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Perceptions and attitudes of students, teachers, and parents about middle school science fairs

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PERCEPTIONS AND ATTITUDES OF STUDENTS, TEACHERS, AND PARENTS ABOUT MIDDLE SCHOOL SCIENCE FAIRS

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education: Secondary

By
Norma Beth Greenfield

December 1996
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ABSTRACT

The primary goals of science fairs as stated in the literature are: instruction in scientific thinking and increasing interest in science. But almost no research exists as to whether students, teachers, or parents perceive that these goals are important or that these goals are accomplished by participation in science fairs. This study examined the perceptions and attitudes of these three groups.

A pilot study was carried out through interviews at a regional science fair and by having middle school students write what they considered to be the main reason to do science projects. From these responses a questionnaire was developed for students, teachers and parents. It was administered through eleven middle/junior high schools. Responses were obtained from 522 students, 23 teachers, and 113 parents.

The major finding of the study was that students, teachers, and parents all perceive the goals of science fairs to be different from those in the literature. Teachers (96%) and parents (78%) feel the most important reason to have science fairs is to expand the mind of the students, while students (55%) perceive the major reasons to be learning about a subject that interests them and preparing for college classes. Instruction in the scientific method and developing interest in science
received low ratings in nearly all instances. Other findings were that students do not like doing science projects; 41% or less of any group feel that fairs accomplish their main goals; the competition in science fairs generally is not enjoyed; and there are strong feelings that everyone who participates should receive some type of award and that participation should be voluntary. Given a choice of a different type of event, most teachers preferred to have symposiums, parents wanted expositions, while students unexpectedly preferred science fairs.
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CHAPTER 1 - INTRODUCTION

Rationale

The subject of science fairs often elicits very passionate discussions, especially in regard to their merit. Students, teachers, and parents alike can be enthusiastically in favor of them, or extremely opposed to them; occasionally people even have mixed reactions, depending on what aspect of science fairs is being considered. Some people value fairs as a means to instruct students in the scientific method and to get them interested in science. Others avoid doing science fairs if possible, because fairs require a great commitment of time and resources to attain those goals, and because fairs often are so competitive. The question that teachers and administrators have to weigh before incorporating science fairs into the school's curriculum is whether the positive goals and benefits of science fairs outweigh the negative aspects that go along with them.

Study Objectives

The primary goals of science fairs as stated in the literature are: instruction in scientific thinking, and increasing interest in science. Gifford and Wiygul (1992) state that "the alleged purpose of science fairs is to teach students how to science [sic], specifically how to design and execute an experiment" (p. 116). Carlisle and Deeter (1989) mention developing positive attitudes toward science.
But do students, teachers, and parents perceive the same goals to be the primary purpose of science fairs, and do they feel that fairs truly accomplish that? What are the benefits of science fairs in the opinions of students, teachers, and parents? Are fairs worth the investment of time, effort, and expense? Are science fairs too competitive, causing damage to the self-esteem of the losers? Are there other options that would serve the students better? These are issues that were examined in this research study. The study examined the perceptions of students, parents, and teachers regarding the goals of science fairs and attitudes toward them, in order to determine how effectively science fairs meet the needs of students.

**Statement of the Problem**

The problem addressed in this study was to determine what students, parents, and teachers perceive to be the main reason a school has a science fair, and whether they believe science fairs accomplish their goals. Attitudes toward competition, awarding of prizes, voluntary versus required participation, and alternatives to science fairs were also examined and compared among the groups. Within the student group, differences in perceptions and attitudes were compared with regard to students' age, gender, and past participation in science fairs.
Summary of Procedure

Statements of purpose for holding science fairs were gathered from various sources: the National Science Teachers Association (NSTA), the San Bernardino City Unified School District's Science Fair Handbook, and research literature. Preliminary input was also gathered at a regional Inland Science and Engineering Fair. The literature was reviewed for published research on the questions. Eleven middle/junior high schools were asked to complete a questionnaire in the Spring of 1994, soon after many of them had participated in a science fair. Data was collected and analyzed, with conclusions and recommendations given.

Significance of the Study

This study may be helpful to teachers and administrators in determining whether or not the science fair program is meeting intended outcomes of science fairs. Teachers might receive insights as to how to improve the science fair program, or encouragement for carrying out a beneficial one. This study may also help in making decisions about whether to hold science fairs or to try some other type of program (such as expositions or symposiums).

Limitations of the Study

There is a definite lack of research material on the opinions and perceptions of participants in science fairs. So there was not much with which to compare the results of
this project. This study was done in a fairly small geographical area and may not reflect the opinions of people from other areas of the state or country. Respondents who had strong opinions on one or two items may not have answered objectively, but allowed their feelings to influence all their responses. They may also have answered differently than they really felt, just because they knew that they were involved in a study and wanted their answers to sway the results. If respondents had questions about the meaning of certain statements, they could not receive clarification from the researcher, since the questionnaires were administered by their teachers. The teacher/administrator sample was small and may not be a true indicator of that group's feelings on a broader scale.
CHAPTER 2 - LITERATURE REVIEW

Introduction

A review of published research material was conducted through an Educational Resources Information Center (ERIC) search. In addition, informal interviews were held with numerous people in the area of science education and curriculum development. Several themes were examined: science fair objectives, attitudes toward science fairs, competition versus cooperation, awards, required versus voluntary participation, and alternatives to science fairs.

A great deal of published material about science fairs exists. Most of it deals with how to organize a fair, how to develop a project and its display, how to judge projects, and timetables for successful projects. Many articles also make some observations about the purposes or goals of science fairs. Some examine the issue of science fair competition versus cooperation in learning. But very few studies have been reported concerning the attitudes and perceptions of participants in science fairs, as to the achievement of purported goals, the benefits of participation, and the degree of enjoyment that participation provides.

Science Fair Objectives

Many writers maintain that the primary objective of science fairs is to "teach students how to science [sic], specifically how to design and execute an experiment"
(Gifford & Wiygul, 1992, p. 116); to teach the use of the scientific method; to provide opportunities to investigate a problem (Carlisle & Deeter, 1989; Greenfield, 1995; McBurney, 1978; NSTA Position Statement on Science Competitions, 1986); and to develop critical thinking skills applicable to all areas of life (Blume, 1985; Fort, 1985). A goal often mentioned is to interest students in science; that effective science education should be enjoyable (Burtch, 1983; Fredericks & Asimov, 1990; Knapp, 1975; Science Framework, 1990). Some research shows that passive forms of instruction (such as memorization and recitation) encourage negative attitudes that may lead to dropout behavior, while hands-on, activity-based science teaching tends to slow down the erosion of favorable attitudes toward science and school (Hartshorn & Nelson, 1990).

Another purpose for science fairs is to create in students an awareness of science, especially in regard to future courses and careers (Burtch, 1992; Fredericks & Asimov, 1990). Enhancing school-community relations or providing social events with an educational flavor are sometimes objectives of science fairs (Hansen, 1983; Junior High Science, 1991; Knapp, 1975). Other benefits and goals occasionally mentioned are the expression of creativity (Science: Grade 7, 1991); development of self-confidence (Edelman, 1988); enhancing an interdisciplinary curriculum, involving writing, math and library skills (Knapp, 1975;
Why? Student Research, 1987). Still other objectives are public recognition of students' academic achievement in science (California State Science Fair Handbook, 1994; Grobman, 1993); interaction with science professionals (Olson, 1985); parental and community involvement in education (Burtch, 1983; Hamrick & Harty, 1983; Henderson, 1983); and sharing with peers work that students have done (Burtch, 1983). Some writers mention preparing students for responsible citizenship, especially regarding development of science and technology policies and research (Mann, 1984; Paldy, 1971).

Attitudes toward Science Fairs

McBurney (1978) believes "we cannot justify conducting a science fair unless it is first and foremost a learning experience for the student—not for the community, nor for other students, nor for parents" (p. 420). There are many writers who feel that science fairs as typically conducted do not relate to the goals of science teaching. Smith (1989) feels that there is "clearly...a disparity between the goals of science fairs and those of science teaching" (p. 22), because most science fair projects are either models, hobby exhibits, demonstrations, or reports, rather than truly investigative projects requiring critical thinking and inquiry. He blames this on a lack of discussion between teachers, students and judges as to the
purposes of the projects and the criteria by which they are judged.

Chiappetta and Foots (1988) point out that many students are disappointed because so few win prizes at the competitions; teachers are often frustrated by demands on time and energy, the excessive paperwork and laboratory preparation in addition to regular instruction; administrators feel overburdened by organizational demands. On the other hand, a study by Carlisle and Deeters (1989) found that teachers are enthusiastic about science fairs and that participation is high. And some colleagues feel that science fairs may spark a student's life-long fascination with science or lead to a career in science.

Nelson (1988) says that teachers are faced every spring with Science Fair Syndrome, characterized by students with low motivation and poorly designed projects. Teachers who dislike science fairs frequently mention these reservations: too great a time and energy commitment that prevents covering the year's work; lack of time to help everyone; parents who do the project for their children; the competition that may turn children off to science if they do not win (Knapp, 1975). Many middle school teachers do not have a science background and would feel more comfortable with better science preparation beforehand and frequent inservice help in how to teach science (Lazarowitz & Tamir, 1994). Educators who are in support of science fairs
mention the various objectives discussed above and how science fairs often accomplish those goals.

A common complaint from parents and teachers alike is that judging of science fair projects "is, at best, subjective and, at worst, borders on the arbitrary" (Goodman, 1981, p. 37). Some writers decry the element of competition found in most science fairs (Grobman, 1993), while others support it as instruction about life and what it takes to succeed (Edelman, 1988).

Some educators (Winicur, 1989) feel that students too often develop projects in isolation from each other and from the classroom experience, regard the science fair as irrelevant to their education, seldom have opportunity to learn from classmates, and rarely come away from the experience with a better feeling for science.

Most of the literature regarding attitudes reports on the opinions of educators and science professionals; only five research projects on student attitudes toward science fairs were found through ERIC. One study was conducted to determine students' attitudes toward science classes (Fraser-Abder et al., 1990). It reports that 75% listed science as their favorite subject; also, when their schools participated in science fairs, 34% of the participants were willing, 40% were bystanders, and 26% were unwilling to participate. Another study suggests that in one state girls have been some of the most enthusiastic science fair
participants (Greenfield, 1995). An attitude survey in another research paper reports increased student motivation, interest and participation in research projects when computer assisted instruction was involved (Price, 1989).

The fourth study (Olson, 1985) surveyed the finalists of the North Dakota Science and Engineering Fair for its 35 year history, regarding educational background, career choice, and perceived benefits to the finalists from science fair participation. The responses (N = 213) show that 75% had participated voluntarily; 74% felt the science fair had some influence on their career choices (indicating science professions by 51%); 96% rated highly the value of participation; and 100% would encourage others to enter science fairs. The greatest perceived benefit was travel (91%), while others were challenge of evaluation by professionals (83%), poise with evaluators (80%), enhancement of creativity (75%), and association with peers (69%). Career direction, education, and employment may have been influenced by participation, and many memories and fun were generated as well.

A fifth study examined the attitudes of teachers, administrators, parents, community volunteers, and students regarding the perceived value of parental and community involvement, the educational focus, and competitive versus social aspects of science fairs. The aim of the study was to determine whether the current program was meeting the
needs of those involved and how a self-help program might affect the science fair (Menicucci, 1992). It was found that of all respondents, 83% perceived a science fair as a fun learning event, rather than serious competition; 80% felt the focus should be on enjoying the experience rather than competition and winning; and 89% preferred group, as opposed to individual, mentoring by parental and community volunteers.

Of the five studies of student attitudes, only Menicucci's study examined students' perceptions of science fair goals and how well science fairs accomplish their objectives. Olson's study surveyed only finalists at the state science fair level, no one at lower levels.

**Competition versus Cooperation**

Research literature reveals conflicting opinions about the issue of competition between students in science fairs. Some writers view science fairs as an academic competition that can challenge and reward able students (*Academic Competitions*, 1984), while others fear the effects of competition among elementary age children and feel varying parental assistance may result in unfair competition (Carlisle & Deeter, 1989).

Science fairs can have a big impact on self-esteem; competition quickly sorts the students into winners and losers. Some researchers believe that how students feel about themselves may be the most important variable in the
process of education, but that schools are turning out more and more students who consider themselves "failures" or "rejects" (Simpson, Koballa, Oliver, & Crawley, 1994). In discussions with colleagues, comments are often heard that fairs tend to eliminate students, producing more losers than winners, which is counter to the goals of science; or that fairs become ego trips for students and parents alike. For very young children a loss becomes a personal failure—in direct opposition to educational goals of developing self-esteem and providing opportunities for successful learning experiences (McBride & Silverman, 1988; Scarnati, Kent, Falsetti, & Golden, 1992).

Burtch (1983) says that, while fairs can encourage and reward excellence, they do little for students who are not particularly gifted or competitive, and he encourages removal of the element of competition. Silver (1994) feels competition may drive some students to success in science fairs, but intimidate others and keep them from enjoying science; parents, too, may feel ill-prepared to help their children compete in contests that often affect science grades. Knapp (1975) states that one of the frequent objections to having science fairs is that children may get turned off to science if their projects do not win; he recommends not grading projects nor awarding prizes, but giving children recognition and praise instead, possibly
presenting a certificate of merit to each child who completes a project.

Gifford and Wiygul (1992) state that, though the purpose of science fairs is "to teach students how to science [sic]....in reality, science fairs have become competitive experiences and are often a required component of a high school science course" (p. 116). They mention the competition encouraged by grades, and also the prestige and financial prizes offered by the Army, Navy, and Westinghouse awards, which encourage projects requiring extensive professional aid, money, and research facilities. Gifford and Wiygul also state that research shows not all students have equal or fair chances of winning, but that those who have access to university or other research facilities have a better chance of winning regional science fair competition. Chiappetta and Foots (1988) express concern that competition may detract from the goals of science fairs, when parents get too involved because they want their children to win, thus robbing students of opportunities to develop their own abilities, as well as disadvantaging students who do most of their own work or who have no one to provide support.

The NSTA position statement on science competitions (1986) simply says that "Emphasis should be placed on the learning experience rather than on the competition."
McBurney (1978) recommends that students compete against a
standard rather than each other; he feels this would not
only encourage judges to reward valid scientific effort and
provide constructive criticism (as opposed to comparing one
exhibit to another), but also promote investigative projects
rather than stereotypical exhibits.

Many writers believe that a cooperative approach to
science fair projects is better than a competitive one.
Grobman (1993) states "Science is a cooperative enterprise
in which scientists routinely refer to the works of their
predecessors and colleagues....Competition for prizes...is
so rare that it becomes newsworthy," as in the awarding of
Nobel prizes (p. 40). He feels that we give students
exactly the reverse impression of science in the way science
fairs are conducted. Paldy (1971) concurs and says that
cooperative interactions are "among the most distinctive
features of the scientific enterprise" (p. 427).

Studies of how students learn best have shown that
cooperaive learning promotes greater mastery and retention
of material being taught, more positive attitudes toward the
instructional methods and teacher, and a positive
correlation to goal achievement; in addition, students
perceive themselves as learning more in a cooperative
setting than in a competitive one (Humphreys, Johnson, &
Johnson, 1982; Tjosvold, Marino & Johnson, 1977). Equally
important, these and other studies indicate that students
prefer to learn science cooperatively, that preference for
competition is a myth (Johnson & Johnson, 1974). The junior high school is a critical level at which to promote achievement and interest in science, because students are deciding whether or not to take high school science courses, which in turn affects the number of those who eventually will pursue a science career. "The beneficial effects of cooperative learning on science achievement and attitudes toward learning indicate that perhaps cooperation should be the principle modus operandi in junior high school science classes" (Humphreys et al., p. 356).

A study of gender patterns in science competitions concludes that girls often are reluctant to compete directly with boys in science or math, and that cooperative learning strategies could better teach science to girls as well as ensure that they receive equal opportunities to participate successfully in experiments (Greenfield, 1995). This same study points out that as of 1993 the International Science and Engineering Fair (ISEF) added a team project category for cooperatively developed projects.

Some schools stress cooperation among students, teachers, and parents (Teachworth, 1987). Slisz (1989) found that the most effective science fairs included cooperative student projects.

Finally, writers emphasize that the reason for science fairs is to build students' science skills and not necessarily ensure their winning skills (Greenfield, 1995).
Isaac Asimov (Fredericks & Asimov, 1990) believes that "youngsters should learn...how to think scientifically...and learn the joy and pleasure of doing all this for the sake of learning and not for awards" (p. vii). Students, teachers, and parents need to perceive science fairs as learning experiences, which can broaden students' backgrounds and enhance self-esteem (Greenfield).

**Voluntary versus Required Participation**

The 1986 NSTA position statement on science competitions states that student and staff participation should be voluntary. An earlier position statement (1968) also stated that participation in science fairs should not be made the basis for a course grade; teacher involvement should be based upon teacher interest rather than on external pressures or administrative directives; and such an assignment should be a replacement for one of the teacher's current responsibilities, not an additional one.

Mandatory participation in science fairs is not recommended by any author, although one study shows that many intermediate teachers (67%) do require students to participate, while 26% have voluntary participation (Carlisle & Deeter, 1989). The suggestion is made that if teachers do require students to participate in the school science fair, they should justify it in terms of stated objectives, as well as provide adequate support for students and integrate the work with science instruction.
Paldy (1971) writes that teachers are sometimes pressured by administrators to participate in science fairs against their wishes, and as a result students feel their participation is mandatory and that their grades may suffer if they do not take part. Streng (1966) and McBurney (1978) both urge voluntary participation with no academic consequences if a student chooses not to do so. Paldy also says that, while leadership and some urging from a teacher are helpful to a child's development of latent capabilities, "it would seem that compulsory participation is basically incompatible with the character of the scientific enterprise with its emphasis on creativity, self-motivation, and self-discipline" (p. 427).

Johnson and Johnson (1974) recommend that students participate in competitively structured situations only on a voluntary basis. Forcing students to compete with peers can turn off the interest in science that science projects are supposed to create (VanDeman and Parfitt, 1985).

**Awards and Prizes**

The issue of awards and prizes is controversial, just as competition is. Awards range from certificates of participation for all exhibitors to ribbons, trophies, cash prizes, scholarships, and trips. Some writers recommend that everyone who participates in the science fair should receive some type of award or acknowledgement of participation (VanDeman & Parfitt, 1985).
Many other writers feel awards help to maintain the competitive nature of science fairs and would like to do away with them. Streng (1966) recommends that judging consist of helpful comments and suggestions rather than comparative ratings or prizes. Knapp (1975) feels that recognition and praise should take the place of grades for projects: "Children do not have to be provided with awards for science projects any more than for drawings and paintings in elementary art shows" (p. 10); however, a certificate of merit can be given to every child who completes a project.

Grobman (1993) maintains that if science fairs emphasize prizes (competition) and not cooperation, they misrepresent the nature of science. He feels the wholesale awarding of prizes requires large numbers of judges, who often are unfamiliar with the instructional background of the students and and the objectives of the fair, and therefore make poor judgments. All the generous awards to students from large corporations and fleeting notoriety from newspapers do not necessarily indicate educational accomplishments. Grobman recommends: phasing out science fairs, except in the classroom setting; evaluation by classroom teachers; cooperative projects; and no prizes or publicity about "winners."

McBurney (1978) states that awards must always be kept in the proper perspective, never becoming more important
than the reason for giving it. He takes a stand against expensive awards: "The more valuable the award, the greater the possibility that receiving it may overshadow what has been done to earn it" (p. 421). McBurney feels the kind of recognition to be given should be decided locally and given with discretion. He makes a comparison to the way 4-H fairs award different ribbons for different accomplishments, and everyone goes home with something. In science fairs, too, the essential minimum should be some acknowledgement of participation. Mann (1984) concurs with McBurney and adds that awards programs are most effective when conducted in the presence of peers as well as adults.

To eliminate competition among students, some writers encourage competition against a prescribed standard (Carlisle & Deeter, 1989; McBurney, 1978). Then every student can receive an award of some type, regardless of the quality of the other projects in the fair.

Alternatives to Science Fairs

Traditional science fairs typically attract highly motivated students who have self confidence in their abilities and enjoy competing with their peers (Silver, 1994). Students who prefer to work cooperatively with peers, or are uncomfortable with or discouraged by the typical science fair, often enjoy a different approach to doing science projects. The literature reveals a variety of suggestions.
Some writers recommend that the standard science fair simply be expanded to include any type of science entry: models, collections, demonstrations, hobbies, report-and-poster projects (VanDeman & Parfitt, 1985). Since these non-investigative types of projects already often predominate at a science fair, some authors suggest calling the event a "technology fair" or a "science, technology, and demonstration fair," but not simply a "science fair" (McBurney, 1978, p. 420). These kinds of projects could serve as a "point of entry" into science, especially for younger students. A separate category ought to be set up for investigative projects (those requiring inquiry and critical thinking), to motivate students and teachers alike to move from the non-investigative entries to truly investigative projects (Smith, 1980). Science fairs might then become "discovery fairs" or inquiry fairs.

The NSTA position statement of 1986 regarding science competitions includes science leagues, symposiums, olympiads, and talent searches along with science fairs. McBurney (1978) endorses the concept of a science congress or symposium, with less emphasis on competition and more on the scientific nature of the event, even to the presentation of oral or written scientific papers. Paldy (1971) discusses science congresses which emphasize student interaction, similar to the types of activities professional scientists engage in at seminars and meetings; students
would work, cooperate, and communicate among themselves, instead of displaying projects primarily for adults.

A Science Expo created by Silver (1994) is an all day event for students, parents, and community. It allows students and visitors to participate in any of several ways: the traditional science fair, a share fair, class demonstrations, the invention convention, family physics fun festival, and the family science olympiad. There are also special presentations and business exhibits from the community and science professionals. Only the science fair participants are judged competitively. At another school all elementary participants are given a participation ribbon and science kit, and are required to take two interactive mini-workshops with a parent; not only do students learn science, but also they enjoy structured time together with family (Kelter, Hughes, & Murphy, 1992). A Science Showcase Night at another school was developed to promote self-esteem and provide successful learning opportunities for all students; it includes classroom/group projects, hands-on activities, research projects (similar to traditional science fair projects), and scientific portrayals of historical figures, concepts, or events (Scarnati, et al., 1992).

Winicur (1989) describes a thematic approach to upper elementary level science fairs. A broad class theme is assigned to each grade, and all projects in that grade are
based on that theme. The theme is discussed by the class as part of the curriculum, and students become colleagues as they see how their projects relate to each other.

A consumer fair, in which consumer products are investigated, helps students see the relevance of science to everyday life and encourages students to use scientific investigation skills to become more knowledgeable and independent consumers (Nelson, 1988).

Cooperative projects are suggested by many authors. Even in competitive science fairs, group projects may now be entered at the state science levels, according to ISEF regulations of 1993 (Greenfield, 1995).

Alternatives to current judging and awards practices include the scouting concept, the county fair concept, and show and tell (McBride & Silverman, 1988; McBurney, 1978). Like a scout works for a badge, the science student would work for an award that has predefined requirements (competition against a standard rather than against other students). In the county fair approach, each participant receives an award within a specific category, and the criteria for each award would be known. In show and tell, the students stand by their projects and explain them to anyone who expresses interest; some schools call this a share fair. Unlike standard science fairs, share fairs are noncompetitive, allow greater freedom for all types of projects, encourage cooperative learning, and thus often
give students confidence to move on to competitive science fairs in the future (Silver, 1994). McBurney mentions two more practices of county 4-H fairs as alternatives to typical science fair customs: explaining to each entrant the reasons why the particular award was assigned; and teaching students about judging procedures by having a student accompany and possibly assist each judge (even to the point of having all-student judged fairs). Gowen and Marck (1993) suggest in-class presentations, with the students themselves picking the top three or four projects to go on to a school fair.
CHAPTER 3 - PROCEDURES

Introduction

In order to examine the effectiveness of a school's science fair program, it was necessary to obtain information about the perceptions of students, parents, teachers and administrators as to the reasons why a science fair is held and their opinions as to whether the fair meets those expectations. A questionnaire was designed and administered to gather that information.

Description

Statements of purpose for holding science fairs were gathered from several sources: the National Science Teachers Association (NSTA), the San Bernardino City Unified School District's Science Fair Handbook, and published literature. Using those statements as the basis for questions, a pilot survey was conducted through informal interviews at the regional Inland Science and Engineering Fair, held in March of 1994 for Riverside, Inyo, Mono, and San Bernardino counties of Southern California. A number of participants, judges, teachers, parents, and fair organizers were asked what the main reasons are for doing science fairs and whether fairs accomplish those goals. (See pilot study questionnaire, Appendix A.)

In addition, three middle school classes were asked to write in their own words what they felt is the main purpose of a science fair. From those responses and interviews, a
two-page questionnaire was designed using the wording of the students themselves to phrase each item. Separate versions were made for students, parents, and teachers/administrators, with the same basic questions reworded for each group. (See questionnaires, Appendix B.)

Instrumentation

The questionnaire was designed for anonymity, however, the students did indicate grade level, gender, and past involvement in science fairs. Parents answered in reference to their middle school children, and teachers/administrators responded regarding students in their classes/schools in general.

Questions were designed to obtain information in these categories:

- organization: grade, gender, previous participation, voluntary versus required participation;
- objectives of science fairs: the importance of various reasons for participation;
- attitudes: regarding effectiveness of fairs, competition, awards, other types of presentations;
- suggestions for change.

Participants in this study were asked to rank on a scale of 1-3 a list of 17 student-generated reasons for doing science fair projects. A (1) meant the reason was very important, (2) meant somewhat important, and (3) meant
Respondents ranked attitudes and feelings toward science fairs on a scale of 1-5, with (1) showing the most agreement with a statement and (5) the least agreement. A third area of questioning was to rank preferences regarding the type of presentation of science projects, with the choices being exposition, science fair, or symposium. Finally, opportunity was given for respondents to suggest changes in the way in which science fairs are conducted, or to make further comments.

Data Collection

The questionnaire was distributed in the Spring of 1994, after many of the students had participated in science fairs. Permission to have science teachers administer the questionnaire was received from the administrators of eleven middle/junior high schools (nine public and two private) in the Inland Empire of Southern California. (See letter, Appendix B.) The schools presented a diverse demographic background, based on the researcher's knowledge of the area. Students ranged from middle socioeconomic levels to lower socioeconomic levels. The schools were located in the inner city of San Bernardino, suburban Redlands, and more rural Yucaipa.

File Preparation

Each questionnaire was reviewed individually. Three student questionnaires were discarded because they did not indicate that the responses were taken seriously by the
students. The rest were put into three general groups of students (N = 522), parents (N = 113), and teachers (N = 23). (Since there were only two administrator responses, they were included in the teacher group.) Responses were tabulated for each group overall, and also for only those who have actually participated in science fairs at some time. Students were further sorted into sub-groups by grade and gender. Total responses were tabulated for each question for each group and sub-group. (See Appendix C.)

**Data Analysis**

To control for variables, non-participating students and their parents were not included in the results. That left 442 students who at some time have actually done a science fair project, and 99 parents of participating students.

When the results were analyzed, data from the 442 students were examined first from an overall perspective, then by gender, and finally by grade. The parent and teacher groups were considered to be too small for meaningful analysis by sub-groups. Therefore, all 23 teachers constituted one group and the 99 parents of participating students made up another group.

Reasons for participating in science fairs were examined by looking first at the most frequently ranked very-important reasons, then at the most often ranked not-important reasons. Attitudes toward fairs were analyzed in
the same groupings; when responses were compared, the (1) and (2) categories were considered to show agreement, while (4) and (5) were considered to show disagreement. Finally, a comparison was made of preferences for different types of displays of science projects.
CHAPTER 4 - RESULTS AND DISCUSSION

Introduction

Teacher and parent perspectives were examined first and compared to findings from the literature. Student responses were then compared to both of these. The reader is referred to Appendix C for tabular data from the questionnaires.

Reasons for Participation: Teacher and Parent Responses

Respondents ranked 17 student-generated reasons for participating in science fairs on a scale from 1 to 3. A (1) meant the reason was very important to the individual, (2) meant somewhat important, and (3) meant not important. The reasons receiving the three highest ratings by teachers (N = 23) were expanding the child's mind (96%), developing interest in science (87%), and letting the child be creative in learning (87%). The three reasons considered least important were to give the school publicity (52%), to compete for awards (39%), and to prepare for college classes (26%).

Parents of students who have participated in science fairs at some time (N = 99) indicated that these reasons were important: expanding the child's mind (78%), learning to use the scientific method (69%), and a tie between learning through one's own research and giving the child recognition/self esteem (68% each). Unimportant reasons for parents were giving the school publicity (41%), competing
for awards (29%), and preparing for careers in science (26%).

Instruction in scientific thinking (use of the scientific method) and increasing interest in science are the primary goals of science fairs as discussed in science curricula and research literature. However, teachers ranked instruction in the scientific method in 5th place out of 17 as a very important reason; they also ranked it as high as 5th place for unimportant reasons. Parents felt more strongly about the importance of the scientific method, ranking it in 2nd place as very important. It is interesting that parents see instruction in scientific thinking as a more important goal of science fairs than teachers and administrators do.

For teachers, developing more interest and enjoyment in science tied with letting students use creativity in learning as the 2nd highest important reason. Parents ranked developing interest in science in a three-way tie for 11th place.

Teachers and parents both perceived the most important reason for doing science fairs to be expanding the student's mind, challenging him/her, making him/her think. It would seem that parents are more concerned about academic goals such as the scientific method and one's own research, while teachers lean more to affective goals of enjoying science and expressing creativity. Both groups indicated similar
perceptions about goals that were not important: publicity for the school, competition for awards, and preparation for the future (college classes or careers).

Respondents were given opportunity to indicate additional reasons for doing science fairs. Of those who did respond in some way, most of the comments were rephrases of the reasons already given. However, there were two new thoughts that were mentioned several times. Several parents and teachers indicated that science fairs give parents and children the opportunity to work together and enable families to spend quality time together. There were also several who felt that science projects help teach children responsibility; to plan, organize, budget, and follow through on a project; to go the extra step, to do more than just get by.

**Reasons for Participation: Student Responses**

Students who have participated in science fairs at some time (N = 442) indicated the top three important reasons for themselves to be as follows: learning about a subject that really interests me and helping me prepare for college classes, in a tie for first place at 55%; in third place, finding new ways to help the earth/environment (52%).

Overall, positive responses were given by 41% of students for learning how to use the scientific method (9th place), and 37% for becoming more interested in science/enjoying it more (13th place).
At the negative end of the scale, the reasons that are least important to students included giving the school publicity about its science program (45%), preparing for a career in science (35%), and sharing what a student learns (33%).

When middle school girls (N = 227) were compared to middle school boys (N = 215), the results revealed some interesting differences. For the girls, the top three positive responses were: finding ways to help the earth (59%), preparing for college (56%), and learning about a subject that interests me (55%). The boys' top three choices were: learning about a subject that interests me (55%), preparing for college (53%), and expanding my mind/challenging me (49%). For girls, expanding my mind was in 4th place (54%); for boys, finding ways to help the earth was in 6th (45%), with competing for awards in 5th place (46%). Girls ranked competition in 11th place (40%).

Middle school girls and boys overall were in agreement about goals that are not important, indicating the same three reasons as mentioned above for all students: giving the school publicity (girls 43%, boys 48%), helping prepare for a science career (girls 34%, boys 36%), and sharing what I learn (girls 34%, boys 33%). For girls, learning how to use the scientific method was in 8th place out of 17 in importance (44%), and becoming more interested in science was in 11th place (38%). Boys ranked the scientific method
in 11th place (39\%) and interest in science in 13th place (35\%).

The 442 student responses were also considered by grade and gender. At the sixth grade level, 25 girls and 20 boys had participated in science fairs at some time. The girls gave positive responses to finding ways to help the earth/environment, followed by a tie between sharing what I learn and learning more about a subject that really interests me. Male participants' top rating went to learning more about a subject that interests me, followed closely by helping prepare for college, and helping the earth. The scientific method was in 9th place for both the sixth grade girls and boys, while developing an interest in science came in 13th for the girls and 11th for the boys. Negative responses from the sixth grade girls went to applying classroom learning to new situations, followed by preparing for a career in science. For the boys science fairs are considered unimportant for preparing for a science career, and for giving the school publicity about science programs.

At the seventh grade level, there were 108 female and 84 male participants. Female participants' most important reason was to find ways to help the earth, with preparing for college classes in second place. Male participants considered science fairs very important in order to learn more about things that really interest them, and to prepare
for college classes. Learning the scientific method was in 9th place for both the boys and the girls. Developing interest in science was in 10th place for girls and in 14th place for boys. The seventh grade girls felt school publicity and a career in science are least important, while boys' negative responses were for school publicity and sharing what I learn.

Respondents from the eighth grade who had done science fairs numbered 50 girls and 68 boys. At this level, the female participants felt the most important reason is to find new ways to help the earth, with second place a tie between learning more about a subject that really interests me and helping prepare for college. The boys felt expanding the mind and learning about an interesting subject are the two top reasons. Learning the scientific method came in 7th for girls and 12th for boys, while developing interest in science was 10th for both sexes. The two reasons least important to both girls and boys were giving the school publicity about science and sharing what I learn and enjoy.

In the 9th grade, there were 44 females and 43 males who had done science fair projects. The reason for participating in fairs that the girls felt to be most important is to expand my mind, challenge me, make me think. There was a three-way tie for second between letting me show my potential, learning more about an interesting subject, and helping me prepare for college. For the boys, the most
highly rated reason was to compete for awards/let skills and talents be judged, with second place going to helping prepare for college. The scientific method and developing an interest in science tied with four other reasons for 6th in importance to girls. For the boys, scientific method was 9th and interest in science tied with another reason for 12th place. The girls considered preparing for a career in science as least important, with a tie for second between sharing what I learn and giving the school publicity. The boys ranked school publicity in last place and careers in science next.

When students were given the opportunity to suggest additional reasons for doing science projects, they mentioned only a few ideas different from those already stated. One was that science projects help students get along more often; another was that projects teach non-traditional ideas; and a third was that they could provide new discoveries in science.

**Attitudes toward Science Fairs: Value of Participation**

Respondents ranked eight statements about their feelings toward science fairs on a scale from 1 to 5, with (1) showing the most agreement with the statement and (5) the least agreement. Attitudes were examined regarding the effectiveness of fairs in achieving their goals, enjoyment in doing projects, competition, awards, required versus voluntary participation, and other types of presentations.
When responses were compared, the (1) and (2) categories were considered to show agreement, while (4) and (5) were considered to show disagreement.

Four statements concerned perceptions about the effectiveness of science fairs and the value of participation. Respondents were considered to value participation if they agreed that a science fair accomplishes its goals (#7), enjoyed doing projects (#8), felt a science fair should be held every year (#10), and considered it worth their time and effort to do a project (#14).

When asked if science fairs accomplish their main goals, teachers overall and parents of participating students both had the greatest response at (3) on the scale, indicating a middle level of agreement. Teachers indicated 39% agreement and 22% disagreement, while parents showed 38% agreement and 28% disagreement. When asked if they enjoyed having their students/children do projects for fairs, less than 44% of either showed agreement, yet 74% of teachers and 63% of parents felt it was worth the child's time and effort to do the projects. Although 52% of teachers were in agreement to having a science fair every year, they gave an equal number of (1) and (5) ratings to the statement. Parents were more divided on yearly fairs, with 38% in agreement and 31% in disagreement.
Students overall, as well as girls versus boys, had most responses at (3) on the scale, regarding science fairs accomplishing their goals, just as teachers and parents did. Students overall showed 41% agreement and 21% disagreement, with another 11% not responding at all. Girls indicated 37% agreement and 11% disagreement, with no response from 13%. Boys showed 45% agreement, 20% disagreement, and 8% no response.

When students were asked if they enjoyed doing projects for science fairs, the greatest response in all cases was level (5) on the scale. Overall, 44% of students disagreed, while 34% agreed. Girls indicated 44% disagreement, 34% agreement, while boys showed 43% disagreement and 34% agreement.

Responses toward science fairs being worth the time and effort revealed student attitudes similar to those about enjoying projects. The highest individual response in all three groups again was (5) on the scale. But the differences in percentage between agreement and disagreement were smaller, with 37% agreeing and 38% disagreeing overall. Girls showed 34% agreement and 39% disagreement, while boys showed the only instance of more agreement (40%) than disagreement (37%) with the statement.

Very strong attitudes were indicated about having a science fair every year, again with the greatest single response being (5) on the scale. Students overall indicated
50% disagreement and 30% agreement. Girls showed 52% disagreement and 30% agreement, and boys responded at 49% disagreement and 29% agreement.

An interesting trend in attitudes emerged when gender and age were considered. Sixth graders were overwhelmingly in agreement with the four statements. Seventh graders felt goals are accomplished and fairs are worth the effort, but enjoyment and yearly fairs received less agreement. Eighth graders still perceived goals being accomplished, but the other three areas grew in disagreement. In ninth grade, the only item receiving more agreement than disagreement was boys' perceptions that goals are accomplished.

In addition to indicating whether they felt science fairs accomplish their goals, respondents were asked why they felt that way. For those who felt science fairs do accomplish their goals, the primary response was that students do learn new things and are challenged to think. Other positive responses were that science fairs let the students show their creativity and how they think through their own work, and that they can learn by doing. Negative responses included complaints about too much parental help, too much competition, lack of organization and support, forced participation instead of real interest, too much stress for both students and parents, and lack of enjoyment.
Attitudes toward Science Fairs: Competition

Statement #9 commented: "I enjoy the competition of a science fair." Teachers and parents both had the strongest single response at level (3) on the scale, and leaned more toward disagreement than agreement. Teachers agreed 26% of the time and disagreed 30%, while parents of participating students showed agreement at 22% and disagreement at 43%.

Students overall and middle school boys showed strong responses at both (1) and (5) on the scale, while middle school girls showed greater response to (5) on the scale. Overall, students agreed 35% and disagreed 44%. Boys indicated an even split, with 41% on both, while girls showed 29% agreement and 46% disagreement.

Sixth grade girls and boys both indicated a strong enjoyment of competition, at 56% and 65% respectively. Seventh grade girls agreed 34% and disagreed 36%, while boys agreed 44% and disagreed 36%. In the eighth grade, there was a marked shift against competition, with girls disagreeing 70% and boys 50%. Ninth graders continued that trend, with girls against competition 64% and boys at 44%.

Attitudes toward Science Fairs: Awards

Two statements on the questionnaire concerned opinions about awards for participation in science fairs. Number 13 indicated a desire for 1st, 2nd and 3rd place awards in each category of a fair, while number 12 was more general in recommending an award of some type for all participants.
Nearly 61% of teachers felt all participants ought to receive some award, with another 35% in the middle ranking. There were 48% who agreed with #13 and 30% more who were in the middle. Parents of participating students showed even stronger response, with 74% in agreement for awards for everyone, and 62% supporting 1st, 2nd and 3rd place awards.

Students overall and middle school girls had results of the same type as parents and teachers, with a slightly higher rating for #12 than for #13, but with both between 60% and 75%. The boys also had ratings above 60%, but gave a slightly higher rating to #13.

Sixth graders were overwhelmingly in favor of presenting every participant with an award, with 85% of boys and 88% girls in favor. Seventh grade boys dropped to 69%, eighth to 41%, but ninth grade boys rose again to 72% in favor. Girls in seventh grade were in favor at 79%, eighth grade at 68%, and ninth at 75%. Giving 1st, 2nd and 3rd place awards in each category was approved by 88% of sixth grade girls, 85% of boys; 63% of seventh grade girls, 70% of boys; 48% of eighth grade girls, 53% boys; and 57% ninth grade girls, 60% boys. It is interesting to note that favorable ratings gradually fell to a low in the eighth grade, but that ninth graders again placed greater emphasis on awards of both types; ninth graders also indicated slightly higher approval of competition than eighth graders.
Attitudes toward Science Fairs: Voluntary or Required

Participants in science fairs reported that 63% of the 442 students had been required to do projects, 24% had done so voluntarily, 6% had previously participated under both conditions, and 7% gave no answer. Teacher responses indicated that 74% of them taught at schools that left participation up to the teacher, while 17% were required to participate, one teacher had experienced both situations, and one left the answer blank.

Statement #11 on the questionnaire examined attitudes toward required participation in science fairs. Teachers overall were 52% opposed to requiring every student to participate, in contrast to 30% in favor. Parents of participating students showed the same trend, with 49% opposed and 28% in favor.

Students overall felt even more strongly opposed to required participation of everyone, showing 66% against and 24% in favor. Middle school girls were 67% opposed, 22% in favor; and boys were 64% against, 26% in favor.

In the individual grades, the sixth graders were almost evenly divided pro and con: girls were 44% both for and against, boys were 40% for and 45% against. Seventh graders began a shift toward opposition to the idea of required participation. Girls were 65% against, 24% in favor, while boys were 60% against, 26% in favor. Eighth grade girls opposed the idea 70% and boys were close behind at 69%.
Ninth grade girls were 84% against and boys were 72% opposed to required participation.

**Attitudes toward Science Fairs: Type of Presentation**

The final category of attitude questions concerned preferences for the way in which student projects are presented. Respondents were given descriptions of three possibilities and asked to rank them as first, second and third choices, if they could choose which type of event in which to participate. The choices were a science exposition, described as a public exhibit of student projects without judging; a science fair, where projects are usually evaluated by judges and awards given; and a science symposium, where students present and defend projects and receive critiques from peers.

In analyzing this question, it was noted that many respondents only indicated their first choice, rather than ranking all three. Therefore, the results compare the number of first place responses given to each option. Also, the number of "no answer" responses is fairly high for each choice, since two of the three options were left blank in those cases.

Teachers picked science symposiums as their first choice (43%) followed closely by science expositions (39%). Science fairs received 17% of the first place votes. Parents, on the other hand, chose expositions by 48%, while fairs received 28% and symposiums received 25%. It was also
revealing to look at the number of third place responses from those who did rank all three choices. Science fairs received the largest number of third place ratings. Teachers had 7 third place votes for fairs, 4 for expositions, and 3 for symposiums, while parents had 32 third place responses for fairs, 24 for symposiums, and 13 for expositions.

Student responses were unexpected, given the strong feelings revealed by some of the other attitude questions. Overall, they picked science fairs as first choice 52% of the time, with expositions at 28% and symposiums at 15%. Middle school girls ranked fairs in first place 44%, expositions 34%, and symposiums 15%. Boys chose science fairs first 60% of the time, with expositions at 22% and symposiums at 14%. For students who did all three rankings, symposiums received the greatest number of third place responses. Girls and students overall had fairs in third place next, while boys went with expositions.

When individual grades were examined, both sexes in all four grades chose science fairs as their preference, except for the ninth grade girls who picked expositions by 48% and fairs by 36%. Sixth grade girls were the only other group that was very close in results, with science fairs at 44% and expositions at 40%. Symposia received the greatest number of third place votes from all groups, except sixth
grade boys who chose fairs, and ninth grade girls who tied fairs with symposiums.

Respondents' Comments and Suggestions for Change

The last two questions on the questionnaire asked if respondents would change anything about science fairs and invited any additional comments. The changes and comments that were given showed very divergent opinions in all three groups. Most of the comments from students were either that science fairs are boring, a waste of time, and no fun, or that they are usually fun, "cool," or okay. Some felt that fairs are educational and students learn a lot, while others thought there is too much pressure and interest is killed. One student commented that fairs are only a forum for teachers to show off what their students have learned, which usually was not much. Some parents felt that the competition is unfair to students without parental support or resources, that many children (as well as parents) struggle and do not enjoy doing projects, that fairs can be very political and results are often fixed; others found fairs educational and interesting. A few teachers considered science fairs a waste of time on projects that students hate to do and therefore do poorly, were tired of doing fairs, and felt there are better ways to experience the scientific method ("the stress on it in fairs is overkill" and "understanding scientific method does not equal child's interest and ongoing participation in
science"). Other teachers felt science fairs should continue as they are, that they are worthwhile if voluntary, that they challenge students to think and encourage responsibility, that most students work hard and do excellent work. One teacher felt too many projects at the State level are sponsored by college professors, which is unfair to other participants.

Many respondents did suggest changes, most of which fell into several main categories. Others had very specific, unique suggestions which only one or two people mentioned. Students and parents strongly recommended making science fairs voluntary instead of mandatory, and giving every participant some type of recognition or award. Students also suggested different, better types of prizes, including money; changes in judging, including no judging at all, judging more fairly, having only science professionals judge, even student judges. Some would like: fewer rules, any type of project, more fun, no grades given (but maybe extra credit), no science fairs at all.

Parents also suggested less parental help on the final project, doing group projects instead of individual ones, and more time/ideas/guidelines/help in class. Some mentioned better judging/grading practices, and more freedom of types of projects and displays. A few wanted to eliminate fairs completely, while one parent suggested science fair participation be a requirement for graduation.
Some wanted more awards, some wanted none. One parent felt science fairs have "gone Hollywood" and become a "beauty pageant approach to an academic area"; the scientific method is a joke, since it rarely is applied as taught; and the whole concept of fairs needs redirecting to "attain the goal of promoting interest in science." Other suggestions for change were: provide mentors, invite elementary students and parents to view middle school fairs, have longer public displays, destroy lists of ideas, limit money spent on projects, do a mid-project symposium to help with the final project. One parent suggested exposing students to the scientific method in a systematic way over three years: class project one year, group projects next, and individual ones the third.

Some changes suggested by teachers were: eliminate judging (promotes competition and elitism), throw out retread projects that show up every year, make certain rules and goals are understood, get more district and parental support, emphasize science more and provide more teacher support in training, allow group projects and other types of displays. Other suggestions included more staff/cross-curriculum involvement and work on projects in other classes, less concentration on the scientific method, voluntary participation with no penalties attached, more/less parental involvement. One teacher suggested doing class symposiums and then a school-wide exposition.
CHAPTER 5 - CONCLUSIONS AND RECOMMENDATIONS

Introduction

The primary goals of science fairs are stated in the literature to be instruction in scientific thinking and increasing interest in science. These are usually the reasons that a middle school has yearly science fairs. It may be helpful to those involved in decisions about how science fairs are conducted at the middle school level to know just what participants really feel about the effectiveness of science fairs, based on actual surveys and not researchers' opinions, in order to determine if the needs of students are being met through participation in science fair projects. However, there are very few studies that report participants' opinions and perceptions.

Purpose

The purpose of this research project was to gather data regarding the efficacy of science fairs. It was done by examining the perceptions of those who are involved with science fairs: students, parents, and teachers. The problem addressed in this study was to ascertain what students, parents, teachers and administrators perceive to be the main reason a school has a science fair, and whether they believe science fairs accomplish their goals. Attitudes toward competition, awarding of prizes, voluntary versus required participation, and alternatives to science fairs were also examined and compared among the groups.
Findings and Conclusions

After researching the literature about science fairs and analyzing the results of the survey of students, parents, and teachers, a few things become obvious. First of all, there are strong opinions on both sides of the question whether schools should hold science fairs. Second, there are certain aspects of science fairs on which nearly everyone does agree, such as voluntary participation.

The findings of this study show that none of the three groups of respondents felt the most important reason to do science fairs is to give instruction in how to use the scientific method, as the literature states. Instead, teachers and parents both felt the most important reason is to expand the child's mind and challenge him/her to think. Students felt it is most important to learn about things that really interest them and to prepare for college classes. Teachers ranked the scientific method in 5th place out of 17, parents in 2nd, and students in 9th place. It is interesting that parents see this as a more important goal than teachers do, and that students do not perceive it to be very important at all. The other main goal of science fairs, according to the literature, is to develop interest in science. Findings show that teachers do rate this quite highly (2nd place), but parents and students do not (11th and 13th places respectively). One can conclude that perceived goals of science fairs are different from what are
commonly published by researchers, that certain things are stated to be the goals and significance of science fairs, but other things are actually experienced and perceived.

Another conclusion of some importance is that students are perceiving science fairs in a much different light than either teachers or parents. Teachers and parents view the purpose one way while students see it entirely differently. Tasker (cited in Lazarowitz & Tamir, 1994) points this out as a common misconception about scientific investigation. In a study of 11- to 14-year-old students, he found that, not only do students fail to understand the relationship between the purpose of investigation and the design of the experiment, but also their view of the purpose is different from that of their teachers. This can have considerable impact on students' motivation, enthusiasm, willingness to participate, and sense of why a project might be important to do. If a goal of science fairs is to get students to enjoy science more, it seems an obvious place to begin would be to make sure that teachers and students are working toward the same purpose. Make it very clear what the goals and purposes of the fair are, and work toward accomplishing them.

The reasons most often given negative responses are also revealing. All three groups mentioned publicity for the school as least important. Parents and teachers also listed competition for awards and preparation for the future
(college classes or careers), while students also mentioned preparing for science careers as unimportant. Yet schools and students receive fairly substantial newspaper coverage of science fair results, and names of winners are usually published somewhere (Grobman, 1993). In discussions with colleagues, the comment is occasionally heard that if a science project can spark just one student's interest in science as a career, it would be worth all the time and energy that a science fair takes. Yet, thoughts of science in one's future seem to be unimportant as goals of a science fair for most teachers, parents and students.

When questionnaire results are examined according to gender and age, the findings suggest that girls have a more outward, global view of science, while boys have a more inward, personal one. Girls overall and in grades six, seven, and eight felt that the most important reason for science fairs is to help the earth and the environment. Boys in the same subgroups indicated that learning about a subject that interests them is most important. Only in ninth grade do both sexes have different primary goals: expanding their minds for girls, competing for awards for boys. Possibly students at this age are somewhat more pragmatic and utilitarian in their thinking. Knowing these differences in viewpoints should help a teacher better direct the efforts of students in science fair projects that are meaningful to them.
The findings from this study reveal some interesting results about attitudes toward science fairs. There is quite a split on most issues, as there also is in the literature. Teachers, parents, and students all indicated a middle level of agreement regarding the efficacy of science fairs and the value of participation. While all agreed more than disagreed that science fairs accomplish their main goals, none of the groups had more than 41% in agreement. Enjoyment in doing science projects was low, with most responses at the lowest level for all groups; students disliked science projects more than they enjoyed doing them. Students also were opposed to yearly science fairs, while teachers and parents were slightly more in favor. But despite the generally negative feelings indicated in these areas, the majority of teachers and parents felt it is worth the time and effort to do science projects, while students were evenly divided in opinion. It would seem reasonable to expect a much higher level of agreement in all these areas about such a major undertaking in the school curriculum.

In light of these findings and the comments respondents made as to why fairs do/do not accomplish their goals, a conclusion might be that, while the goals of science fairs are perceived to be valuable, the way in which fairs are currently carried out is not meeting the expectations, with the result being that most individuals feel frustrated and do not enjoy them. This might also explain the trend toward
greater disfavor toward science fairs as age increases. Younger students, eager at first, find fairs becoming more challenging, harder, no longer novel. Repeated experiences with frustration, and other negatively perceived issues like competition, tend to kill interest in participation in science fairs. This decline in interest in science is also suggested in the literature, where it is noted that attitudes toward science decline across the grade levels, beginning in middle school (Simpson et al., 1994). This same study reports that there may be a gender difference in science attitudes, with boys generally showing slightly more positive attitudes toward science than girls. This might explain why the findings of this study show boys consider fairs more worthwhile than girls.

As discovered in the literature, competition is one of the most debated issues regarding science fairs. The findings of this study reveal the same difference of opinion, with a large portion from each group in the middle. One segment of the population says competition is good and another says it is bad. However, the majority of all respondents indicated a dislike of competition, reaching as high as 70% in eighth grade girls. Comments made by respondents mentioned winners versus losers, feeling bad if one did not win, and losing interest and desire. If competition is perceived as negatively as this study indicates, it would seem beneficial to eliminate it and
spend that energy and time (required for judging) on other aspects of science fairs, such as providing each student with suggestions about how to improve and further develop the project, or discussing the results and implications with him/her. This would make science fairs much more of a learning experience for students, as McBurney (1978) so strongly encourages.

Studies of cooperative versus competitive learning support this idea, as discussed in Chapter 2. The studies showed that students prefer to learn science cooperatively, develop more positive attitudes, and often achieve more in cooperative settings. Tobin, Tippins, and Gallard (1994) consider cooperative learning valuable because of the opportunity for students to clarify, defend, elaborate, evaluate, and argue with one another. These would all promote critical thinking, as well—another goal of science fairs.

Closely related to the issue of competition is the issue of awards in science fairs. The findings of this study reveal that more respondents agreed than disagreed with awarding 1st, 2nd, and 3rd place winners. One could conclude that if there is to be competition, there also exists a felt need to reward the winners. However, a much higher percentage of respondents (over 60% in all groups) agreed that all participants in a fair should receive some type of award, reaching 88% among sixth grade girls. This
would lead to the conclusion that the majority feel a need for recognition of some type for the effort put into a project.

There is not much controversy over voluntary or required participation in science fairs. None of the literature recommended mandatory participation, and the findings of this study concur with the opposition to required involvement. Parents and teachers were 50% opposed to it, while students were 66% against it. Yet, the findings also show that most students (63%) are required to do so by their teachers. So, it seems that even though the majority of teachers oppose the idea, they still enforce it. Perhaps one might conclude that, although they prefer to allow students to choose whether to participate, teachers feel science fairs are so worthwhile (74%) that they want to ensure that everyone will do so, or that school district pressures cause teachers to stress the importance of fairs.

The final attitude section concerned preferences for the type of presentation students would make of their projects. The findings here are very interesting, in light of the negative attitudes revealed in the sections above. Neither teachers nor parents preferred science fairs, with teachers' first choice being symposiums and parents' being expositions. In both groups, science fairs received the most third place choices. These results could be expected, in light of attitudes toward competition. But students, on
the other hand, indicated an overwhelming preference for science fairs (52%), while expositions came in a distant second (28%) and symposiums third (15%). Middle school girls were less strongly in favor of fairs than boys (44% to 60%). Perhaps one conclusion might be that students would still enjoy the science fair format if changes were made, or possibly they still enjoy the idea of awards for their efforts, which probably would not be given in expositions or symposiums. Another possible explanation is that the idea of expositions and symposiums was so unfamiliar that students did not feel comfortable choosing them.

There is one finding from this study that was unexpected and interesting to note. In controlling for variables in this study, non-participant students and their parents were dropped. Yet that smaller group mirrors the results of the larger one. When non-participant students are included with participant ones, the 522 responses show no difference in the ranking of the three most important reasons to do science projects. The same is true when all parents and all teachers are considered in comparison to only the participant members of their groups. Also, all students ranked the scientific method in 9th place, as did participating students, and developing interest in science was in 12th place, compared to 13th place for participating students. This suggests that there is no difference if a
student has participated in science fairs or not; they still have the same perceptions, values and attitudes about fairs.

Another interesting note is that the only time learning the scientific method was ranked in the top three important reasons, it was by seventh grade males who had never done a science fair.

It was noted in the results in Chapter 4 that there was no response by 11% of the students to the statement about science fairs accomplishing their main goals, with 13% of girls and 8% of boys giving no answer. One speculation for this fairly high lack of response would be that students were not really sure what the main goals are, in spite of having just rated a number of reasons as to importance. Another possibility is that they did not want to admit their feelings about the statement, perhaps feeling that science fairs do accomplish their goals, but not wanting to acknowledge that because of other negative attitudes toward fairs.

In conclusion, it is evident that science fairs continue to be held in many schools, and that many teachers and parents feel they have definite benefits for students. Students, although they also see learning taking place, are less happy and satisfied with participation in fairs. The way in which many science fairs are carried out, and the controversial issues that typically remain a part of them, often seem to prevent science fairs from being as effective
as they could be. Science fairs do meet some goals, but the
goals are not always what students, nor even teachers and
parents, consider to be important. Therefore, it seems that
the needs of students are not being met as well as they
should be.

Recommendations

Based on the review of the research literature and the
findings of this study, there are a number of
recommendations this researcher would like to make regarding
science fairs. Since instruction in scientific thinking and
increasing interest in science are not perceived by
students, parents, or teachers to be the primary goals of
science fairs, this researcher recommends a restructured
approach to science fairs. Focus on the goals that students
do perceive to be important reasons for doing investigative
projects. Tie the projects in to the goal they value most:
pursuing a subject that really interests them. Capitalize
on this eagerness. Another reason they consider important
is to prepare for college classes; help them see how their
project will do just that, by equipping them with skills
needed in college. Be sure that everyone involved clearly
understands the goals that are being pursued. (Even judges
often have ideas about the goals of fairs that are different
from those of the participants, and this affects the way in
which they judge projects, which then ends up being unfair
to the participants.) If the value of doing a project is
made clear, then it should no longer be perceived as just another boring assignment. In the process, learning will take place and students' interest and enjoyment of science surely ought to increase. This could even contribute the added benefit of keeping students involved in science classes throughout high school and possibly even lead to careers in science later.

This researcher would also recommend changing the format from science fairs to classroom symposiums, with an all-school exposition to follow. To really teach the scientific method, do a class project first, followed by group or individual ones. Middle school students find problem solving difficult, especially separating and controlling variables (Helgeson, 1994). Learning the steps together ought to help students and give them more self-confidence when they need to try it on their own.

If administrators and/or teachers decide to continue with science fairs, instead of one of the many alternatives discussed in Chapter 2, there are a number of recommendations to make the fair more enjoyable for all involved. Allow either individual or group projects, of a wide variety of types: investigation, invention, consumer problem, demonstration, and so forth. Keep one category for competitive projects in scientific inquiry for those who really enjoy competing. Make the other categories more of an exposition of classroom projects. If it is decided that
only individual projects should be allowed, recommendations include changing the competition to be against a standard, awarding all participants, allowing more types of entries, and easing requirements about displays.

The findings of this study show that the majority of students do not enjoy doing science fair projects, nor do many teachers and parents. The attitude of many students is that science fairs are not fun, but boring, a waste of time, and a drudgery; the dislike of competition and fear of losing are often a big part of that attitude. To change those perceptions, the recommendation is to allow group projects to be entered in science fairs, even in a competitive category. This would alleviate fears of failure in individual competition, as well as teach more about the true nature of scientific inquiry, which is more of a cooperative venture than competitive anyway. In addition, many students and parents would like to do group projects that could allow families to spend more time together. If competition is kept in the activity, make it groups against other groups, or an individual against a set standard. Competition can be against oneself instead of others—can I do better this year than last, can I achieve more or reach a higher standard?

This researcher recommends that all participants receive an award of some type, or that none do. If the nature of the fair is changed to more of an exposition, and
a competitive category is kept for investigative projects, prizes could be awarded there for 1st, 2nd, and 3rd places, but with all entrants again receiving some recognition. Another recommendation is that, instead of an award for the final project, students receive awards throughout the process of doing it: written notes of praise at various steps of completion along the way, peer commendations as they give suggestions and critiques, verbal praise and guidance from mentors or faculty.

Another recommendation based on the results of this study is that participation in science fairs should be voluntary. Plato made the observation that bodily exercise when compulsory, does no harm to the body; but knowledge which is acquired under compulsion obtains no hold on the mind. More students might choose to do a project on something that really appeals to them, if the concept of fairs were broadened to include other types of projects than purely investigative ones. If it is decided that the fair should remain mandatory, recommendations again include changing the competition to be against a standard, awarding all participants, and easing requirements about displays.

One of the biggest complaints of teachers is the amount of time, effort, and loss of classroom instructional time that are needed to successfully carry out a science fair. To ease the burden on teachers, suggestions would be to get parents and community volunteers involved in the
organization of the fair; make it a school community effort. Enlist the aid of mentors for the students, specialists who can share their expertise, and retired professionals. Students enjoy the extra attention and can really learn from a specialist on their topic, while the teacher is freed for other things. Make science projects a cross-curriculum effort, getting the math, English, and library departments involved. Provide teachers with better preservice science preparation and frequent inservice help in how to teach science.

Suggestions for further study would be to do a follow-up study in a few years, to determine whether attitudes have changed. Studies might also be made of schools that do use an exposition, symposium, or other type of presentation for projects, to compare results about efficacy and attitudes with schools that remain with the typical science fair. It would also be interesting to do a longitudinal study of students who participate by choice versus requirement, to see how many continue to take science courses in high school or college, and how many end up in a science-related career.

In order to negate the limitations of this study, a similar study could be carried out in other areas of the country to determine whether science fairs are perceived in the same way and whether attitudes are the same outside the small geographical area of this study. To clarify questions that respondents may have had, perhaps the researcher should
present the survey in person; some individuals indicated that they were not sure what was being asked on some questions. If this study were to be carried out further, a few changes in the questionnaire would be suggested. The rating scales might be more helpful to respondents if the scales had specific descriptions for each number, rather than making the scale a continuum of degree, and if those descriptions were above each column; that way, there should be no mistake of using the scale in reverse ranking, as some obviously did. Also, question #7 might be changed to first ask what the respondent felt is the most important goal of a science fair, then whether that is accomplished. Finally, getting a larger sample of teachers and administrators would give more representative data about their perceptions and attitudes.
APPENDIX A - PILOT STUDY QUESTIONNAIRE

(Questions were asked orally in an interview format.)

My name is Norma Greenfield and I'm asking students, teachers and parents some questions about science fairs for a project I'm doing. Would you mind if I ask you a few? Your answers will be confidential--I won't use your name in anything.

Student name
School name
Project #
Project title

How many science fairs have you been in? Did you ever win any awards?

Are you required to participate or is it voluntary? Which is better?

Does your teacher spend any time in class on your project or do you do it entirely at home? What types of things does your teacher do in class?

How much help did you receive on your project? What type? From whom?

How do you feel a science fair ought to be judged? How should awards be done? Who should receive awards?

What do you think is the main reason we have science fairs?

__ promote scientific literacy
__ promote interest in science
__ provide publicity for the school
__ promote scientific research
__ stimulate competition
__ other (specify)

Do you feel we accomplish that?

__ positively! __ yes __ somewhat
__ no __ definitely not! __ uncertain

What do you feel actually does result from having science fairs?

How could we have better science fairs?

Who benefits the most from participating in a science fair?

Is any student at a disadvantage in doing a science fair project? Who?

Do you enjoy doing a science fair project?

__ positively! __ yes __ somewhat
__ no __ definitely not!

Are there any negative effects or sides to doing a science fair?

Would you change anything about how a science fair is done? How? What?

Is it worth your time and effort to do a science project? Why?

Is there anything else you would like to say about science fairs?

Thanks for your time and answers!
May 1994

Dear Teachers,

My name is Norma Greenfield. I am a graduate student at Cal State University - San Bernardino, working on a Master of Arts in Secondary Education with a science emphasis. My thesis concerns science fairs at the middle/junior high school level.

Your administrator gave me permission to conduct some research at your school. I am very grateful for that. I would also like to ask for your assistance in my research by having one of your science classes at each grade level fill out a questionnaire for me. I believe it should take only about five minutes to complete. There are three different forms: one for students, one for their parents, and a third for administrators and teachers. Sufficient copies of each should be included with this letter; if not, please feel free to make as many copies as needed, so that everyone gets one.

The questions should be self-explanatory. Responses have been expressed in terms that students gave in an exploratory session. Please stress that students may offer any additional information about science fairs that they would like, in the last two questions on the back of the sheet. As stated, all replies should be anonymous.

If there are staff members in your school other than science teachers, who have some connection with science fairs (e.g., math teachers), would you ask them also to fill out one of the teacher forms and return it with your own? I have enclosed several extras for that purpose.

Would you be so kind as to send the parents' copies home with their children and collect them again? You may set any deadline you wish for having the forms returned. When your deadline for returning questionnaires has been reached, please return all the forms in the envelope to the office. I will pick them up when all the packets have been returned.

If you have any questions about my request or the questionnaire, please feel free to call me at home (794-4404) before 8:15 a.m. or in the evening, or at work (793-5172) from 8:30-11:30 a.m.

I would be happy to share with you the information that I gather, if you feel it could be of some help to you in determining whether the science program is meeting the intended outcomes of science fairs.

Thank you very much for all your help in this project. I am truly grateful.

Sincerely,

Norma Greenfield
Science Fair Questionnaire - Student Form

Thank you for your help in this research project. Please answer the following questions carefully and honestly. Your answers will be completely confidential—do not sign your name anywhere on this form.

1. What grade are you in this year? ______
2. What sex are you? Female _____ Male _____
3. Have you ever done a science fair project? Yes _____ No _____
   If yes, how many? ______
4. Did you participate in a science fair this year? Yes _____ No _____
5. If you have been in a science fair, did your school make participation required? _____ voluntary? ______
6. Students have given the following statements as their main reasons for participating in science fairs. Circle the number that shows how important each reason is to you. 1 means the reason is very important, 2 means somewhat important, and 3 means not important.
   a) 1 2 3 learn by doing my own research and seeing what happens, instead of reading about it in a textbook or being taught it by a teacher
   b) 1 2 3 share what I learn and enjoy - let kids know what others are doing in science
   c) 1 2 3 give the school some publicity about what it is doing in science
   d) 1 2 3 find new ways to help the earth/environment/energy/our future
   e) 1 2 3 have students compete for awards (certificates, ribbons, medals, cash, scholarships) - let skills and talents be judged
   f) 1 2 3 learn how to use the scientific method (hypothesis, research, experiment)
   g) 1 2 3 expand my mind - challenge me - make me think
   h) 1 2 3 apply what is learned in the classroom to a new situation
   i) 1 2 3 become more interested in science - enjoy it more - have fun
   j) 1 2 3 let me show my potential (what I can do) outside of textbooks
   k) 1 2 3 learn a subject in more depth than the textbook or class gives
   l) 1 2 3 learn more about a subject that really interests me
   m) 1 2 3 let me use my creativity in learning - be creative
   n) 1 2 3 help me prepare for a career in science - meet and talk with scientists in an area I am interested in
   o) 1 2 3 let me do a project to show pride in myself and what I can do - be recognized and feel good about doing a job well
   p) 1 2 3 help me prepare for college classes
   q) 1 2 3 use the knowledge and skills that come from other classes, like reading, writing, library use, math, art, writing reports
   r) Are there any other reasons you feel are really important? Explain.

(over)
Circle the number which best describes your feeling about each of the following statements. 1 shows the most agreement with the statement and 5 shows the least agreement.

7. I feel a science fair accomplishes its main reasons. 1 2 3 4 5
   Why do you feel as you do?

8. I enjoy doing projects for science fairs. 1 2 3 4 5
9. I enjoy the competition of a science fair. 1 2 3 4 5
10. I think our school ought to have a science fair every year. 1 2 3 4 5
11. I think all students should be required to participate in science fairs. 1 2 3 4 5
12. I think everyone who participates in a science fair ought to receive an award of some type. 1 2 3 4 5
13. I think there should be 1st, 2nd, and 3rd place winners in each category of a fair. 1 2 3 4 5
14. I feel it is worth my time and effort to do a science fair project. 1 2 3 4 5

15. A science exposition is a display of student projects, without judging, where people can come to see what has been done. A science fair generally has projects evaluated by judges and awards given. A science symposium is a gathering where each person presents his or her project, explains what was done, and gets opinions from fellow students about how well it was done. If you had a choice about which of these you would participate in, what would be your first, second and third choices?
   __ exposition  __ fair  __ symposium

16. Would you change anything about how a science fair is done? What? Why?

17. Is there anything else you would like to say about science fairs?
Science Fair Questionnaire - Teacher/Administrator Form

Thank you for your help in this research project. Please answer the following questions carefully and honestly. Your answers will be completely confidential—do not sign your name anywhere on this form. Please return all the forms to the office when they are finished. - Norma Greenfield

1. What is your position in the school? __________________________________________

2. Have you ever had your middle/junior high school students do science fair projects? Yes ___ No ___ If yes, how many years? ______

3. Did your school have a science fair this year? Yes ___ No ___ If not, why? __________________________________________

4. Did your school participate in the district science fair this year? Yes ___ No ___ If not, why? __________________________________________

5. Is your school's policy to have participation in science fairs be required? ____ up to the teacher? ____

6. Students have given the following statements as their main reasons for participating in science fairs. Circle the number that shows how important each reason is to you. 1 means the reason is very important, 2 means somewhat important, and 3 means not important.

a) 1 2 3 learn through child's own research, instead of reading it in a textbook or being taught about it by a teacher

b) 1 2 3 share what the child learns and enjoys - share what others are doing in science

c) 1 2 3 give the school some publicity about what it is doing in science

d) 1 2 3 develop research to help the earth/environment/energy/our future

e) 1 2 3 have students compete for awards (certificates, ribbons, medals, cash, scholarships) - let skills and talents be judged

f) 1 2 3 learn how to use the scientific method (hypothesis, research, experiment)

g) 1 2 3 expand child's mind - challenge him/her - make him/her think

h) 1 2 3 apply what is learned in the classroom to a new situation

i) 1 2 3 develop more interest in science - enjoy it more - have fun

j) 1 2 3 show child's potential in areas other than textbook learning

k) 1 2 3 learn a subject in more depth than the textbook or class gives

l) 1 2 3 learn more about a subject that the child is really interested in

m) 1 2 3 let child use creativity in learning - be creative

n) 1 2 3 help child prepare for a career in science - meet and talk with scientists in an area he/she is interested in

o) 1 2 3 develop self esteem and pride in doing a job well - be recognized

p) 1 2 3 help child prepare for college classes

q) 1 2 3 use the knowledge and skills that come from other classes, like reading, writing, library use, math, art, writing reports
6-r: Are there any other reasons for doing science fairs that you feel are really important? Explain.

Circle the number which best describes your feeling about each of the following statements. 1 shows the most agreement with the statement and 5 shows the least agreement.

7. I feel our science fairs accomplish the main reasons indicated above. Why do you feel as you do? 1 2 3 4 5

8. I enjoy having students do projects for science fairs. 1 2 3 4 5

9. I like the competition of a science fair. 1 2 3 4 5

10. I think our school ought to have a science fair every year. 1 2 3 4 5

11. I think all our students should be required to participate in science fairs. 1 2 3 4 5

12. I think everyone who participates in a science fair ought to receive an award of some type. 1 2 3 4 5

13. I think there should be 1st, 2nd, and 3rd place winners in each category of a fair. 1 2 3 4 5

14. I feel it is worth students' time and effort to do a science fair project. 1 2 3 4 5

15. A science exposition is an public exhibit of student projects, without judging. A science fair generally has projects evaluated by judges and awards given. In a science symposium each student presents and defends his or her project, and receives critiques from peers. If you could decide which type of event your students would participate in, what would be your first, second and third choices? 1 2 3 4 5

   exposition  fair  symposium

16. Would you change anything about how a science fair is done? What? Why?

17. Is there anything else you would like to say about science fairs?
Science Fair Questionnaire - Parent Form

I am a graduate student conducting a survey about science fairs. I would be happy to share the results with your school or anyone interested. The information may be of use to your school in determining whether the science program is meeting intended outcomes of science fairs. Please answer the following questions carefully and honestly. Your answers will be completely confidential—do not sign your name anywhere on this form. Please have your child return this form to his/her teacher as soon as possible. Thank you for your help in this project. - Norma Greenfield

1. What grade is your child in this year? _____
2. What sex is your child? Female _____ Male _____
3. Has your child ever done a science fair project? Yes ____ No _____
   If yes, how many? _____
4. Did your child participate in a science fair this year? Yes ____ No _____
5. Does your school make participation in science fairs required? _____ voluntary? _____
6. Students have given the following statements as their main reasons for participating in science fairs. Circle the number that shows how important each reason is to you. 1 means the reason is very important, 2 means somewhat important, and 3 means not important.
   a) 1 2 3 learn through child's own research, instead of reading it in a textbook or being taught about it by a teacher
   b) 1 2 3 share what the child learns and enjoys - share what others are doing in science
   c) 1 2 3 give the school some publicity about what it is doing in science
   d) 1 2 3 develop research to help the earth/environment/energy/our future
   e) 1 2 3 have students compete for awards (certificates, ribbons, medals, cash, scholarships) - let skills and talents be judged
   f) 1 2 3 learn how to use the scientific method (hypothesis, research, experiment)
   g) 1 2 3 expand child's mind - challenge him/her - make him/her think
   h) 1 2 3 apply what is learned in the classroom to a new situation
   i) 1 2 3 become more interested in science - enjoy it more - have fun
   j) 1 2 3 show potential (what child can do) in areas other than textbooks
   k) 1 2 3 learn a subject in more depth than the textbook or class gives
   l) 1 2 3 learn more about a subject that the child is really interested in
   m) 1 2 3 let child use creativity in learning - be creative
   n) 1 2 3 help child prepare for a career in science - meet and talk with scientists in an area he/she is interested in
   o) 1 2 3 let child be recognized and feel good about doing a job well - do a project to show pride in self and what he/she can do
   p) 1 2 3 help child prepare for college classes
   q) 1 2 3 use the knowledge and skills that come from other classes, like reading, writing, library use, math, art, writing reports

(over)
6-r: Are there any other reasons for doing science fairs that you feel are really important? Explain.

Circle the number which best describes your feeling about each of the following statements. 1 shows the most agreement with the statement and 5 shows the least agreement.

7. I feel a science fair accomplishes its main reasons. 1 2 3 4 5
   Why do you feel as you do?

8. I enjoy having my child do projects for science fairs. 1 2 3 4 5
9. I like the competition of a science fair. 1 2 3 4 5
10. I think our school ought to have a science fair every year. 1 2 3 4 5
11. I think all students should be required to participate in science fairs. 1 2 3 4 5
12. I think everyone who participates in a science fair ought to receive an award of some type. 1 2 3 4 5
13. I think there should be 1st, 2nd, and 3rd place winners in each category of a fair. 1 2 3 4 5
14. I feel it is worth my child's time and effort to do a science fair project. 1 2 3 4 5

15. A science exposition is a display of student projects, without judging, where people can come to see what has been done. A science fair generally has projects evaluated by judges and awards given. A science symposium is a gathering where each person presents his or her project, explains what was done, and gets opinions from fellow students about how well it was done. If you had a choice about which of these your child would participate in, what would be your first, second and third choices?
   __ exposition    __ fair    __ symposium

16. Would you change anything about how a science fair is done? What? Why?

17. Is there anything else you would like to say about science fairs?
### APPENDIX C - QUESTIONNAIRE RESULTS

**Table 1: Total 6th Grade Responses**

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**Table 1b: Total 6th Grade Responses**

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### Table 5b: Participating Student Responses

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<tr>
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### Table 6: Teacher and Parent Responses

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<th>Parents</th>
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<td>2/67/24/6/2</td>
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<td>57/50/5</td>
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### Table 6b: Teacher and Parent Responses

<table>
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</thead>
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</tr>
</tbody>
</table>

**Note:** Numbers indicate frequency of 'Yes' responses out of total responses. **Table continued...**
REFERENCES


National Science Teachers Association position statement on science competitions. (Adopted by the NSTA Board of Directors, July 1986).


