</td>
</tr>
</tbody>
</table>

*Appendix B, item 4, page 128.*

**Tendency of Science Courses to Produce Superior Projects.**—Although the total enrollments for science courses do not include all schools from which the 80 superior projects in Table 2 came, it would not be inappropriate to compute the ratio of superior projects from a certain course to the total enrollment in that course. This is shown in Table 4. The ratio is not absolute, but merely
an index of the tendency to produce superior rated projects. The high ratio shown in Table 4 for earth science is due to the contribution of one school. Its validity is, therefore, not certain. Physics, biology, chemistry, and general science follow in that order. This can be partly explained in terms of interest in science. Physics students, for example, are generally more science oriented than general science students. The low ratio of superior projects from chemistry students cannot be easily explained, as it was mentioned previously.

**TABLE 4.** Tendency of science courses to produce superior projects.

<table>
<thead>
<tr>
<th>Science Course</th>
<th>Number of Superior Projects per 1,000 Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Science</td>
<td>3.0</td>
</tr>
<tr>
<td>Biology</td>
<td>6.8</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4.1</td>
</tr>
<tr>
<td>Physics</td>
<td>17.0</td>
</tr>
<tr>
<td>Earth Science</td>
<td>21.4</td>
</tr>
</tbody>
</table>

Field of Entry.— Table 5 shows the distribution of all projects from grades 9-12 at the District Science Day according to field of entry; also, the distribution of the superior rated projects. Although the number of physics projects was greater than the number in any other field,
most of the superior ratings went to zoology. The project
distribution by field of entry at the State Science Day of
1963, which followed the district days, was similar to that
of the Central District Science Day as shown in Table 6.

**TABLE 5. Distribution of projects by field of entry at the
Central Ohio District Science Day of 1963.**

<table>
<thead>
<tr>
<th>Field</th>
<th>Total Number of Projects</th>
<th>Percentage</th>
<th>Superior Number (%)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany</td>
<td>37</td>
<td>7.9</td>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td>Zoology</td>
<td>134</td>
<td>28.6</td>
<td>33</td>
<td>37.5</td>
</tr>
<tr>
<td>Chemistry</td>
<td>75</td>
<td>16.0</td>
<td>11</td>
<td>12.5</td>
</tr>
<tr>
<td>Physics</td>
<td>166</td>
<td>35.5</td>
<td>27</td>
<td>30.7</td>
</tr>
<tr>
<td>Earth Science</td>
<td>32</td>
<td>6.8</td>
<td>8</td>
<td>9.1</td>
</tr>
<tr>
<td>Mathematics</td>
<td>22</td>
<td>4.7</td>
<td>4</td>
<td>4.6</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>0.4</td>
<td>1</td>
<td>1.1</td>
</tr>
</tbody>
</table>


**TABLE 6. Distribution of projects by field of entry at the
State Science Day of 1963 (Wiberforce, Ohio).**

<table>
<thead>
<tr>
<th>Field</th>
<th>Total Number of Projects</th>
<th>Percentage</th>
<th>Superior Number (%)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany</td>
<td>49</td>
<td>3.5</td>
<td>21</td>
<td>8.7</td>
</tr>
<tr>
<td>Zoology</td>
<td>209</td>
<td>36.2</td>
<td>72</td>
<td>29.3</td>
</tr>
<tr>
<td>Chemistry</td>
<td>88</td>
<td>15.2</td>
<td>39</td>
<td>16.1</td>
</tr>
<tr>
<td>Physics</td>
<td>145</td>
<td>25.0</td>
<td>67</td>
<td>27.7</td>
</tr>
<tr>
<td>Earth Science</td>
<td>28</td>
<td>5.0</td>
<td>10</td>
<td>4.1</td>
</tr>
<tr>
<td>Mathematics</td>
<td>49</td>
<td>8.5</td>
<td>28</td>
<td>11.6</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>1.6</td>
<td>5</td>
<td>2.1</td>
</tr>
</tbody>
</table>

577 100.0 242 100.0

Zoology and physics claim the largest numbers of projects entered and superior projects. The large number of zoology projects as compared to botany projects may be partly explained in terms of student interest in animals, the human body, the medical sciences, and insects, which are included under zoology.

**Preliminary Information (Summary).**-- Some preliminary data are reported and discussed in this section which are related to the background of students with superior rated science projects:

1. Sex: Boys outnumbered girls two to one. This can be explained in terms of occupational plans and present interests.

2. Grade level: There were more sophomores than students from any other grade, followed by freshmen, juniors, and seniors.

3. Science course: Students enrolled in biology produced more superior projects than students enrolled in any other course. In terms of percentages, however, earth science and physics students produced more than twice as many projects as biology students. General science students were the least productive, followed by chemistry students.
4. Field of entry: Zoology projects and physics projects account for most of the projects entered, and most of the superior projects in both the District Science Day and the State Science Day.

**Family Background**

The family background of students with superior rated science projects was examined for common characteristics with regard to the following factors: 1) parental occupations, 2) educational level of parents, 3) siblings, and 4) residence.

**Parental Occupations.**—The occupations of most of the fathers may be classified as middle class occupations, that is, business, professional, and other white-collar occupations. About 71 per cent of the occupations fall in this category. The remaining 29 per cent can be classified as skilled labor. About 40 per cent of all occupations could be termed professional. More than three-fourths of the professional occupations are scientific or technological, with more engineers than any other occupation in this subgroup. About 25 per cent of all occupations can be classified as business occupations, with business executives
making up two-thirds of this subgroup. The occupations of
the fathers are shown in Table 7.

**TABLE 7. Father's occupation.**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Professional</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineers</td>
<td>10</td>
<td>12.7</td>
</tr>
<tr>
<td>College teachers</td>
<td>5</td>
<td>6.3</td>
</tr>
<tr>
<td>Scientists</td>
<td>4</td>
<td>5.1</td>
</tr>
<tr>
<td>Physicians</td>
<td>4</td>
<td>5.1</td>
</tr>
<tr>
<td>Pharmacists</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Attorneys</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Artists</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Accountants</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Air Force officers</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>*TOTAL</td>
<td>32</td>
<td>40.5</td>
</tr>
<tr>
<td><strong>Business</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Executives</td>
<td>13</td>
<td>16.5</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>8.9</td>
</tr>
<tr>
<td>*TOTAL</td>
<td>20</td>
<td>25.4</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technicians</td>
<td>8</td>
<td>10.1</td>
</tr>
<tr>
<td>Civil Service</td>
<td>4</td>
<td>5.1</td>
</tr>
<tr>
<td>Farmers</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Skilled labor</td>
<td>13</td>
<td>16.5</td>
</tr>
<tr>
<td>*TOTAL</td>
<td>27</td>
<td>34.2</td>
</tr>
<tr>
<td><strong>ALL OCCUPATIONS</strong></td>
<td>79</td>
<td>100.0</td>
</tr>
</tbody>
</table>

In many of the occupations shown some college training
or a degree is required or desirable. Although less than
half of these occupations are clearly scientific or techno-
logical, many of the remaining occupations, such as business
executives, may involve some knowledge and appreciation of science and technology.

Approximately three-fourths of the mothers were housewives. The remaining were mainly secretaries, teachers, and nurses. The occupation of the mothers ran as follows: 59 housewives (75 per cent), 7 secretaries (9 per cent), 7 teachers (9 per cent), 2 nurses (2.5 per cent), and four others (5.1 per cent). The percentage of working mothers was small, considering that only thirteen of the mothers had children under six years of age.

Educational Level of Parents.-- More than two-thirds of the fathers had at least some training beyond high school; 61 per cent had at least one year of college training; 41 per cent had at least a Bachelor's degree and 15 per cent a post graduate degree. More than 58 per cent of the mothers had at least some education beyond high school, 53 per cent at least one year of college, and 23 per cent at least a Bachelor's degree. These results are shown in more detail in Table 8.
TABLE 8. Educational level of parents.

<table>
<thead>
<tr>
<th>Educational Level Attained (highest)</th>
<th>Father</th>
<th>Mother</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per Cent</td>
</tr>
<tr>
<td>Grades 6-12</td>
<td>4</td>
<td>5.1</td>
</tr>
<tr>
<td>High school diploma</td>
<td>21</td>
<td>26.6</td>
</tr>
<tr>
<td>Trade school</td>
<td>6</td>
<td>7.6</td>
</tr>
<tr>
<td>College (1-4 years)</td>
<td>16</td>
<td>20.3</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>20</td>
<td>25.4</td>
</tr>
<tr>
<td>Master's degree</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Ph. D. degree</td>
<td>5</td>
<td>6.3</td>
</tr>
<tr>
<td>M. D. degree</td>
<td>5</td>
<td>6.3</td>
</tr>
<tr>
<td>Registered nurse</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>79</td>
<td>100.0</td>
</tr>
</tbody>
</table>

In 38 cases (48 per cent) both parents had at least one year of college work, and in 52 cases (66 per cent) at least one parent had one year of college training, or more. Data from the 1950 census show that approximately 18 per cent of all family heads in the United States had any college training at that time. If this figure is even approximately valid for Central Ohio in 1963, it becomes apparent that the educational level of the group of parents considered in this study is rather high.

**Siblings.**—The median number of children per family was 3.3. One would expect then that one out of 3.3 students (about 30 per cent) in the group of students with superior
rated projects would be a first born child. The results from the student questionnaire, however, show that 62 per cent of the boys and 65 per cent of the girls are first born children. In other words a first born child is more than twice as likely to produce a superior rated project than a child with older siblings. The results related to number of siblings are shown in Table 9.

**TABLE 9. Number of siblings.**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Boys with Siblings</th>
<th>Girls with Siblings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per Cent</td>
</tr>
<tr>
<td>Younger only</td>
<td>26</td>
<td>46.4</td>
</tr>
<tr>
<td>No siblings</td>
<td>9</td>
<td>16.0</td>
</tr>
<tr>
<td>Older only</td>
<td>9</td>
<td>16.0</td>
</tr>
<tr>
<td>Older and younger</td>
<td>12</td>
<td>21.4</td>
</tr>
<tr>
<td>Twin</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>100.0</td>
</tr>
</tbody>
</table>

An investigation of the age difference between students with superior rated projects and their siblings showed that students with older siblings were, on the average, four years younger than the immediately older brother or sister; students with younger siblings were, on the average, three years older than their immediately younger brother or sister. This suggests that having an older brother or sister tends to inhibit the production of a superior project,
especially if the older brother or sister is not much older than the potential science day participant. Age differences between the participants and their siblings are shown in Table 10.

**TABLE 10. Age difference between participants and their siblings.**

<table>
<thead>
<tr>
<th>Number of Students with Older Siblings</th>
<th>Age Difference (years)</th>
<th>Number of Students with Younger Siblings</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>7 or more</td>
<td>6</td>
</tr>
</tbody>
</table>

28<sup>a</sup> 51<sup>b</sup>

<sup>a</sup> Median age difference 3.9 years.

<sup>b</sup> Median age difference 2.9 years.

**Residence.** — Approximately 91 per cent of the participants indicated that they lived with their mother and father. The remaining 9 per cent (7 students) indicated that they lived with their mother, father, or guardian. This suggests a small number of families broken by death, separation, or divorce. The median number of years at their present residence was 6 years. However, about 28 per cent of all the families have lived at their present address for only one
to three years. The type of residence indicated was city (44.3 per cent), or suburban (44.3 per cent). The remaining 11.4 per cent indicated that they lived in rural areas.

**Family Background (Summary).** -- The findings of this study related to the family background of students with superior rated science projects can be summarized as follows:

1. Approximately 71 per cent of the fathers were engaged in professional, business, or other white collar occupations. The remaining occupations (29 per cent) can be classified as skilled labor.

2. About 75 per cent of the mothers were housewives. Most of the remaining 25 per cent were secretaries, teachers, and nurses.

3. Sixty-one per cent (61) of the fathers had at least one year of college training; 41 per cent had at least a Bachelor's degree, and 15 per cent had post graduate degrees. Only 5 per cent had not received high school diplomas.

4. Fifty-three per cent (53) of the mothers had at least one year of college, and 23 per cent had at least a Bachelor's degree. Ten per cent (10) had not received high school diplomas.
5. Sixty-two per cent (62) of the boys who participated in this study and 65 per cent of the girls were first born or only children.

6. Participants with older siblings were, on the average, four (4) years younger than their immediately older sibling. Those with younger siblings were, on the average, three (3) years older than their immediately younger sibling.

7. Ninety-one per cent (91) of the participants lived with their mother and father.

8. The median number of years that the participants have lived at their present address is six (6) years; however, 28 per cent have lived at their present address for 1-3 years.

9. The type of residence which the participants indicated was city (44.3 per cent) or suburban (44.3 per cent); only 11.4 per cent indicated that they live in rural areas.

**Interests**

The following criteria were used in evaluating the interests of students with superior rated science projects: 1) vocational and educational plans, 2) relation between science project title and occupational preference, 3) favorite and least favorite subjects, 4) hobbies and interests,
5) persons most helpful with the science project, 6) materials read, and 7) extracurricular activities.

**Educational and Occupational Plans.**-- All but two of the participants indicated that they were planning to attend college upon graduation from high school. The other two students, who indicated they were not planning to attend college, did express plans for continuing their education, one in electronics and the other in nursing. One student indicated that she would attend college if she received a scholarship. Almost three-fourths of the group (73.9 per cent) indicated that upon the completion of their studies they were planning to enter a scientific or technological occupation. The most popular area, as indicated by the students' plans, was the medical sciences (20 per cent), followed by the physical sciences (19 per cent), and engineering (16 per cent). The most popular non-science area was education (9 per cent). Only 7 per cent of all participants indicated that they had no definite occupational plans. In order to avoid ambiguity with regard to occupational plans, the participating students were asked what subject they planned to study if they attended college and what occupation they planned to enter upon completion of
their studies. Their answers were generally consistent. The results of the study related to occupational plans are shown in Table 11.

**TABLE 11. Occupational plans.**

<table>
<thead>
<tr>
<th>Field</th>
<th>Number of Choices</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medical Science</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicine</td>
<td>12</td>
<td>13.6</td>
</tr>
<tr>
<td>Medical technology</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Nursing</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Dentistry</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>*TOTAL</td>
<td>18</td>
<td>20.5</td>
</tr>
<tr>
<td><strong>Physical Science</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>8</td>
<td>9.1</td>
</tr>
<tr>
<td>Astronomy</td>
<td>6</td>
<td>6.8</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>*TOTAL</td>
<td>17</td>
<td>19.3</td>
</tr>
<tr>
<td><strong>Engineering</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>6</td>
<td>6.8</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>9.1</td>
</tr>
<tr>
<td>*TOTAL</td>
<td>14</td>
<td>15.9</td>
</tr>
<tr>
<td><strong>Biological Sciences</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Bacteriology</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Conservation</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>*TOTAL</td>
<td>7</td>
<td>7.9</td>
</tr>
</tbody>
</table>
TABLE 11. Occupational choices.  (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Number of Choices</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Other Sciences</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Science&quot;</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>Archaeology</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Geology</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Lab. Technology</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Psychology</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Aviation</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>9</td>
<td>10.2</td>
</tr>
<tr>
<td><strong>Non-Science</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>7</td>
<td>7.9</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>Political Science</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Art</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Business</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Language</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Religion</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>17</td>
<td>19.3</td>
</tr>
<tr>
<td><strong>Undecided</strong></td>
<td>6</td>
<td>6.8</td>
</tr>
<tr>
<td><strong>ALL CHOICES</strong></td>
<td>88</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\*From a total of 79 students.

**Occupational Preference and Science Project Title.**

More than three-fourths of the students who indicated plans for continued study in a scientific or technological field (47 out of 62 total, or 75.8 per cent) did their superior rated science project in the specific area of their occupational choice. A partial list of occupational choices
paired with the science project title of the same student is shown in Table 12.

**TABLE 12. Occupational choices paired with the science project titles for each student who plans a career in science or technology (a partial list).**

<table>
<thead>
<tr>
<th>Occupational Choice</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>Boron Chemistry</td>
</tr>
<tr>
<td>Engineering</td>
<td>Satellite Communication</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>Design of Digital Computers</td>
</tr>
<tr>
<td>Electronics</td>
<td>Reproduction of Sound</td>
</tr>
<tr>
<td>Medicine</td>
<td>Anatomy of a Cat</td>
</tr>
<tr>
<td>Physics</td>
<td>Dissociation of Wire ...</td>
</tr>
<tr>
<td>Conservation Education</td>
<td>Soil Conservation</td>
</tr>
<tr>
<td>Astronomy</td>
<td>4-1/2-inch Reflecting Telescope</td>
</tr>
<tr>
<td>Laboratory Technology</td>
<td>Blood Typing</td>
</tr>
<tr>
<td>Nursing</td>
<td>Our Teeth</td>
</tr>
<tr>
<td>Medicine</td>
<td>Embryology</td>
</tr>
<tr>
<td>Biology, Engineering</td>
<td>The Future Human</td>
</tr>
<tr>
<td>Psychology</td>
<td>Schizophrenia</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>DNA</td>
</tr>
<tr>
<td>Astronomy</td>
<td>Astronomy</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>Transistors -- Theory and Application</td>
</tr>
<tr>
<td>Physics</td>
<td>Experimental Design of an Electronic Telephone</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Modern Algebras and Their Application</td>
</tr>
<tr>
<td>Astronomy</td>
<td>Principles of the Reflecting Telescope</td>
</tr>
<tr>
<td>Medicine</td>
<td>Comparison of Blood Cells ...</td>
</tr>
<tr>
<td>Art</td>
<td>... Development of Creativity</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>Paper Chromatography</td>
</tr>
<tr>
<td>Astronomy</td>
<td>Vector Analysis</td>
</tr>
<tr>
<td>Medicine</td>
<td>Protozoa</td>
</tr>
<tr>
<td>Astrophysics</td>
<td>VHF Radio Telescope</td>
</tr>
</tbody>
</table>

......... (twenty-two more pairs)
The relationship between the occupational choice as indicated in the student questionnaire and the science project title as it appeared in the judging cards is, indeed, remarkable. This is especially significant since, as shown on page 37, sixty-two per cent (62) of the participants are freshmen and sophomores with occupational plans not yet fully formulated.

**Favorite and Least Favorite Subject.**—The question for the respondents "favorite subject" and "least favorite subject" provided for multiple responses. The percentages in Table 13 would, therefore, add up to more than 100 per cent. Science, or specific science subjects were listed as favorite by 78 per cent of the respondents; however, only 6.5 per cent (5 out of 77 responding) listed a science subject as a least favorite one. Mathematics was second from the top in the favorite list and second from the bottom in the least favorite list. The results are shown in Table 13.
TABLE 13. Favorite and least favorite subjects.

<table>
<thead>
<tr>
<th>Favorite Subject</th>
<th>Number</th>
<th>Per Cent</th>
<th>Least Favorite Subject</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>60</td>
<td>78.0</td>
<td>Foreign Language</td>
<td>25</td>
<td>32.5</td>
</tr>
<tr>
<td>Mathematics</td>
<td>45</td>
<td>58.5</td>
<td>English</td>
<td>20</td>
<td>26.0</td>
</tr>
<tr>
<td>English</td>
<td>17</td>
<td>22.1</td>
<td>History</td>
<td>13</td>
<td>16.9</td>
</tr>
<tr>
<td>Foreign Language</td>
<td>13</td>
<td>16.9</td>
<td>Mathematics</td>
<td>9</td>
<td>11.7</td>
</tr>
<tr>
<td>History</td>
<td>8</td>
<td>10.4</td>
<td>Science</td>
<td>5</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Hobbies and Interests.—The participating students were asked to list their hobbies and interests. No attempt was made to evaluate the number of activities listed since responses such as "sports" may involve several distinct activities. The activities listed were merely classified according to type, as shown in Table 14. A preliminary investigation of the responses in the student questionnaire suggested that they should be tabulated separately for boys and girls. It can be thus seen that there are marked differences in hobbies and interests, as one might expect, between boys and girls. A large percentage of both groups listed sports in general, or various specific sports, and outdoor activities, although girls lead somewhat in this category. Sixty-one per cent (61) of the girls listed music activities and art, but only two boys (3.6 per cent) listed such activities. More than half of the girls (52 per cent)
but only 27 per cent of the boys listed reading. In scientific and shop activities boys surpassed girls, as expected.

TABLE 14. Hobbies and interests.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Boys Number</th>
<th>Per Cent</th>
<th>Girls Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sports, outdoor</td>
<td>40</td>
<td>75.5</td>
<td>20</td>
<td>87.0</td>
</tr>
<tr>
<td>Music, art</td>
<td>2</td>
<td>3.6</td>
<td>14</td>
<td>61.0</td>
</tr>
<tr>
<td>Reading</td>
<td>15</td>
<td>26.8</td>
<td>12</td>
<td>52.2</td>
</tr>
<tr>
<td>Scientific, shop</td>
<td>34</td>
<td>60.7</td>
<td>6</td>
<td>26.1</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>100.0</td>
<td>23</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Reading.— The participants were asked to list the titles of the books they read during the past year, the names of the magazines they read regularly or often, and the reference materials they used in carrying out their science project. Responses such as "several" or "many" made it difficult to interpret some of the results. These results are summarized below.

1. Books: A total of 72 students listed anywhere from 2 to 100 titles. The median for the entire group was 6 books.

2. Magazines: A total of 77 participants listed anywhere from 1 to 13 magazines read regularly or often. The magazines listed were classified into two categories — scientific or technological, and general. Forty out of
seventy-seven respondents (51.6 per cent) listed three or more general magazines. Forty-four out of fifty-four boys (81.5 per cent) listed one or more scientific or technological periodicals; however, only five out of twenty-three girls (21.7 per cent) listed any scientific or technological periodicals.

3. References: A total of 77 students listed from none to more than 10 references which they used in carrying out their superior rated science project. Seventy-two students (93.5 per cent) listed at least one reference. Fifty students (65.0 per cent) listed three or more. Seventeen students (22.1 per cent) listed seven or more references.

Persons Most Helpful with the Science Project.—Each participant was asked to list the names of the persons who were most helpful with their science project. They were also asked to indicate the title of each person listed, or his relation to the respondent. Persons who were not designated as teachers or members of the respondent's family are referred to in this study as resource persons. The results are shown in Table 15.
TABLE 15. Most helpful persons (multiple responses).

<table>
<thead>
<tr>
<th>Individual</th>
<th>Responses (number)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>47</td>
<td>59.5</td>
</tr>
<tr>
<td>Parents</td>
<td>34</td>
<td>43.0</td>
</tr>
<tr>
<td>Resource persons</td>
<td>41</td>
<td>52.9</td>
</tr>
<tr>
<td>None</td>
<td>7</td>
<td>8.9</td>
</tr>
</tbody>
</table>

The names of 68 resource persons (other than teachers and parents) were listed by 41 students. Three companies were also named. The occupations of the resource persons were classified as shown in Table 16. It is apparent from these data that the science day programs are instrumental in bringing many capable high school students together with college teachers and persons from scientific and technological occupations in an informal working relationship. This relationship is most valuable from the standpoint of motivation and occupational orientation.

TABLE 16. Resource persons.\textsuperscript{a}

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientists</td>
<td>20</td>
</tr>
<tr>
<td>College instructors</td>
<td>16</td>
</tr>
<tr>
<td>Engineers</td>
<td>6</td>
</tr>
<tr>
<td>Medical doctors</td>
<td>9</td>
</tr>
<tr>
<td>Technical experts</td>
<td>4</td>
</tr>
<tr>
<td>College students</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Listed as most helpful persons by 41 students.
**Extracurricular Activities.**—The participants were asked to list all the extracurricular activities in which they took part. An examination of the results in Table 17 suggests that this group of high school students is more active in extracurricular activities than one would expect from a randomly selected group of high school students.

Sixty students (76 per cent) reported at least one club membership. Fifty-three students (67 per cent) indicated participation in at least one activity requiring some degree of leadership, such as a club office, membership in the student council or an honor society, and involvement in a school publication. Thirty-seven participants (47 per cent) indicated membership in a science club or a science seminar. Twenty-four listed participation in varsity sports. Only four students did not list any extracurricular activities. The total number of extracurricular activities for individual participants ranged from 0 to 16. The median number of extracurricular activities reported per student was 3.6.
TABLE 17. Extracurricular activities.

<table>
<thead>
<tr>
<th>Membership or Activity</th>
<th>Number of Students</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2 clubs</td>
<td>34</td>
<td>43.1</td>
</tr>
<tr>
<td>3 - 4 clubs</td>
<td>19</td>
<td>24.1</td>
</tr>
<tr>
<td>5 - clubs</td>
<td>7</td>
<td>8.9</td>
</tr>
<tr>
<td>Club office(s)</td>
<td>22</td>
<td>27.9</td>
</tr>
<tr>
<td>Student Council</td>
<td>12</td>
<td>15.2</td>
</tr>
<tr>
<td>Honor Society</td>
<td>24</td>
<td>30.4</td>
</tr>
<tr>
<td>School publication</td>
<td>8</td>
<td>10.1</td>
</tr>
<tr>
<td>Varsity</td>
<td>24</td>
<td>30.4</td>
</tr>
<tr>
<td>Cheer leaders</td>
<td>3</td>
<td>3.8</td>
</tr>
<tr>
<td>None reported</td>
<td>4</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Interests (Summary).— The main findings of this study which are related to the interests of students with superior rated science projects can be summarized as follows:

1. All participants indicated plans to continue their education upon graduation from high school. Seventy-four per cent (74) were planning to continue their education in the sciences or in engineering.

2. Seventy-six per cent (76) of those students who chose a scientific or technological career did their superior rated science project in the specific field of their occupational choice, or in a very closely related field.

3. Seventy-eight per cent (78) of the participants listed science, or a specific science course, as a favorite
subject; however, only five participants (6.5 per cent) listed a science course as a least favorite subject. Mathematics was listed as a favorite subject by 58 per cent of the group, and as a least favorite by 12 per cent. Thus, the two most popular subjects among the members of the group were science and mathematics, in that order.

4. Hobbies and interests were studied separately for boys and girls. Sports and outdoor activities were listed by a large fraction of both groups -- 76 per cent of the boys and 87 per cent of the girls. In music and art there was a marked difference between the two groups. Sixty-one per cent (61) of the girls but only 4 per cent of the boys listed music or art. In reading, likewise, the girls surpassed the boys, 52 per cent to 27 per cent. In scientific and mechanical hobbies, however, 61 per cent of the boys but only 26 per cent of the girls were involved.

5. The number of books read by each student during the past year varied from 2 to 100. The median was 6 books. The number of magazines read regularly or often varied from 1 to 13. The median number of general magazines read was 3. Eighty-one per cent (81) of the boys read one or more scientific or technological magazines regularly or often; however, only 22 per cent of the girls read such magazines.
6. Teachers were listed most often as "most helpful" with the science projects (60 per cent), followed by resource persons (53 per cent), and parents (43 per cent). Sixty-eight scientists, college teachers, engineers, medical doctors, and other resource persons were listed by 41 students as most helpful persons with their science projects.

7. The participating students listed from 0 to 16 extracurricular activities. The median was 3.6 activities reported per student. Seventy-six per cent (76) of the group reported one or more club membership. Sixty-seven per cent (67) participated in at least one activity which requires some leadership (club offices, student council, honor societies, and school publications). Forty-seven per cent (47) indicated membership in a science club, and 30 per cent in varsity sports.

The Science Project

This section is concerned with data related to the initiation, construction, and completion of the science projects. The factors considered here are 1) the number of previous science day projects, 2) the amount of time spent on the most recent science project which was rated superior,
3) the place at which the project was carried out, 4) class
time spent on science projects, and 5) the cost of project
materials which were purchased.

**Previous Science Day Projects.**—The participants were
asked how many science projects they had entered in a sci-
ence day exhibit prior to the most recent one. Eighty-two
per cent (82) of the group indicated that they had entered
one or more projects in a science day previously; 56 per
cent had entered two or more, and 41 per cent three or more.
Fourteen out of seventy-eight participants who responded to
the previous question (18 per cent) indicated that they had
not entered any projects in a science day program previously.

**Time Spent on the Most Recent Science Project.**—The
participants were asked to give the number of weeks they
spent on their most recent science project which was rated
superior. From a total of 77 students who responded, 69
(90 per cent) gave 6 weeks or more, 52 (68 per cent) gave
11 weeks or more, 36 (47 per cent) gave 16 weeks or more,
and 22 (29 per cent) gave 26 weeks or more. Eleven students
(14 per cent) indicated 46 weeks or more, which is consider-
ably longer than one school year. The median number of weeks
spent on the science project was 15.
Place At Which the Project Was Carried Out.-- The participants were asked to indicate whether most of the work involved in carrying out the project was done at home or at school. Seventy-one from a total of 79 respondents (90 per cent) indicated that most of the project work was done at home.

Class Time Spent on Projects.-- The participants were asked whether any class time was spent on science projects. Forty-eight students (61 per cent) indicated that some class time was devoted to project work, and 31 students (39 per cent) indicated that no class time was taken up for projects.

Cost of Project Materials.-- The participants were asked to give the cost of project materials that they purchased. The cost ranged from a few cents to $400.00. The median cost was $8.00. Sixteen students (20 per cent) spent more than thirty dollars ($30.00).

The Science Project (Summary).-- The findings of this study related to superior rated projects can be summarized as follows:

1. The number of science day projects which preceded each superior rated project varied from 0 to 5. Eighty-two
per cent (82) of the participants had entered one or more projects previously, and 56 per cent had entered two or more.

2. The median number of weeks required to complete a superior rated science project was 15. Twenty-nine per cent (29) of the group spent 26 weeks or more, and 14 per cent 46 weeks or more.

3. Most of the work required to complete 90 per cent of the science projects considered in this study was done at home.

4. Sixty-one per cent (61) of the respondents reported that some class time was devoted to science projects.

5. The cost of materials purchased for a science project varied from a few cents to $400.00. The median cost was $8.00.

**Ability and Achievement**

The only available measure of the mental ability of the participants was their intelligence test score (IQ or percentile). Achievement was evaluated in terms of grade point-averages. Both the intelligence test scores and grades were obtained from transcript forms completed for each participating student by their school.
Mental Ability. IQ scores were available for 56 students and percentile scores for 11 students. Whenever more than one score was available, the most recent one was considered. These scores were obtained by using group tests such as the Henmon-Nelson Test, the Otis Mental Ability Test, and several others, or by individual tests such as the Stanford-Binet test. These tests were standardized on different groups using different statistical techniques. In addition to that, different tests do not measure exactly the same abilities. However, since no single standard was available, the distribution of the available IQ and percentile scores was studied as if they represented a single standard. The median of the fifty-six IQ scores was found to be 125, and the median of the eleven percentile scores was 83. The IQ scores ranged from 104 to 153, and the percentile scores from 51 to 99.8. The score distributions are shown in Table 18.

Although a precise interpretation of the intelligence scores in Table 18 is not possible, it appears very likely that all of these students have above average intelligence and that some of them are mentally superior.
TABLE 18. Intelligence scores.

<table>
<thead>
<tr>
<th>IQ Range¹</th>
<th>Number</th>
<th>Percentiles</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>102 - 109</td>
<td>7</td>
<td>51 - 60</td>
<td>2</td>
</tr>
<tr>
<td>110 - 119</td>
<td>13</td>
<td>61 - 80</td>
<td>3</td>
</tr>
<tr>
<td>120 - 129</td>
<td>18</td>
<td>81 - 90</td>
<td>2</td>
</tr>
<tr>
<td>130 - 139</td>
<td>13</td>
<td>91 - 95</td>
<td>1</td>
</tr>
<tr>
<td>140 -</td>
<td>5</td>
<td>96 -</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>56²</td>
<td></td>
<td>11³</td>
</tr>
</tbody>
</table>

¹IQ scores were available for 56 students.

²IQ scores were not available for these 11 students.

Grades.-- The over-all grade point-average was computed for each student as follows: All letter grades that the student received in grades 9-12 (depending on his present grade level) were converted into numbers by counting a grade of A as 4 points; B, 3 points; C, 2 points; and D, 1 point. Then, all points were added, and the sum divided by the total number of credit units. The science grade point-average was computed in a similar manner. The results are shown in Table 19. Sixty-nine per cent (69) of the group had a cumulative grade point average of 3.0 (3) or higher. Twenty-two per cent (22) all A's. Eighty per cent (80) of the group, however, has an average of 3.0 or higher in science courses, and 45 per cent have all A's in
science. It is then apparent that the achievement of the group as a whole is above average, and that achievement in science courses is considerably higher than the over-all achievement. About 30 per cent of the students in this group are not high achievers. To these students, the science day experience could become a stimulus for increased effort.

TABLE 19. Cumulative grade point average in all subjects and in science.

<table>
<thead>
<tr>
<th>Grade Point Average</th>
<th>All Subjects</th>
<th>Science</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Students</td>
<td>Per Cent</td>
</tr>
<tr>
<td>2.0 - 2.4</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>2.5 - 2.9</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>3.0 - 3.4</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>4.0</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>100</td>
</tr>
</tbody>
</table>

Ability and Achievement (Summary).-- Intelligence test scores and grades were used in evaluating the mental ability and level of scholastic achievement of the participants. The main findings may be summarized as follows:

1. IQ test scores from various intelligence tests were available for 56 students. These scores ranged from IQ 102
to IQ 153. The median was 125. For 11 more students no IQ scores were available; however, percentile scores for mental ability were given. The median percentile for those 11 scores was 83.

2. Sixty-nine per cent (69) of the group had a cumulative grade point-average of 3.0 or higher (in all subjects); however, 30 per cent of the group had 3.0 average or higher in science courses. Twenty-two per cent of the group had A's in all subjects, but 45 per cent had A's in all science courses they had taken in grades 9-12.

Chapter Summary

Various factors related to the student with a superior rated science project and his family were examined in this chapter. Most of the data were obtained by means of a questionnaire which was filled out by each one of the participating students. The main findings were summarized at the end of each main section of the chapter.
CHAPTER V

THE SCHOOL, THE SCIENCE TEACHER, AND THE COMMUNITY

The school, the community, and the science teachers of students with superior rated projects at the Central Ohio District Science Day are examined in this chapter in order to determine what factors favor the production of superior science projects. The thirty-seven schools that cooperated in this study were divided into two groups, the high group consisting of schools with three or more superior rated projects at the District Science Day of 1963, and the low group consisting of schools with only one or two superior rated projects. The same terms, high group and low group, are used in classifying the cooperating science teachers, depending upon whether they taught in a high school of the low group or the high group. The chapter is divided into three sections dealing with 1) the school, 2) the science teacher, and 3) the school district and immediate community.
The School

Each one of the thirty-seven participating schools was asked to fill out a short questionnaire, which is referred to as the school questionnaire. Other sources of information were the Ohio School Directory for 1962-63 and the records of the Central Ohio District Science Day Committee. The following factors were examined: 1) school enrollments, 2) college orientation of the participating schools, 3) local science exhibits, and 4) past performance of the schools at the District Science Day.

School Enrollment.-- Enrollment figures were obtained from the Ohio School Directory for 1962-63. All except one of the schools in the high group (three or more superior projects) had a total enrollment of over 400 students. The only exception was the University School of The Ohio State University, which cannot be considered as a typical high school. In the low group, however, there were six schools with an enrollment of less than 400 students. This shows that small enrollment tends to limit the number of superior projects. Many large high schools are included in the low group, as shown in Table 20. This indicates that size alone does not favor the production of more superior projects, but
merely limits their number according to the laws of proba-
bility. This, however, may not be the case with small high
schools that cannot support an effective science program.
The median enrollment for the high group was 1087 students,
for the low group 774 students, and for both groups 960
students. The most definite statement that can be made con-
cerning these results is that larger schools tend to produce
more superior science projects if other projects are also
present.

TABLE 20. School enrollments.

<table>
<thead>
<tr>
<th>Enrollment</th>
<th>Number of Schools (high group)</th>
<th>Number of Schools (low group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>81 - 199</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>200 - 399</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>400 - 599</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>600 - 799</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>800 - 999</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>1000 - 1199</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>1200 - 1399</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1400 -</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
<td><strong>28</strong></td>
</tr>
</tbody>
</table>

College Orientation.-- The participating schools were
asked what percentage of their students followed an "aca-
demic" or "college" course. The responses ranged from 20
per cent to 90 per cent for each group. The median for the
high group was 45 per cent and for the low group 54 per cent. Another index of college orientation used was the percentage of students enrolled in physics, chemistry, advanced biology, and their equivalents. This percentage was computed from the total enrollment in those courses (school questionnaire) and the total school enrollments. The median for the high group was 16 per cent and for the low group 13 per cent. In the opinion of the author, neither index of college orientation revealed any significant difference between the two groups.

Local Science Days.— The participating schools were asked to give the number of years during which a local science day or science fair was held. The responses showed a significant difference between the two groups, as shown in Table 21. The median number of years that a local science day was held is 6.5 years for the high group and 3.6 years for the low group. This shows that the establishment of a science day tradition in a school tends to favor the production of superior science projects.
TABLE 21. Local science days -- number of years held.

<table>
<thead>
<tr>
<th>Number of Years</th>
<th>Number of Schools (high group)</th>
<th>Number of Schools (low group)</th>
<th>All Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

| Total           | 10                            | 25                           | 35          |

Past Performance at the District Science Day.-- Six out of eleven schools in the high group had 3 or more superior projects at the District Science Day each year for the past three years, including 1963. Two more schools in the high group had three or more superior projects in two out of the last three years. Only five out of twenty-nine schools in the low group have had three or more superior projects in any one year and only two for two years.\(^1\) These

\(^1\)This information was gathered from mimeographed reports which are issued annually by the Central Ohio District Science Day Committee.
results show that most schools in the high group have consistently produced more superior science projects than the schools in the low group. This would lead us to expect other significant differences between the two groups of schools. Indeed, differences have already been established regarding enrollment and experience with local science days. More differences are shown in the next section, which deals with the characteristics of the science teachers.

The School (Summary).-- The schools that participated in this study were divided into two groups -- those with three or more superior projects at the Central Ohio District Science Day (high group), and those with only one or two superior rated projects. The main differences between the two groups may be summarized as follows:

1. The schools in the low group ranged in enrollment from small (less than 300) to large (1400 or more). The schools in the high group ranged from medium (about 450) to large. The median enrollment of the low group was 774 students, the high group was 1087 students, and both groups 960 students.

2. The two groups did not show any significant difference in college orientation, which was measured by the
percentage of students in the "college" course and the percentage of students in advanced high school science courses.

3. Schools in the high group have held local science days or science fairs for a median of 6.5 years; however, schools in the low group have held local science days for a median of only 3.6 years.

4. Schools in the high group have consistently produced more superior projects each year during the past three years, including 1963, than schools in the low group.

The Science Teacher

Almost all students who produced a superior rated science project were enrolled in a science course during 1962-1963. Their science teachers were asked to fill out a questionnaire (teacher questionnaire) in order to determine what characteristics in the background of the teacher tend to favor the production of superior science projects. The following factors were examined: 1) fields of certification, 2) experience, 3) graduate study, 4) professional memberships, and 5) attitude toward science days. Those teachers who teach in schools with three or more superior
science projects are referred to as the **high group**, and those from schools with one or two superior projects the **low group**.

**Fields of Preparation.**-- The cooperating teachers were asked to give their major and minor fields of certification. The data in Table 22 reveal some significant differences between the two groups of teachers. A higher percentage of the teachers in the high group were certified in biological science, in physical science, and in mathematics. The greatest difference was in the physical sciences, in which 92 per cent of the high group were certified but only 52 per cent of the low group. A higher percentage of the teachers in the low group were certified in comprehensive science and in non-science areas. This suggests strongly that the production of superior science projects reflects the quality of science teaching.

**Teaching Experience.**-- Table 23 shows some difference in length of teaching experience in science between the two groups. The high group has fewer teachers with short experience (1-5 years) and more with long experience (21 or more years). In the 6-20 year range there is no significant difference.
### TABLE 22. Fields of teacher certification.\(^a\)

<table>
<thead>
<tr>
<th>Field of Certification</th>
<th>High Group Number</th>
<th>Per Cent</th>
<th>Low Group Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Science</td>
<td>17</td>
<td>71</td>
<td>16</td>
<td>64</td>
</tr>
<tr>
<td>Physical Science</td>
<td>22</td>
<td>92</td>
<td>13</td>
<td>52</td>
</tr>
<tr>
<td>Mathematics</td>
<td>8</td>
<td>33</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Comprehensive Science</td>
<td>4</td>
<td>17</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Home Economics</td>
<td>0</td>
<td>--</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Physical Education</td>
<td>4</td>
<td>17</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Language and Social Studies</td>
<td>6</td>
<td>25</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td></td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)Major or minor.

### TABLE 23. Teaching experience in science.

<table>
<thead>
<tr>
<th>Years</th>
<th>High Group Number</th>
<th>Per Cent</th>
<th>Low Group Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 5</td>
<td>7</td>
<td>30</td>
<td>11</td>
<td>42</td>
</tr>
<tr>
<td>6 - 10</td>
<td>6</td>
<td>26</td>
<td>6</td>
<td>23</td>
</tr>
<tr>
<td>11 - 15</td>
<td>5</td>
<td>22</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>16 - 20</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>21 -</td>
<td>4</td>
<td>17</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td></td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>
Graduate Study. -- The cooperating teachers were asked to give their degrees, and the number of graduate semester hours in science, science education, and non-science education courses.

1. Graduate degrees: Twelve out of twenty-three teachers (52 per cent) in the high group had Master's degrees. In the low group 9 out of 26 (35 per cent) had Master's degrees.

2. Graduate work in science: The numbers of graduate semester hours in science were tabulated as shown in Table 24. The percentage of teachers who had done some graduate work in science was comparable in both groups. However, the teacher in the high group generally had a greater number of hours of graduate work in science.

TABLE 24. Graduate work in science.

<table>
<thead>
<tr>
<th>Semester Hours</th>
<th>High Group</th>
<th>Low Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per Cent</td>
</tr>
<tr>
<td>0</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>5 - 34</td>
<td>8</td>
<td>33</td>
</tr>
<tr>
<td>35</td>
<td>7</td>
<td>29</td>
</tr>
<tr>
<td>Not given</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

a These teachers did have Master's degrees.
3. Graduate work in education: Seven out of twenty-one teachers in the high group (33 per cent) reported some work in science education. In the low group, 5 out of 25 teachers (20 per cent) reported some work in science education. Thirty-eight per cent (38) of the high group reported graduate work in non-science education courses. However, 52 per cent of the low group reported non-science education courses.

*Professional Memberships.*—The participating teachers were asked to list all of the professional associations of which they were members. Membership in science and science educations is shown in Table 25.

**TABLE 25. Membership in science and science education professional associations.**

<table>
<thead>
<tr>
<th></th>
<th>NSTA\textsuperscript{a}</th>
<th>OAS\textsuperscript{b}</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per Cent</td>
<td>Number</td>
</tr>
<tr>
<td>High Group (23)</td>
<td>11</td>
<td>48</td>
<td>13</td>
</tr>
<tr>
<td>Low Group (25)</td>
<td>8</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>Both Groups (48)</td>
<td>19</td>
<td>42</td>
<td>21</td>
</tr>
</tbody>
</table>

\textsuperscript{a}National Science Teachers' Association.

\textsuperscript{b}Ohio Academy of Science.
It is apparent that teachers in the high group are considerably more active in professional science and science education associations than teachers in the low group. Table 26 shows teacher membership in the National Education Association, the Ohio Education Association, and local education associations. In these associations the low group shows a slightly greater percentage of membership. This difference, however, may not be significant.

**TABLE 26. Membership in professional education associations.**

<table>
<thead>
<tr>
<th></th>
<th>NEA Number</th>
<th>NEA Per Cent</th>
<th>OEA Number</th>
<th>OEA Per Cent</th>
<th>Other Number</th>
<th>Other Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Group</td>
<td>23</td>
<td>11</td>
<td>74</td>
<td>48</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>Low Group</td>
<td>25</td>
<td>14</td>
<td>80</td>
<td>56</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Both Groups</td>
<td>48</td>
<td>25</td>
<td>77</td>
<td>52</td>
<td>15</td>
<td>31</td>
</tr>
</tbody>
</table>

**Attitude Toward Science Days.**—The attitude of the science teachers toward science days was evaluated as follows:

1. They were asked whether they require, encourage, or do not place much emphasis on science projects. Only two teachers from each group indicated that they do not place much emphasis on science projects. In the high group seven teachers (32 per cent) indicated that they "require" science
projects and 13 teachers (59 per cent) that they "encouraged" their students to do project work. In the low group, 18 teachers (72 per cent) indicated that they "required" science projects and 5 teachers that they "encouraged" their students to carry out science projects. These results suggest that the teachers in the high group tend to use a subtle approach in creating interest in project work among their students.

2. The science teachers were asked what fraction of their students' grades were based on science projects. The responses varied considerably with no apparent difference between the two groups. Seventeen teachers in the high group (74 per cent) and twenty teachers in the low group (80 per cent) indicated that at least a small fraction of the yearly grade depended on projects. In about 60 per cent of each group this fraction varied from 1/9 to 1/24. Two teachers in the high group and three in the low group reported that 1/4 to 1/6 of their students' yearly grade depended on the science project. Some teachers commented that the amount of grade credit depended on the quality of the science project. Others said that the project would make a
difference in borderline cases between two letter grades. Others commented that some research work was required for a grade higher than a C.

3. The participating teachers were asked how many years they had been actively involved in science days. The number of years reported was tabulated, as shown in Table 27.

**TABLE 27. Teacher involvement in science days (number of years).**

<table>
<thead>
<tr>
<th>Number of Years</th>
<th>High Group (number)</th>
<th>Low Group (number)</th>
<th>Both Groups (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
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<td>0</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

|                | 20                  | 22                 | 42                  |

The median for the high group was 4.8 years and for the low group 1.8 years. These results indicate that the experience of the science teacher with science days is an important factor in producing superior science projects.
4. The science teachers were asked whether they helped their students in choosing and planning their science projects. Only three teachers responded "No," -- one from the high group and two from the low group. Several teachers, including two who responded "No" qualified their answer by stating that the help they provided their students was limited, and that they expected their students to take the initiative in asking for help.

The Science Teacher (Summary).-- The science teachers of high school students with superior rated projects at the Central Ohio District Science Day were divided into two groups: those who taught in schools with three or more science projects (high group), and those from schools with only one or two superior projects (low group). The difference between the two groups may be summarized as follows:

1. A higher percentage of teachers in the high group were certified in biological science, in physical science, and in mathematics than in the low group. The difference was particularly pronounced in physical science (92 per cent to 52 per cent). A higher percentage of teachers in the low group were certified in comprehensive science and in non-science subjects than in the high group.
2. The high group included fewer teachers with 1-5 years of experience and more teachers with experience of more than 20 years than the low group (in absolute numbers and in percentage).

3. Teachers in the high group had more Master's degrees, more graduate semester hours in science, and were more likely to have taken graduate courses in science education than teachers in the low group. However, teachers in the low group had more semester hours in graduate non-science education courses.

4. A considerably higher percentage of teachers in the high group were members of professional science education and science associations than in the low group.

5. Teachers in both groups placed considerable emphasis on science projects and based part of the yearly grade on the science day project or some other research activity.

6. The teachers in the high group had considerably longer experience with science days through active involvement in them than teachers in the low group. The median for the high group was 4.8 years and for the low group 1.8 years.
The County, the School District, and the Immediate Community

The distribution of superior rated science projects according to county, school district, and immediate community are briefly examined in this section. Although no extensive information is available, the author felt that the characteristics of the school which were examined earlier would become more meaningful if they were viewed in relation to the community in which the school is located.

The County.-- The distribution of superior rated science projects is shown in Table 28. The Central Ohio District Science Day serves seven counties. It is held annually in Columbus, which is located in the heart of Franklin County. Columbus and Franklin County have a large population, many industries, museums, libraries, three universities, several research facilities, and some prosperous suburban areas. This explains why fifty-eight out of eighty-eight superior science projects in 1963 came from within the boundaries of Franklin County. Delaware County and Licking County followed with ten projects and eight projects respectively from within their boundaries. Each of these two counties have a university and some industry. The
remaining four counties have no universities and they are not as heavily populated, judging from the population of their largest city which is also the county seat.

**TABLE 28. Distribution of superior rated science projects by county.**

<table>
<thead>
<tr>
<th>County</th>
<th>County Seat</th>
<th>Population&lt;sup&gt;a&lt;/sup&gt; (County Seat)</th>
<th>Projects (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Franklin</td>
<td>Columbus</td>
<td>471,316</td>
<td>58</td>
</tr>
<tr>
<td>Delaware</td>
<td>Delaware</td>
<td>13,282</td>
<td>10</td>
</tr>
<tr>
<td>Licking</td>
<td>Newark</td>
<td>41,790</td>
<td>8</td>
</tr>
<tr>
<td>Fairfield</td>
<td>Lancaster</td>
<td>30,500</td>
<td>6</td>
</tr>
<tr>
<td>Madison</td>
<td>London</td>
<td>6,379</td>
<td>4</td>
</tr>
<tr>
<td>Pickaway</td>
<td>Circleville</td>
<td>11,059</td>
<td>2</td>
</tr>
<tr>
<td>Union</td>
<td>Marysville</td>
<td>4,952</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>a</sup>1960 census.

**The School District.**— Most of the superior projects were produced in urban areas, which include city school districts, parochial and private schools, and exempted villages. The contribution from local school districts, which include small towns and rural areas, was small. Enrollment sizes and lack of industrial and educational resources are probably related to this.
TABLE 29. Distribution of superior rated science projects by type of school district.

<table>
<thead>
<tr>
<th>District Type</th>
<th>Number of Districts</th>
<th>Number of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>City</td>
<td>9</td>
<td>49</td>
</tr>
<tr>
<td>Exempted Village</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Parochial</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Private</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Local</td>
<td>9</td>
<td>13</td>
</tr>
</tbody>
</table>

The Immediate School Community.--- It has already been suggested that high schools in urban or suburban areas are more likely to produce superior science projects owing to the proximity of industrial and educational resources. Assuming, however, that this condition is met, three additional factors must be considered: The family, the school, and the science teacher. A middle class residential community would be probably favorable with respect to all three factors. Earlier data related to college orientation, however, do not particularly support this hypothesis. This suggests that an effective school program and a good science teacher are most important in producing superior science projects. Most urban schools have a sufficient number of students with favorable family background for superior science project work if the school environment is also favorable.
Summary.-- Schools in urban areas near industrial and educational resources, especially universities, tend to produce more superior science projects than schools in small towns and rural areas. This comparison, however, is valid only when the school and the science teacher provide adequate encouragement for project work in science.

Chapter Summary

The role of the school, the science teacher, and the community was examined in relation to the production of superior rated science projects at the Central Ohio District Science Day. It was found that the following factors tend to favor the production of superior projects:

1. A large school enrollment.

2. Long experience by the school and the science teacher in science day programs.

3. A science teacher with a good background in the sciences, especially physical science; one who had some graduate training in science education, has a Master's degree, and is professionally active in science education.

4. Proximity to industrial and educational resources, especially colleges and universities.
CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Chapter VI is divided into four parts: 1) a summary of the major findings of this investigation, 2) a discussion of the findings in relation to those of other investigators in related studies, 3) conclusions, and 4) recommendations.

Summary

The Student and His Family

The "typical" student who received superior rating for his science project at the Central Ohio District Science Day is described by means of characteristics which are possessed by a large fraction of the group of students studied. The percentage of students who possess a particular characteristic is given in parenthesis.

General Information.-- The typical student in the group is a boy (70 per cent); a sophomore (37 per cent); in biology (43 per cent). However, if he is enrolled in physics, he is 2.5 times more likely to produce a superior
rated project than if he were enrolled in biology, and four
times more likely than if he were enrolled in either chem-
istry or general science. His project was done in zoology
(37 per cent) or in physics (31 per cent).

Family.-- The father is engaged in a professional oc-
cupation (40 per cent) or in a business occupation (25 per
cent). The mother is a homemaker (75 per cent), a secre-
tary (9 per cent), or a teacher (9 per cent). The father
has one year of college training or more (61 per cent), a
college degree (26 per cent), or a post graduate degree (15
per cent). The mother has one year of college or more (53
per cent); she has a college degree (23 per cent). The
participating student is a first born or an only child (63
per cent). If he has an older sibling, he is four years
younger than the immediately older sibling (50 per cent).
If he has younger siblings, he is three years older than
the immediately younger sibling (50 per cent). He lives
with his mother and father (91 per cent) in a suburban (44
per cent) or urban (44 per cent) residence. His family has
resided at their present address for six years or more (50
per cent).

Interests.-- He plans to continue his education after
high school graduation (100 per cent) in science or in
engineering (74 per cent). He plans a career in the medical sciences (20 per cent), or in the physical sciences (19 per cent), or biological science (8 per cent). His science project is directly related to his occupational plans (60 per cent). Science is listed among his favorite subjects (78 per cent) with mathematics (59 per cent). Boys are active in at least one sport or outdoor activity (76 per cent) and have a scientific or mechanical hobby (61 per cent). They read a science or technological magazine regularly or often (81 per cent). Girls are active in at least one sport or outdoor activity (87 per cent), in music or art (61 per cent), and they like to read (52 per cent). The typical participant (boy or girl) used three or more reference materials in carrying out his superior rated science project (65 per cent). Most helpful persons with his project include his science teacher (60 per cent), his parents (43 per cent), and one or more resource persons (53 per cent). (Sixty-five scientists, engineers, medical doctors, college professors, and other resource persons were listed by forty-one participating students.) He is active in three or more extracurricular activities (70 per cent), including one that requires some leadership (67 per cent).
The Project.-- The typical superior rated science project was preceded by at least one previous science day project (82 per cent); it was done primarily at home (90 per cent) and it required fifteen weeks or longer (50 per cent). The cost of project materials purchased varied from a few cents to $400.00; however, it was generally $8.00 or less (50 per cent).

Mental Ability and Achievement.-- The typical student of this study had a median IQ of 125 and a cumulative grade average of B or better in all subjects (69 per cent) and A average in science (45 per cent). (Eighty per cent of the students had an average of B or better in science courses.) He may be a member of a scholastic honor society (30 per cent).

The School, the Science Teacher, and the Community

The schools that participated in the study were divided into two groups -- those with three or more superior projects in 1963, and those with only one or two superior projects. The terms high group and low group are used in reference to those two groups. The difference in the characteristics of the two groups was used in deciding what
factors tend to favor the production of superior rated science projects. It was found that the following factors favor superior rated science projects:

1. Enrollment of 400 or more students.
2. A tradition of local science days.
3. A record of consistently large numbers of superior rated projects in District Science Days.
4. A capable science teacher who can be described as follows: He has a good background in the sciences -- especially the physical sciences -- and in mathematics; he is experienced, has a Master's degree, and has had a large number of semester hours in graduate science courses; he is professionally active in science and science education, and places emphasis on project work and research in science by his students; part of his student's grade is based on projects and other research activities; he has been active in local science days for a number of years.
5. Proximity to industrial and educational resources -- especially colleges and universities.
Relation Between the Findings and Those of Other Studies

Family Background

The family background of students with superior rated science projects, which was described earlier, is very similar with the background of high achieving students in Gowan's study.¹ MacCurdy's study, however, is more closely related to the present study, since he investigated the background of talented science students who chose science, engineering, or a profession for their career. He describes the family background or potential scientists as follows:

Stable, cultured, economic advantages. First born son with ample facilities, time and encouragement for self development in science.²

With regard to sources of influence other than the family, MacCurdy states that potential scientists "are strongly influenced by scientific associates, scientific friends, and contact with a scientist."³

¹Gowan, op. cit.
²MacCurdy, op. cit., 14.
³Ibid.
The previous quotations suggest considerable similarity between MacCurdy's study group and the group of students with whom the present study is concerned.

Personality and Interests

MacCurdy describes potential scientists as "antisocial," who show leadership only in science activities; whereas potential engineers, professional persons, and women in science show leadership in all fields. Potential women in science were found to be less active in science activities than men. A large fraction of the group presently studied were active in extracurricular activities. No attempt was made to differentiate between potential men scientists and other categories. It was determined, however, that girls had fewer scientific hobbies and read fewer science magazines.

The Science Teacher

The science teacher of the potential scientist is described by MacCurdy as follows:

Inspirational person, good personality, well trained, experienced and educated. Set good example, gave students opportunity for self development, professional, permissive and progressive.4

4 Ibid.

5 Ibid.
No information regarding the teacher's personality was available in the present study; however, the description of teachers who favor the production of superior science projects is very similar to MacCurdy's description (see page 94 of this work).

**Conclusions**

1. Factors which are conducive to the production of superior rated science projects can be identified. These factors are classified into two categories: 1) those factors which are related to ability, interests, and family background of the student, and 2) factors related to the schools, the science teacher, and the community. Both categories were found to be important, although the relative importance could not be assessed with precision.

2. A family background which includes stability, economic advantages, appreciation of education and science, and opportunity for individual development, is most favorable to the production of superior rated science projects. The first born or the only child appears to have better opportunities for individual development in science.

3. A superior rated science project is generally an indication of strong interest in science and specific
occupational plans toward a career in science or a science allied field.

4. A consistently high rate of production of superior rated science projects is a sign of a school program which challenges and stimulates the better than average student; it is also a sign of effective science teaching by a capable, dedicated science teacher.

5. The science day project provides the science teacher with the opportunity to guide his better students in research activities of the student's own choice. A well prepared science teacher can be very effective in this guidance role. A capable student would acquire a more realistic view of scientific processes in this manner than by strict adherence to conventional classroom routines.

6. The science day project has great motivational value because it involves some competition and valuable personal contacts with scientists, engineers, college teachers, other resource persons, and students with similar interests. Personal contacts, recognition and reassurance are as important in science as in any other field.

7. The school and the science teacher should not expect superior project work unless they assume a positive attitude toward such activity. A well planned local science
day program, adequate guidance, and available resource persons are important in carrying out effective science project work.

8. The science teacher is a key person in initiating and guiding good project work. His background in the sciences, his professional preparation, and his motivation -- as evidenced by professional memberships in science education and his involvement in science days -- are important to his effectiveness.

9. The results which have been obtained on the background of students with superior rated projects suggest that a broader study on the background of science day participants and non-participants will prove useful. Only then will it be possible to determine which characteristics of students with superior rated projects, as revealed by this study, are most significant.

Recommendations

Teaching of Science and Science Days

1. High schools should plan local science day programs with care, in order to encourage independent activity in science by all students -- and especially the more
capable. The emphasis should be on learning and research rather than competition and dramatic effects.

2. Schools and science teachers should not expect even their more capable students to be entirely self-motivated. They should make available to them human resources, physical resources and time for independent and co-curricular activities in science. The most important human resource that a school can provide is a well prepared, hard working, experienced and highly motivated science teacher. Many other resource persons are available, however, in any community. A properly planned science day program should provide for most effective use of human resources (consultants, judges, guest speakers, etc.). A reference library and time for guidance, exchange of ideas and brainstorming should also be provided.

3. Science should be taught by teachers with a strong background in their teaching field who are curious and continually enhance their competence through reading, experimenting, and graduate work in science; who are professionally active in science education -- and whose strongest interest is the teaching of science. A good background in the physical sciences should be expected of
all science teachers -- including those in the life sciences. (Physical science and mathematics are important to all those who are conducting or guiding experimental work.) Science should not be taught by those whose greatest interests and time demands lie in other fields.

4. Science teachers should not be burdened with duties which would make it difficult for them to give individual assistance to their students and would prevent them from establishing a well planned program of co-curricular activities in science (field trips, science day programs, etc.). An additional month's salary to a science teacher for ordering materials, planning of curricular and co-curricular activities, organizing laboratory equipment, etc., during the summer is a worthy investment.

5. Science day participation and performance should be studied continuously. The State Science Day Council and the District Science Day Committees could devise an information form to be filled out by all science day participants. This form should require more background information than is required on the present registration cards. The personal data forms used by the National Talent Search, or the questionnaires used in the present study could serve as guides. These forms could be sent to the science teachers
or local science day chairmen prior to the district science days in order to be filled out by the science day participants. The information obtained from these forms would be useful for both background and follow-up studies.

**Hypotheses Which Could Serve as the Basis for Further Study**

Many useful insights for which no sufficient evidence is yet available were gained as a result of the study. These insights are presented here in the form of hypotheses. Further study based on these hypotheses would be most fruitful, in the opinion of the author.

1. Many characteristics which are possessed by a large fraction of the "superior" rated group are not possessed by as large a fraction of a group of participants with lower ratings -- excellent, good, or satisfactory.

2. The difference in characteristics between a "superior" group and a group of participants with lower ratings is not as great as the difference between the "superior" group and a group of non-participants at District Science Day.

3. The differences revealed by this study between schools with several superior rated projects and schools with only one or two superior rated projects are not as great as the difference between the "high group" and a group of high schools that either did not participate or did not receive any superior ratings.
4. A state wide study of common characteristics of students with superior ratings at the District or State Science Days would reveal characteristics similar to the ones revealed by the present study.

5. Science teachers in Ohio and in other states who have a good background in science and science education place more emphasis on project and research activities than teachers with poor background.

6. Science day participants -- especially those with high ratings -- are stimulated toward raising their educational goals and toward improved scholastic achievement as a result of their participation.

7. The areas in which most of the superior rated projects were carried out represent areas in which the greatest number of projects were entered. They also represent areas in which high school teachers are most competent.

8. The first born and the only children tend to achieve higher in several areas, including science.

9. College students in science who have successfully participated in science days tend to achieve higher than college students in science with no science day (or equivalent) experience. They also tend to change to non-science
areas less frequently than students with no science day (or equivalent) experience.

10. The science day experience is most valuable to students from schools that do not have well planned curricula for their gifted students in science.

11. The science day experience is of no great value to college success in science unless the participant is stimulated toward the attainment or maintenance of high scholastic achievement in science and in other subjects (mathematics, English, etc.).

12. College graduates in science with science day experience are more likely to enter a field of research than college graduates in science with no science day (or equivalent) experience.

13. Science day participation and performance of high school students is related to the science background they received in the junior high and elementary grades (science projects, laboratory work, time spent on science, methods of teaching, teacher qualifications, etc.).

14. Science teachers who are employed during after-school hours are less active in science days and other co-curricular science activities.
Organization of The Junior Academy

Science Day Districts

1963 District Science Days:

Southeast District, March 9
Ohio University, Athens

East District, March 30
Muskingum College, New Concord

Northeast District, April 6
Kent State University, Kent

Mohican District, April 6
Ashland College, Ashland

North Central District, April 6
Heidelberg College, Tiffin

Central District, April 6
Ohio State University, Columbus

Southwest District, April 13
Miami University, Oxford

West District, April 6
Central State College, Wilberforce

Northwest District, April 6
Bowling Green State University, Bowling Green

North District, April 13
Defiance College, Defiance

Central Office
Ohio Academy of Science
506 King Avenue
Columbus 1, Ohio

Phone: 299-9097   Area Code: 614

STATE SCIENCE DAY, CENTRAL STATE COLLEGE, APRIL 26, 1963
DIRECTOR
GERALD ACKER
DEPARTMENT OF BIOLOGY
BOWLING GREEN STATE UNIVERSITY

ASSISTANT DIRECTOR
ROBERT E. MCKAY
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STUDENT'S ROOM ASSIGNMENT
Grade. Room. Space.
Name.
School. Town.
Name of Project.

Judging Team. Judges' Initials.

Important. Remain with your exhibit at the space assigned you until after your project has been judged.

JUDGE'S RATING CARD
Grade. Room. Space.
Name.
School.
Facilities needed: (Circle) AC; Water; Gas.
Field of Entry.
Name of Project.

Criteria for Judging:

<table>
<thead>
<tr>
<th></th>
<th>SUPERIOR</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>SATISFACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Achieved</td>
<td>10-9</td>
<td>8-7-6</td>
<td>5-4-3</td>
<td>2-1</td>
</tr>
<tr>
<td>Use of Scientific Method</td>
<td>10-9</td>
<td>8-7-6</td>
<td>5-4-3</td>
<td>2-1</td>
</tr>
<tr>
<td>Clarity of Expression</td>
<td>10-9</td>
<td>8-7-6</td>
<td>5-4-3</td>
<td>2-1</td>
</tr>
<tr>
<td>Originality and Creativity</td>
<td>10-9</td>
<td>8-7-6</td>
<td>5-4-3</td>
<td>2-1</td>
</tr>
</tbody>
</table>

Note to Judges: Circle number of points awarded for each criterion.

TOTAL POINTS: ___________ RATING ___________

JUDGES: 1 ___________ 2 ___________

(Judge's remarks on reverse side)
OHIO ACADEMY OF SCIENCE  
"SCIENCE DAY"  
Instructions to Judges

1. In judging the student projects, you will normally work in a team of two, - a high school teacher and a college professor or industrial person.

2. Identify yourself to the exhibitor as the judging team assigned to his project.

3. The student should be given the opportunity to discuss briefly his or her project, and to answer questions about the project as well as questions within the discipline or subject matter involved, at his level of learning.

4. Attempt to put the student at ease, especially "first timers".

5. It is suggested that only a tentative rating on the four criteria be given at the time of judging and that the final rating be withheld until you have judged all of your exhibits. DO NOT DISCLOSE YOUR RATING TO THE STUDENT AT THE TIME OF JUDGING.

6. In order to be rated "Superior" the student must have a rating of at least 9 points each on Knowledge Achieved and Effective Use of Scientific Method.

7. You will judge the student and his project on the following four criteria on a basis of 1-10 points. Circle the numerical rating which you feel best evaluates the student's work at his grade level.

<table>
<thead>
<tr>
<th>Superior</th>
<th>Excellent</th>
<th>Good</th>
<th>Satisfactory*</th>
</tr>
</thead>
</table>
| KNOWLEDGE
ACHIEVED     | 10-9      | 8-7-6| 5-4-3 | 2-1         |
| EFFECTIVE USE
OF SCIENTIFIC
METHOD   | 10-9      | 8-7-6| 5-4-3 | 2-1         |
| CLARITY OF
EXPRESSION | 10-9      | 8-7-6| 5-4-3 | 2-1         |
| ORIGINALITY
AND CREATIVITY| 10-9     | 8-7-6| 5-4-3 | 2-1         |

* There is no "Satisfactory" Rating given at State Science Day.
8. Minimum number of points for each rating:
Superior 34, Excellent 25, Good 15, Satisfactory 5
(Not Considered at State Science Day).

9. The following paragraphs are given as an interpretation of the various CRITERIA on which the project or exhibit will be judged. The Committee realizes the highly subjective character of the judges' task.

A. KNOWLEDGE ACHIEVED—(CONSIDERING THE STUDENT'S AGE AND GRADE LEVEL)
1. Has there been a correct use of scientific terms? Does he understand these terms?
2. Is there evidence of an acquisition of knowledge (Depth) through his research or has he merely acquired a manipulative technique?
3. Does he show evidence of knowing what the underlying principle(s) is (are)?
4. In brief, has he actually learned something through his study and research above and beyond his level of classroom work?

B. EFFECTIVE USE OF SCIENTIFIC METHOD
1. Does the student have a clear-cut idea of the purpose of his project, or is it something thrown together and manipulated?
While the mere assembly of a "kit" is frowned upon, there can be a definite research approach through such a project wherein there may be an effective use of the Scientific Method.
2. Is he aware of other approaches or theories relative to his problem or project?
3. Is there evidence of literary and/or experimental research? Has he been thorough and have there been some prolonged or sustained experimentations?
4. Has he observed any basic phenomena?
5. Has he experimented sufficiently to have collected any data?
6. Has he analyzed his observations in a logical manner and drawn valid conclusions?
C. CLARITY OF EXPRESSION
1. Can he orally explain his project concisely and answer questions well? Discount a "glib tongue", but try to weigh evidence of nervousness when talking to a "pro", as you are considered. Watch out however for a memorized speech with little understanding of principles.
2. Has he expressed himself well in all written material, such as abstracts (if submitted)? Consider that this material might have been copied or written by another person.
3. Is the physical display neat and sufficiently definitive? Discount printed posters and professional placards unless you have evidence he has made them and has a depth of knowledge of such material.
4. Beware of misspelled words.

D. ORIGINALITY AND CREATIVITY
1. Is the problem or the approach to the problem developed in a particularly significant or unique manner? It is true that the approach may not be new to the judge but does he show an enthusiasm that one less versed in the subject or phenomena might think it was "brand new".
2. Has he a new approach to an old subject?
3. Has he a unique presentation or organization of materials?
4. The assembly of a "kit" may not be original or creative but again it may be a new and unique approach to a problem and may economize on time and effort.
5. Is there evidence of initiative? Place premium on ingenious use of available materials. Collections and manufactured apparatus can be creative if they are assembled and used to achieve, show, or prove a stated purpose.

We hope that the above descriptive material will serve as a guide and will aid you in judging Science Day projects.

JUDGING COMMITTEE

11762
1. Judges are asked to be present for a short briefing session at 10:45 a.m., and to pick up the cards of the students who you will judge.

2. You will work, if possible, in teams of two; (a) one college professor or industrial employee, and (b) one high school teacher. Bear in mind that the students are from high school grades 9 to 12 and that their level of development may vary from exhibit to exhibit.

3. It is suggested that only a tentative rating be given at the time of judging and that the final rating be withheld until you have judged all exhibits. DO NOT DISCLOSE YOUR RATING. THEY WILL BE INFORMED AT THE AWARDS MEETING IN THE AFTERNOON.

4. Will you please rate the student on all seven criteria on the card, if possible. Any comments can be written on the reverse side of the card. For a student to receive a final rating of "Superior" five of the seven criteria must be "Superior" with Knowledge Achieved mandatory.

5. Be sure to check name on Registration Card against the real name of the exhibitor. In the past years projects have been judged and awards issued to students who were not in actual attendance. Be sure you are talking to the person whose name appears on the registration card.

6. Be sure to identify yourself to the exhibitor. The student doesn't want to give as full an account to the casual passer-by as he would to a judge. In past years it has happened. Students were judged and did not know it!

7. Don't stress too much the interview, especially with "first timers". Apply various tactics in cases of timidity. Try to put them at ease before beginning your questioning.
8. Be sure you understand the "Purpose of Project". In the past the exhibitor has thought he was showing one thing, while the judge evaluated the project from an entirely different viewpoint.

9. When the criteria listed below do not seem to apply - ask yourself these two questions:
   a. Did the student show what he or she set out to show?
   b. Did he or she do a good job?

10. The seven criteria for judging which follow are also printed on the bottom of the Judges Card which you will have with you on Science Day. The following paragraphs attempt to interpret these ideas in order that the judging will be more uniform and more objective. The committee realizes the highly subjective character of the judges' task. The suggestions below are offered only to help you - not to dictate what you are to do.

11. The seven criteria are:
    A. Scope of project  D. Thoroughness
    B. Neatness  E. Knowledge achieved
    C. Clarity of explanation  F. Period of sustained interest
    G. Originality

A. SCOPE OF PROJECT
   a. "Purpose of Project" should be clearly set forth by the exhibitor. Judges should know what the student is trying to show.
   b. "Selection of Materials" should be such that the purpose of Project can be accomplished. Remember these boys and girls often cannot afford to spend much money - and if they do use a lot of manufactured apparatus - is it really their work? However, if the Purpose is to show use of manufactured apparatus there should be no penalty.
   c. "Scope of Project" may lack definiteness. A superior project may involve only a single idea. It will be superior if other criteria have been achieved.
   d. Are there any applications or uses of the principles involved in the project which may contribute to the betterment of society or our economy?
B. NEATNESS
   a. Has the exhibitor shown good craftsmanship or has the project been "thrown together" at the last minute in a hasty and careless manner?
   b. Is it reliable and dependable - or will it fall apart before the demonstration is over?
   c. In case of collections - consider handling, preparation, mounting, labeling, etc.
   d. Dramatic Value: How does the attractiveness of the project under consideration compare with others in the same field? Don't be influenced too much by frills, useless lights, gadgets, ribbons and the like which do not have any positive values in the realization of the "Purpose of Project".

C. CLARITY OF EXPLANATION
   a. Consideration of age of exhibitor is of prime importance. Don't expect a Ph. D. dissertation.
   b. Build Confidence before you start questioning the exhibitor, perhaps by asking a few personal questions. Remember that they are probably "scared stiff" and lack ability to express themselves, yet they may have considerable knowledge about their projects. Try to draw them out sympathetically.
   c. Discount a "Glib Tongue". Some exhibitors can "talk" a better project than they can build.

D. THOROUGHNESS
   a. Does it work? Results may tell more about the ability and the achievement on the part of the students than they can tell you during the interview.
   b. Valuation. Put more value on a job well done. Even if it lacks originality, the treatment given by the student may be original with him.
   c. Is it well done? The test of this is the answer to this question. "Has the purpose of the project been completely realized?" Don't forget to consider the limited amount of funds or material available to the student, considering what may have been included, improved or added. Has the student done a good job with the materials at his disposal?
   d. Clarity: Is the project properly labeled, or explained in posters. All explanatory matter should be neat, attractive and informative.
E. KNOWLEDGE ACHIEVED
   a. Depth of Knowledge. Perhaps Depth of Knowledge would better express this criterion. Has the exhibitor shown familiarity with the "Scientific Method?" Does the project show careful planning? Do not overlook the fact that some projects are based on important historical discoveries and inventions - the student should have deep knowledge of these, if they apply. Have variable factors been properly controlled to arrive at satisfactory conclusions. Check the exhibitor for a real understanding of basic laws and principles involved. How much real study and effort has gone into the project, pertaining to the "Purpose of Project"?
   b. Knowledge Gained. Does it appear to you that the student has gained a depth of knowledge in making the project that other students in his class missed by not making such a project? Keep in mind that fundamentally the project is a teaching device. If the project is a success, the maker must have learned something about the subject embodied in it. Rate the exhibitor on the basis of knowledge gained rather than on "Scope of Project".

F. PERIOD OF INTEREST
   a. Last minute effort: A project thrown together at the last minute should not receive a high rating even though the exhibitor can make a very creditable explanation.
   b. Projects may differ in the length of time required for preparation. One of the objectives of your interview should be to gain this information from the exhibitor.
   c. How much real study and effort have gone into the project? Has the study been directed toward achieving the "Purpose of the Project"?

G. ORIGINALITY
   a. Approach: Don't expect high school students to do much original research. They may show a new approach to an old subject. Treatments can be original too.
   b. Arrangement: New uses for conventional apparatus, or parts made from available materials may show originality.
c. **Manufactured Apparatus**: Don't penalize for using manufactured materials if they can best be used to achieve a stated purpose.

d. **Collections** are creative if they are assembled to show or prove a stated purpose. We can't expect students to create their own specimens.

e. Place premium on ingenious use of available materials. Perhaps months of planning have gone into a project which does not represent the outlay of much money. Sometimes, "Necessity is the mother of invention".

Revised-3/15/60
Dear Educator:

Mr. George Kalligeros plans to study the results from Central District Science Day in effort to determine whether or not there is a correlation between the students' background and the rating. Initially, the study will involve only those students who received Superior ratings at the 1963 District Science Day.

Mr. Kalligeros has agreed to report his findings through appropriate media and to make his study available to interested persons.

As Director of the Junior Academy, I feel that this study will aid in evaluating our Science Day Program.

Very truly yours,

/s/

Gerald Acker
Dear Fellow Educator:

Mr. George Kalligeros is making a study of those students who were rated superior at the Central Ohio District Science Day. His work is concerned with the study of common characteristics of these students and the relationship of those characteristics to creativity in science activities.

Mr. Kalligeros is a very professional student and teacher. You may depend on him to report his findings in a strictly professional manner. His present study is done as one of the requirements for the Master of Arts Degree in Science Education here at the Ohio State University. Your cooperation in making this study will be greatly appreciated.

Sincerely yours,

/s/

Fred R. Schlessinger
Professor--Department of Education
George A. Kalligeros  
41 Parana Drive  
Newark, Ohio  

4/22/63  

Dear Mr. (Superintendent)  

One or more students from your school district have won superior rating for their science project at the Central Ohio District Science Day. I am certain they are a credit to your schools. I am conducting a graduate study at the Ohio State University under the supervision of Drs. John S. Richardson and Fred R. Schlessinger. The problem of the study is concerned with the backgrounds of those students who received superior rating in the Central Ohio District Science Day. The relation between their background and this creative accomplishment is of interest to science educators and to educators in general.  

We are asking for your permission and help in enlisting the cooperation of the students involved, their principal, and their science teachers. We have prepared three questionnaires to be filled out by the principal, science teacher, and student respectively. We will also ask for a transcript of each student's school record.
Since the number of students involved in this study is small, your support will be most valuable. All information will be held confidential and no names will be used in any publication of this study. A summary of this study will be sent to you, when it is completed. Please let us know whether you will be able to give us your permission and support so we may contact the proper persons in your school district.

Yours very sincerely,

George A. Kalligeros

P. S. Samples of the three questionnaires and supporting letters from the Ohio State University and the Ohio Junior Academy of Science are enclosed.

-----------------------------

Mr. George A. Kalligeros
41 Parana Drive
Newark, Ohio

Dear Mr. Kalligeros:

We (will, will not) be able to cooperate in your study. You may (may not) proceed to contact the students and school personnel involved in your study.

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(superintendent)

---------------------------------

(school district)
Dear Mr. (Principal)

Your superintendent, Mr. [Name], has indicated his willingness for your school to participate in a graduate study at the Ohio State University concerning the background of students who received "superior" rating at the Central Ohio District Science Day. We are enclosing a questionnaire for each student involved, and another one for his science teacher(s). Also, we are enclosing a questionnaire to be completed by you or a member of your staff.

Finally, we are asking for a complete transcript of grades, extracurricular activities, and standardized tests that each subject has taken. We are perfectly aware that we are asking for adds an extra burden to your time demanding schedule. This information, however, is vital to this study.

Since this study involves a small number of students, your help and cooperation will be of the utmost importance to the success of this study. All information will be handled confidentially, and no names will be used, when this study
is published. We are enclosing a stamped, addressed Manila envelope for the three questionnaires and the transcript.

A summary of this study will be sent to your school, when it is completed. I am enclosing the judging cards of the students involved so that they may be returned to them. They were made available to me by the Ohio Junior Academy of Science. We are asking each one of those students to fill out the questionnaire marked #3. Each one of their science teachers in 1962-63 is asked to fill out the questionnaire marked #2. The questionnaire marked #1 is to be filled out by you or a member of your staff (one copy). The transcript of the academic, test, and extracurricular record could be filled out in the enclosed transcript form under "CLASS RECORD", "TEST RECORD", and "ADDITIONAL INFORMATION" (for extracurr. act.). It may be more convenient, however, to make Thermofax copies of the appropriate sections of the student's cumulative record.

The questionnaires are not lengthy, and with the help of your staff we hope not to occupy too much of your valuable time. A checklist is enclosed for all the materials that are to be
returned in the addressed Manila envelope. Your help is most appreciated.

Yours very sincerely,

George A. Kalligeros
Checklist of Materials to be Returned

I  Questionnaire #1  (principal)

II  Questionnaire #2  (teacher)

(names)

________________________  __________________

________________________  __________________

________________________  __________________

________________________  __________________

________________________  __________________

III  Questionnaire #3  (student)

(names)

________________________  __________________

________________________  __________________

________________________  __________________

________________________  __________________

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IV  Transcripts

(names in III)
STUDENT'S NAME:

Note: Please give yearly grades, if available. If not, give semester grades. Also, please list mental ability and/or IQ tests and scores.

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CLASS RECORD

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<th>ADDITIONAL INFORMATION</th>
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<td>(Extracurricular, etc.)</td>
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(see letter p. 2)
COPY

School Questionnaire

Research Project on Characteristics of Science Day Participants
The Ohio State University, Columbus, Ohio

To the principal: The following questionnaire may be filled out by you and/or a member of your staff. Your help is appreciated.

1 Name of school: ______________ Name of Sch. District: ______________

2 Does your school hold a science day annually? Yes ___ No ___ (check one). For how many years? ___ (number).

3 What percent of the total number of students in your school are following a college or academic curriculum? ____%

4 Please list all science courses offered in your school during the current school year and the enrolment in each:

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5 What are the names of your science teachers whose students received superior ratings at the Central Ohio District Science Day?

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<tr>
<th>STUDENT'S NAME</th>
<th>TEACHER'S NAME</th>
<th>SCIENCE COURSE</th>
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6 Please list on the back page the main industrial, scientific and educational resources in your community (industrial plants, universities, etc. If possible, list individually).
Research Project on Characteristics of Science Day Participants
The Ohio State University, Columbus, Ohio

Dear student:

Your science project has been given "superior" rating in the recent Central Ohio District Science Day. This is a worthwhile accomplishment and a credit to you and to your school. As part of a research project at the Ohio State University, we are interested in knowing the characteristics that you may or may not have in common with other participants with superior rated projects. Any information that you give us in the attached questionnaire will be held confidentially and your name will not be used when this study is published.

When this study is completed, your school will receive a summary of the knowledge gained as a result of this research project. Will you help in a worthwhile study by filling out the attached questionnaire and returning it to your science teacher or principal? Your time and care in completing it will be most appreciated.

Yours very sincerely,

George A. Kalligeros
COPY

STUDENT QUESTIONNAIRE

Research Project on Characteristics of Science Day Participants
The Ohio State University, Columbus, Ohio

To the student: Please fill out the following questionnaire. Write on the back page whenever additional space is needed.

1 Name ______________________ Age: ___ Sex: M___ F___
   (first) (middle) (last)

2 Address: __________________________
   (number) (street) (city)

3 We have lived at this address for _____ years.
   (number)

4 Our residence may be classified as: City ___ Suburban ___
   Rural___ (check one)

5 I live with my: Mother and father ___ Mother ___ Father ___
   Guardian___ (check one)

6 My father's education includes:
   Elementary and/or high school _____ years (number)
   A high school diploma yes ___ no ___ (check one)
   Trade school _______ (number of years)
   College _______ (number of years)
   College degree yes ___ no ___ (check one)
   Other degrees (list) ____________________

7 My mother's education includes:
   Elementary and/or high school _____ (number of years)
   A high school diploma yes ___ no ___ (check one)
   Trade school _______ (number of years)
   College _______ (number of years)
   College degree yes ___ no ___ (check one)
   Other degrees (list) ____________________

8 My father's occupation is ______________________

9 My mother's occupation is ______________________
10 I have _____ older brothers, age(s) ______________
   (number)
I have _____ older sisters, age(s) ________________
I have _____ younger brothers, age(s) ______________
I have _____ younger sisters, age(s) ________________

11 When I finish high school, I plan to enter college ___
   I do not plan to enter college ___ (check one)

12 When I enter college, I plan to study ________________
   (subject area)

13 The type of work I plan to do when I complete my educa-
   tion is: ____________________

14 My favorite subject(s) in school (is, are) ____________

15 My favorite leisure time activities and hobbies are:

16 The subject(s) I like the least (is, are) _____________

17 I read the following magazines regularly or often:

18 I have read the following books during the past year:

19 In doing my science project I consulted the following
   reference materials (books, magazines, etc.): ________

20 The number of science projects that I have done in the
   past and entered in a science project exhibit is ____

21 The amount of time I spent on this most recent science
   project, which was rated superior is ____ (number of weeks)

22 The materials which I had to buy for my science project
   cost me approximately $ ________.

23 Most of the work involved in planning and carrying out
   my science project was done ___ at home ___ at school ___
   (check one)

24 In my science class some ___ no ___ time was spent for
   discussing and planning our science projects (check one)

25 The following persons have been most helpful with my
   science project:

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<th>NAME</th>
<th>OCCUPATION</th>
<th>TITLE OR RELATION</th>
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Extracurricular Activities:  (school year 1962-1963)

(a) I am a member of the following school clubs:
(Please indicate any club offices that you may hold)

(b) I hold the following class offices:

(c) I am (am not) a member of our student council.

(d) I am a member of the following honor society(ies):

(e) I take part in the following interscholastic sports:
(as a member of our varsity team)

(f) I also take part in the following school activities which are not included above:
Dear science teacher:

It must be a source of satisfaction for you that some students of yours have received "superior" rating at the Central Ohio District Science Day. As part of a graduate research project at the Ohio State University, I am interested in common characteristics in the family and school background of those students that received superior rating at the Central Ohio District Science Day. We are asking those students and their science teachers to fill out appropriate questionnaires. All information will be held confidential and no names will be used in any publications of this study.

Your help and your students' cooperation will be vital to this study and greatly appreciated.

Yours very sincerely,

George A. Kalligeros
Teacher Questionnaire

Research Project on Characteristics of Science Day Participants
The Ohio State University, Columbus, Ohio

To the teacher: Please fill out the following questionnaire. Your help is appreciated.

1 Name: (Mr. Miss Mrs.) (first) (middle) (last)

2 Subjects taught this year: ____________________________

3 Number of years of teaching experience (total) ______

4 Number of years you have taught science: ______________

5 Field(s) of certification: Major _________________
 Minor _________________

6 Degrees held: __________________________________________________________________

7 Number of semester hours of credit in graduate courses:
 Science __________________
 Science Education _____________
 Other education courses ______

8 Professional memberships (please check):
 National Educ. Assn. ______ Other:
 Ohio Educ. Assn. ______
 Nat. Sci. Tea. Assn. ______
 Ohio Academy of Sci. ______

9 Please check the most appropriate statement:
 _____ I require at least one project from all my science students
 _____ I encourage my science students to do science projects
 _____ I do not place much emphasis on science projects

10 What fraction of a student's yearly grade in your science classes depends on his science projects? ______________
 Comments (if any): ______________________________________

11 Have you been actively involved in organizing a science day or science fair in your school? Yes____ No____ (check one)
 Number of years__________.

12 Do you help your students in selecting and/or planning their science project? Yes____ No____ (check one)
BIBLIOGRAPHY

Books


Periodicals


Newspapers

1. Ohio Academy of Science Newsletter, II, No. 3 (March, 1950), 1.

2. Ohio Academy of Science Newsletter, VIII, No. 2 (February, 1956), 1.

Theses and Dissertations


Mimeographed Materials