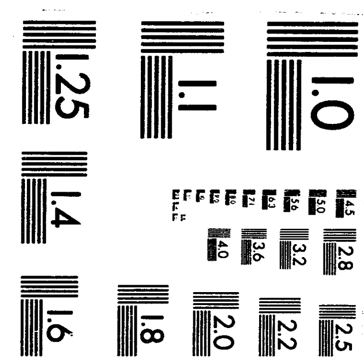
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How to Implement the Science Fair Self-Help Development Program in Schools

DISCLAIMER

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Preface

Many elementary, middle, and high schools sponsor a Science and Engineering Fair during the school year. The purpose is to promote an understanding of the scientific and engineering methods among students and also to give the students practical experience in using these methods. But often the burden of promoting the fair falls upon science teachers who have to add the organizational activities for the fair to their normal teaching load.

This manual is intended to assist in the Science Fair process by providing information about how to create a team of volunteers to manage the organizational activities. Although published materials about Science Fairs are abundant, nearly all of the materials focus on how to develop and complete a Science Fair project. In general, these documents are aimed at science teachers and students and describe how to select a project, apply the scientific or engineering method, and create a display and report. A few publications address how to conduct the Science Fair itself, including organizing the judging, determining techniques for scoring projects, and establishing rules about project displays.

Virtually no published material exists that describes how a school can develop internal support for its Science Fair based on parent and community involvement. This manual is intended to fill that gap for those schools that want to build a productive and successful Science Fair program.

The manual describes the Science Fair Self-Help Program, which was developed by Sandia National Laboratories, and explains how to implement such a program at your school. The materials are based on a pilot Self-Help Program developed by Sandia at three middle schools in Albuquerque, NM, during school year 1991-92 (Menicucci, 1992). The principal objective of the program is to help schools create a team of parent and community volunteers that will work in concert with the school's science teachers to assist and manage all areas of the Science Fair. In this manual, this support team is referred to as the Science Fair Volunteer Support Committee (SFVSC). With the bulk of the organizational and specialized activities managed by this team, science teachers can concentrate on their primary job -- teaching.

Please note that the schools in the pilot program are located within a region that is affiliated with the International Science and Engineering Fair (ISEF) and operate in accordance with the guidelines and structure provided by the ISEF. Much of the material in this manual has been reprinted from the *Official Rules, Judging Guide, and Fair Director Guide* of the ISEF with the generous permission of Science Service, Inc., founders and administrators of the ISEF. Science fairs affiliated with the ISEF closely adhere to these guidelines, which allow students and educators to simulate a professional research experience, while ensuring the protection of participants. Science Service encourages the use of their established criteria as a model for any science fair organizer.

Science Service, Inc., also participated in the field testing of this manual and companion videotape. They distributed 50 copies to various schools around the country, consolidated review comments, and forwarded the comments to Sandia National Laboratories for inclusion in this final version of the manual.

Finally, the authors wish to express their appreciation for the support and encouragement of the U.S. Department of Energy (DOE), which sponsored this project.

Contents

1. What This Manual Is and How to Use It

This manual is intended to act as a working guide for setting up a Science Fair Volunteer Support Committee at your school. The Science Fair Volunteer Support Committee, or SFVSC, is the key component of the Science Fair Self-Help Program, which was developed by Sandia National Laboratories and is designed to support a school's science activities. The SFVSC is a team of parents and community volunteers who work in concert with a school's teaching staff to assist and manage all areas of a school Science and Engineering Fair. The main advantage of creating such a committee is that it frees the science teachers from the organizational aspects of the fair and lets them concentrate on their job of teaching science.

This manual is based on information gained through a Self-Help Development pilot program that was developed by Sandia National Laboratories during the 1991-92 school year at three Albuquerque, NM, middle schools. The manual describes the techniques that were successful in the pilot program and discusses how these techniques might be implemented in other schools. This manual also discusses problems that may be encountered, including suggestions for how they might be resolved.

This manual contains information on the following topics:

- Why Implement a Self-Help Program?
- What Does an SFVSC Do?
- Where Does an SFVSC Work Best?
- How To Develop an SFVSC
- Suggested Organizational Activities, including
  - Organizing and Conducting the Fair
  - Organizing Judging Activities
  - Organizing Mentoring Program
  - Soliciting Contributions
- Suggested Workshops and Meetings, including
  - Promotional Meeting
  - Parent/Student Orientation Workshop
  - Teachers' In-Service Training
  - Pre-Fair Mentoring
  - Mentoring Hotline
  - Fundamentals of Judging
  - Post-Fair Mentoring

The appendices to this manual contain materials that can be copied and used by the SFVSC for its activities. These materials include items such as SFVSC organizational guides, handouts for workshops, judging guides, and information about the mentoring process.

2. Why Implement a Self-Help Program?

The main reason for implementing a Self-Help Program is to free the science teaching staff from the organizational details of a school's Science and Engineering Fair and let them concentrate on their primary job — teaching. Currently many schools depend on the science teachers for all aspects of the Science Fair including planning the fair, helping students prepare their projects, soliciting and qualifying judges, and attending to all of the details in organizing and conducting the fair. As might be expected, many science teachers are discouraged. Not only does the Science Fair bring extra work, most of which must be performed after school hours and without additional compensation, but some of the tasks require specialized background and/or training that they often lack. For example, the procedures for soliciting, qualifying, and organizing judges demand special knowledge about judging criteria, techniques, and organizational theory.

Teachers aren't the only group dismayed by the current situation. Parents can also become discouraged with the Science Fair process. Many parents, even those with scientific backgrounds, do not understand the Science Fair process. They are confused by or unaware of the schedule of events, the fair's rules and regulations, the selection of topics for projects, the judging criteria, and the educational value of the experience.

When both teachers and parents are discouraged, students also have difficulty in developing the motivation and enthusiasm to create innovative and competitive projects. Diminished motivation on the part of the students leads to disinterest, which in turn can sharply reduce participation in a Science Fair or even kill it.

Creating an SFVSC, which is the key component of the Science Fair Self-Help Program, is a positive step toward resolving these problems. The Self-Help Program is based on the concept that schools can benefit from the involvement of parents and community volunteers. These benefits are well documented in the educational research community.

The principal objective of the Self-Help Program is to help schools organize parent and community volunteers into a team that will work in concert with the school's science teachers to assist and manage all areas of the fair. The Self-Help Program was pilot tested in three middle schools in Albuquerque, NM, during the 1991-92 school year (Menicucci, 1992). The results of the pilot testing suggest that the program is effective in creating a Science Fair support structure for schools based on parental and community involvement. Some of the most important findings from the pilot program are outlined below.

1. In all three pilot schools, the Self-Help Program aided the school community in creating an SFVSC consisting of teachers, parents, and community volunteers to assist and manage all aspects of the fair. Near the end of the year, all the parents, students, and teachers who were involved in the Science Fair were surveyed concerning the effectiveness of the SFVSC. The majority of the respondents indicated that the Self-Help Program was effective and that the SFVSC's efforts were recognized and appreciated.

2. An important feature of the Self-Help Program is its flexibility, which encourages each school to tailor its Science Fair support activities to meet its specific community needs. All of the pilot schools successfully designed unique support programs to meet their needs.

3. One purpose of the Self-Help Program is to promote the development of a sustainable Science Fair support activity within the schools. The early indications are that this is occurring in the pilot schools. Each pilot school has plans to expand and enhance its SFVSC in the upcoming years. At present, each school's SFVSC is identifying its successes, assessing the remaining problem areas and developing solutions, and planning next year's activities.

4. Support from the administration, teachers, parents, and community was excellent in each pilot school. The responsiveness and enthusiasm of the community volunteers, particularly retirees, were especially noteworthy.

3. What Does a Science Fair Volunteer Support Committee Do?

The Self-Help Program is a means to involve parents and community volunteers in the organizational aspects of a Science Fair. The Science Fair Volunteer Support Committee (SFVSC) is the key component of the Self-Help Program and is comprised of at least three subcommittees, each of which is responsible for an important aspect of the Science Fair process. The three committees are Logistics, Judging, and Mentoring. Additional subcommittees can be created to address specific problem areas. In general, the SFVSC is encouraged to formalize its operation by electing officers and committee chairs, keeping minutes of meetings, and maintaining financial records.

Logistics Subcommittee

The Logistics subcommittee has the broadest charter and is the least specialized. This committee handles all of the organizational activities needed to organize and run the fair. Examples of these activities include securing a location for the fair, selecting and ordering prizes and awards, publishing and distributing information about the fair, organizing and conducting educational workshops for parents and students, soliciting and thanking volunteers, and managing refreshments for volunteers. The Logistics subcommittee also provides support to other committees as needed, for example, handling mailings to prospective judges. One of the subcommittee's most important functions is to act as an interface between the SFVSC and the school, particularly the administration and the school's science teachers.

Judging Subcommittee

The Judging subcommittee specializes in the judging, and its main responsibilities include identifying, soliciting, and training judges, as well as organizing and conducting the judging process. Managing the judging process includes assigning judges to projects, collecting and summarizing scores, and selecting fair winners.

Mentoring Subcommittee

The mentoring activities are handled by a third subcommittee. The word mentor comes from a Greek myth and historically denotes a trusted guide and counselor for a younger member of society. The Mentoring subcommittee's purpose, therefore, is to guide and assist the Science Fair students in conducting their experiments, drawing conclusions, and preparing their displays. Mentoring may involve one-on-one tutoring between a student and a technical professional, or it may occur through workshops in which technical guidance is provided in a group setting.

SFVSC Members

The three principal subcommittees within the SFVSC offer a variety of opportunities for parents and volunteers with different skills and talents. Individuals with little or no technical background can serve on the Logistics committee, which is often in need of personnel for its large variety of organizational tasks. Those with technical skills can serve on the Judging and/or Mentoring subcommittees.

4. Where Does an SFVSC Work Best?

An SFVSC will be effective in school settings that exhibit three basic characteristics:

1. The school must be struggling with the Science Fair process. This means that the school must show an interest in the Science Fair, but have demonstrated difficulties in achieving success. Success is defined qualitatively as the students, parents, and teachers enjoying the experience. More quantitatively, success is defined as a reasonable number of students successfully proceeding to higher level fairs, like the regional and state fairs, and consistently scoring well and winning some awards.

2. The school community must recognize that a problem exists with the Science Fair process and show a desire for developing a solution based on its own resources and tailored to its own needs. This means that the school community must want to solve its own problems with its own resources. This is not meant to imply that some external help is not welcome. But any help that is provided, such as that derived from the Self-Help Program, would be considered an initial and temporary step to assist the school community in developing its own permanent Science Fair support structure.

3. The school must have demonstrated that the administration and teaching staff support the Science Fair. This means that the principal and the key science teachers must believe, at least philosophically, in the value of parental and community involvement in the school. They must be willing to accept parents and community volunteers as partners in the process of developing a Science Fair support system in the school.

5. How to Develop an SFVSC

There are six basic steps to developing an SFVSC:

Step 1: Develop a Core Group

The core group can originate with the school's staff or interested parents. When school staff are trying to develop an SFVSC, often the principal and the science teachers are the first members. In this case, they should recruit at least one to two parents to form a core group of three to four members dedicated to organizing the SFVSC.

Sometimes parents initiate the activity by forming a core group of interested individuals. Since the involvement of the teachers is very important and the approval of the administration is essential, the core group of parents should contact the key science teachers and administration officials as soon as possible to secure approval for the committee and to establish a mode of operation.

Step 2: Understand the Science Fair Self-Help Process

A fundamental step in developing a productive SFVSC is knowing about the Self-Help Program. Each member of the core group should read about and understand the ideas behind the self-help process. For example, members should read Chapters 1 through 4 of this manual. Menicucci (1992) provides additional details about how the Self-Help Program was implemented at three pilot schools. New members to the group should be provided with copies of these materials so that they have access to the same information.

Step 3: Recruit Volunteers

The core group should begin recruiting both parents and community volunteers to serve on the committee.

Recruiting Parents

One way to recruit parents is to advertise. Appendix A contains suggestions for how to word advertisements that can be placed in the school's newsletter or sent home to parents.

Another method of recruiting parents is to use a database that contains names of parents. Often the principal or the school's PTO maintains such a database, including parents' skills and the areas for which they wish to volunteer. If such a database exists, it is a useful way to identify parent volunteers to serve on the SFVSC. For example, parents with technical backgrounds can be called to work on the Judging and Mentoring subcommittees.

For those schools that do not have such a database, Appendix B contains a sample of the type of information such a system tracks and an explanation about how to create such a system on the Apple computer.

Recruiting Community Volunteers

Community volunteers should also be recruited to help the committee. Retired professionals are very good sources of talent. For example, retired business people can help organize the SFVSC, while retired technical professionals, like engineers and scientists, can help judge and mentor. Sources for community volunteers are civic organizations that support education, such as the Lions, Civitan, and Kiwanis clubs. The local chamber of commerce may be able to provide additional sources.

Another resource is the professional business community, especially those whose business involves science and engineering. The businesses can be identified in the telephone directory's Yellow Pages under headings such as "Scientific Research," and Development," or "Engineering." The businesses can be contacted directly. Larger business often identify a particular individual who manages community relations and volunteer activities. In this case, talk to this person directly. For smaller businesses, you can speak directly to the president or one of the top managers. It is important to note that many of these businesses may also be a source of financial contributions for the school Science Fair (see "Soliciting Contributions" under "SFVSC General Organizational Tasks").

Although there is no limit to the size of the SFVSC, the optimal number of members ranges from about 10 to 20 (excluding those volunteers who serve only as judges and mentors). However, as a general rule, the larger the committee, the more formally it should be organized and run.

Step 4: Hold a Kick-Off Meeting

After recruiting is underway and volunteers have been identified for the key areas of responsibilities, the core group should organize a meeting to formally introduce the self-help concept to the school community and to initiate the SFVSC's activities. The principal, interested teachers, parents and community volunteers should be invited. Appendix C contains a sample presentation describing the Self-Help Program. This presentation, or parts of it, can be used to present the self-help concept to the attendees at this meeting.

At this meeting, the following officers should be elected:

- An SFVSC chairperson
- Chairpersons for each major subcommittee (i.e., Logistics, Judging, Mentoring)
- A secretary to record the minutes of the meetings
- A treasurer.

To insure efficiency and productivity, the SFVSC should operate in a formal manner including holding regular meetings, maintaining records of the meetings and, if the committee is large (i.e., greater than 15 members), using formal procedures, such as Robert's Rules, to conduct the meetings (Robert, 1967). (The use of Robert's Rules for all meetings is a good practice because it improves the overall efficiency.) Appendix A contains examples of minutes of SFVSC meetings.

Step 5: Assess Problem Areas

The first SFVSC task is to identify existing problems in the Science Fair process. Each principal subcommittee (Logistics, Judging, and Mentoring) should assess problem areas and prepare a report to the SFVSC with recommendations about how to correct them. (See Appendix D for a sample survey to assess problems.) Depending on the findings, other subcommittees can be formed to address them. The result of this effort is a prioritized set of goals for the year. The following list is an example of such a set of goals:

1. To increase the level of parental involvement in the Science Fair process.

2. To encourage more student participation in the school's fair.

3. To improve the overall quality of the Science Fair projects over the previous year.

4. To improve the performance of the students who are selected to participate in the regional fair.

Step 6: Develop a Plan of Action

The SFVSC is now ready to develop a plan of action for each subcommittee, including a schedule of activities for all subcommittees. It is essential to remember that the science teachers are the key persons in the Science Fair process. Therefore, coordinate any action plan closely with them. A sample schedule of activities is found in Appendix E (under subsection, "Sample Materials Used by SFVSC to Organize Science Fair").

SFVSC meetings should be held regularly or as frequently as required to meet its action plan. In addition to the SFVSC meetings, the subcommittees can meet independently; each subcommittee should maintain its own set of records and report to the SFVSC at the general meetings.

Some of the most important responsibilities of the SFVSC are outlined below.

General Responsibilities:

1. Maintain open communication with parents/students about the committee's activities. (A sample of such a communication is found in Appendix A.)

2. Insure that all activities are coordinated with the science teachers and the principal.

3. Remain flexible in responding to the needs of the students and parents involved in the Science Fair.

4. Provide technical support and training for students and their parents as the students prepare their projects for the Science Fair. Such support may include workshops and in-service sessions.

Specific Responsibilities:

1. Organize and conduct the judging.
2. Organize and conduct the fair.
3. Organize and conduct mentoring program for the students.
4. Raise funds to support the Science Fair activities.

A description of each of these activities is outlined in the next two sections.

6. SFVSC General Organizational Tasks

This chapter describes the organizational activities that the SFVSC will pursue. The activities include organizing and conducting the fair, judging, and mentoring, soliciting contributions, and showing appreciation to the volunteers. Specific workshops and meetings to supplement these activities are described in Chapter 7. Materials for the organizational activities are provided in Appendixes D through J.

Organizing and Conducting the Fair

The Logistics subcommittee, operating in cooperation with the science teachers, has the major responsibility for organizing and conducting the Science Fair. Some of the most important organizational items to be addressed include

- Selecting the date of the fair
- Selecting the type of awards to present
- Securing a facility for the fair
- Identifying who should provide refreshments for students and judges
- Deciding how to recognize and encourage all student participants
- Procuring tables for the Science Fair projects (a problem for many schools).

Other activities are

- Coordinating the activities of the other subcommittees (particularly judging)
- Scheduling general meetings (e.g., Science Fair open house)
- Copying documents
- Communicating the committee's activities to the school community.

Arranging for the Location and Materials for the Fair

Tending to the physical organization of the fair is an important task for Logistics because it involves selecting a building that is large enough to house all of the Science Fair projects. Usually the size of a project can be 48 inches wide, 30 inches deep, and up to 9 feet above the floor. Most projects are placed on tables so that the printed material on the display backboards is at eye level and related materials, such as reports, can be placed in front of the project and within easy reach of observers. The tables are arranged in rows that are spaced about 5 to 6 feet apart.

When many projects are expected, a large building, like a gymnasium, is needed to house the event. Also a large number of tables must be procured (because most projects are placed on a table). A simple rule for estimating the number of tables is that about two projects can be placed on an 8-foot table (i.e., 200 projects will require about 100 tables). If the fair is held on the weekend, then the school can probably use the cafeteria and its tables. However, when the fair is held on a school day (as is often the case), these tables are in use. In this case, table rental is an option. When renting tables, the following should be considered:

- Contact local furniture supply houses as early as possible, since other schools may also be planning to rent.
- Remember that renting can be expensive. Plan to include table rental in the budget.

Categorizing Projects and Rewarding the Student

The Logistics subcommittee is responsible for working with the science teacher(s) and Judging subcommittee to determine how projects are categorized and how students are rewarded. Traditionally, projects in a Science Fair are organized by placing each project into 1 of 14 scientific/engineering categories. (Science Fair categories are listed in Appendix J, under subsection "Choosing Project Categories.") In this situation, the projects are judged by category by a team of individuals who have expertise in the related fields of science or engineering. Generally, awards are presented to the top winners in each category. Top winners for the entire fair are also selected.

In practice, schools fairs do not always conform to this model. The following section describes a few different approaches both for categorizing projects and presenting awards. Consider these approaches and modify them as necessary to meet the needs at your school.

Project Categories:

- An alternative to placing projects in 14 separate categories is to group projects into three main categories: Biological sciences, physical sciences, and engineering. This method is particularly helpful at smaller schools where the total number of projects is low.
- Projects can also be categorized first by grade level, and then by the three main categories described above. This option is effective especially when lower grades are involved so that they can compete against their peers.
- Some schools have added a "consumer science" category, which includes experiments such as "which soap is best?". The purpose of this category is twofold: (1) to provide an avenue for students who need to submit a project to satisfy a class requirement, but are not interested in further competition, and (2) to conserve judging efforts for the more rigorously developed projects. Although the consumer science category merits first-, second-, and third-place awards in the school science fair, the winners probably should not be sent to the next level of competition (since the projects cannot effectively compete). If such a category is used, however, the students should be told at the outset that winners in this category will not advance to regionals.

Awards:

- One method of presenting awards is to give them only to those students who will proceed to the next level of competition. No overall fair winners are selected. The objective of this method is to reward equally all students who will continue to compete.

- An alternative is to heavily reward many projects in each category (for example, there may be as many as 5-6 awards for each of the 14 categories), and let science teachers present honorable mentions to students of their choosing. The objective of rewarding many students is to stimulate their enthusiasm. The purpose of the honorable mentions is to encourage students who have marginal projects but a special need for attention.
- Most schools favor awarding a ribbon to every participant (regardless of how the top awards are presented). The objective is to express appreciation for the students' efforts and is especially important in schools where participation in the Science Fair is voluntary.

General resource materials for organizing and conducting the Science Fair are found in Appendix J.

Logistical Support to Other Committees

The Logistics subcommittee's major responsibility in conducting the fair is to provide support to other subcommittees as needed. For example, the Judging subcommittee generally needs support with a variety of activities such as providing refreshments and insuring that materials for judging are available (e.g., copies of handouts, judging criteria). The Logistics subcommittee should become familiar with the Judging and Mentoring activities so that it is ready to offer its services, as needed. Information on both subcommittees is provided in the following sections.

Information relating to all logistical support activities is found in Appendix E.

Organizing the Judges and Conducting the Judging

The Judging subcommittee usually has two principal areas of interest: (1) recruiting, qualifying, and training judges and (2) developing a judging procedure and adopting judging criteria. If the subcommittee is large enough, divide these activities among the subcommittee members, with a single individual coordinating each area. It is also possible for the subcommittee as a whole to address both areas. Information related to judging and judges is found in Appendix F.

Recruiting Judges

Recruit by contacting local technical organizations such as research and development companies, engineering firms, and government laboratories. Local retired technical professionals as well as other community volunteers can be recruited through local civic organizations such as the Kiwanis, Lions, and Civitans. After the initial contact the committee should send a solicitation package containing the following items:

- Cover letter thanking the prospective judge and informing him/her about the time and place of the judging
- Description of the judging criteria and scoring sheets
- Questionnaire in which the potential judge is asked about his/her expertise and education. The information on the questionnaire can be used to qualify the judge and, if qualified, assign him/her to specific projects.

Organizing Judges

In general, the judges are often organized into teams that address a certain project category. In most school fairs, only three teams are necessary because there may be only three categories. If needed, you may use other criteria to organize the judging teams.

It is important to select a chairperson for each judging team who has judging experience and leadership ability. It is recommended that you select the chairperson before the day of the fair. In addition to managing the judges, the chairperson also leads the caucuses, advises the judges on technical matters regarding how to judge specific exhibits, and represents the team of judges in any higher level discussions. For example, the top Science Fair winners are often selected in a caucus comprised of the judge chairpersons.

Establishing Judging Criteria

Various judging criteria can be used for a school fair. The judging criteria are the rules upon which the student projects are to be scored. Generally, these criteria consist of different characteristics, such as creative ability and thoroughness. Each characteristic is weighted differently to emphasize those that are considered most important.

Many characteristics can be selected with various weighting schemes. However, it is in the students' interest to use a set of judging criteria that is consistent with the regional and state fairs so that those who progress to the next levels are not be subjected to different criteria. The set of criteria that is often selected for Science Fairs is based on the one used at the International Science Fair. These criteria, along with their weighting factors, are as follows:

- Creative ability (30%)
- Scientific thought/engineering goals (30%)
- Thoroughness (15%)
- Skill (15%)
- Clarity (10%).

These weighting factors are usually integrated into the scoring scheme, which is often based on a 100-point scale. Thus, the percentages become the point totals for each area. For example, using this system, a perfect project would receive a total of 100 points which is the sum of the points in the five areas, i.e., 30 points for creative ability, 30 points for scientific thought/ engineering goals, 15 points for thoroughness, etc.

Additional information about the judging criteria along with some sample scoring sheets is found in Appendix F.

Determining Judging Procedures

The procedures used by each team of judges vary among schools and should be determined by the preferences and needs of the school community. Two methods are often used: (1) individual judging in which each project is judged by a single individual and (2) group judging in which each project is judged by a group of judges. The decision to use individual or group judging is often governed by the number of projects and available judges. A discussion of each method is outlined below.

Group judging is often used where the expertise among the judges varies widely, especially when some judges do not have strong technical backgrounds. In these cases, the judges with technical backgrounds can be teamed with those who are less technical. This type of teaming will help insure that the important scientific/engineering points about the project are not overlooked during the judging.

However, if an adequate number of highly qualified judges is available, it is probably best to conduct individual judging. Individual judging allows each judge to draw conclusions about projects independently, without influence from others. The judges can then discuss their observations during caucus sessions during which they jointly agree on the final ranking of the projects as well as the winners.

If group judging is used, each judging team should be relatively small—perhaps two to five individuals. The small number allows all of the team members a reasonable opportunity to interact with the student exhibitors as well as to discuss key features of the projects with the other members of the team. A team can optimally judge about 15 projects, with a maximum of about 25. Therefore, to determine the *minimum* number of judges for a fair, divide the total number of projects by 25 and multiply the result by the total number of judges in each judging team. (For example, if the school has 100 projects and hopes to use 3 judges per team, at least 12 judges are needed.) Typically, judges may spend between 3 and 15 minutes per project, depending on the project's quality and student interest.

Judges operating individually can be expected to judge up to about 20 projects, with an optimal number of about 10. It is best if each project is judged by at least two judges and preferably three or four. Therefore, to determine the *minimum* number of judges needed, multiply the total number of projects by the number of times each project is to be judged and divide the result by 20. (For example, if the school has 100 projects and hopes to have each project judged 3 times, at least 15 judges are needed.)

Another important consideration about judging is its schedule. Judging during school hours is preferable, if possible, since all students are present. If you must conduct judging after school, be aware that some students may be denied the opportunity to interview because they must ride home on the bus.

In many cases, the required number of judges is far greater than the supply. One way to mitigate this problem is to use pre-screening, i.e., to identify the projects that are worthy to be judged. Often some projects do not represent serious efforts by the students. With pre-screening, the less serious projects can be identified and eliminated, thus allowing the limited judging resources to be conserved for the more serious students. There are at least two methods of pre-screening.

The first type of screening, which is called two-stage judging, is integrated into the judging process and is performed by the judges. This technique, which was pioneered by Taylor Middle School in

Albuquerque, NM, begins with the judges reviewing all of the projects without the students present. After the review, the judges caucus and decide which projects warrant an interview with the student. This interview, which is performed the following day and is part of the second stage, is then used as the basis for determining the final scores and the winners.

In the second type of screening, the science teachers together can review all of the projects and jointly decide which ones should be judged. Usually, these selections can be made a day or two before the fair.

The advantage to the first screening method is its impartiality and thoroughness. By allowing the judges to make the initial selections of the projects to be judged, the maximum amount of impartial and professional expertise is applied to the process. However, the process is very time consuming and may require judges to spend up to two days to complete both stages of the judging. Moreover, to avoid a single judge from imposing his or her personal biases on a certain project, at least two judges should screen each project.

Using science teachers to screen the projects can save time. In many cases the teachers are familiar with each of the projects and know the ones that are worthy for judging. They can make these selections with little or no review of the projects. However, because the teachers are so intimately familiar with some of the projects, they may overlook flaws or good points that would be noticed by an impartial individual.

If screening is used, it is important to inform students of this procedure so that they are not disappointed if they are not interviewed. Also, it is a good practice to give students whose projects were rejected the option of talking directly with the judges. Sometimes even a very poor project can be significantly improved through an interview.

Qualifying Judges

Because judges are often in short supply for school fairs, there is a tendency by the school's Science Fair officials to accept any individual who volunteers to judge. However, it is a better practice to apply some qualification criteria to insure quality judging, especially if individual judging is to be used. Unqualified judges not only may pass incorrect technical information to the student, but more important, they also may not appreciate an important scientific or engineering principle in a project and so assign an inappropriately low score, which would be a disservice to the student.

For individual judging, it is best that all judges hold a bachelor of science degree or equivalent. For the purposes of judging, individuals with associate degrees in science or engineering and with more than five years of direct technical experience can be considered equivalent to an individual with a bachelor of science degree.

For group judging, less stringent qualifications may be required. In this setting, it is essential that at least one member of each judging team be a scientist or engineer. In this case, acceptable qualifications may include a bachelor's degree in any field with a preference for a background in science or engineering.

Training Judges

For most judges, especially the experienced ones, the solicitation package contains all the preparational materials they need. Other judges may require special instructions. At a minimum, just prior to judging, the Judging committee should brief all of the judges about the fundamentals of judging and the specific procedures to be used.

In cases where there is a large number of inexperienced judges, it may be best to conduct a Judging Workshop in which the judging fundamentals are explicitly outlined. This type of workshop is described in detail in this manual under "SFVSC Workshops and Meetings."

Encouraging Judge Caucusing

During the fair, encourage the judges to caucus to discuss their observations and compare their conclusions and findings; doing so is especially important if individual judging is used. For example, a typical judging and caucusing in a school fair may follow this sequence of events:

1. Each judge would first review all of the projects without students present.
2. Following the review, the judges would caucus and develop preliminary rankings; during the caucus, the students would arrive at their exhibits.
3. Each exhibitor would then be interviewed by at least two judges.
4. The judges would caucus, discuss their findings and scores, finalize the rankings, and select the top three winners. They also may rank all of the exhibits for use in selecting those students who would proceed to the regional fair.

In general, the purpose of caucusing is to help calibrate the judges' scores to a common standard. At the beginning of the caucus, it may be worth requesting each judge to submit one "top project" and one "bottom project" in each category. This method effectively helps to sort the projects and provides a basis for discussion.

Finally, it is often the case that an excellent project has been entered in an inappropriate category. In this case, judges of a more appropriate category for that project should be asked to review the project before final decisions are made. Also, the caucus team should recommend the category be changed, especially if the project is to proceed to the next level of competition.

Assigning Judges

Prior to the fair, assign individuals to judge certain projects by matching a judge's expertise with a project. In most cases, a match can be made. In a few instances, however, you must assign judges to projects outside their expertise. In these cases, encourage them to consult about the project with other judges. Record and monitor the assignments to insure that all of the exhibitors are interviewed.

On the day of fair, present each judge with an envelope containing information about the judging. The material should include

- Copy of the judging criteria
- Map of the project layout
- Schedule of judging events
- List of the projects to which the judge was assigned
- Score sheet for each project.

Consider adding to each score sheet a section in which the judge is asked whether the project is currently worthy to compete in the regional science fair. You may also want to ask whether the project has potential to compete at regional and what improvements might be needed to bring it to a competitive level. This information can be used in selecting which projects will progress to the next level of Science Fair competition, recognizing that some mentoring may be offered to help improve the project.

Information relating to Science Fair judges and judging can be found in Appendix F.

Organizing Mentors and Conducting the Mentoring

Many methods are available to help students better prepare their Science Fair projects. Some of these methods include a pre- and post-fair mentoring workshop, both of which are discussed in the section, "SFVSC Workshops and Meetings." The workshops provide a one-time, group-oriented method of mentoring the Science Fair students.

If more intensive and individualized mentoring is required, you may want to develop a mentoring program in the school. Such a program was developed at Washington Middle School and was successfully applied during the 1991-92 school year. This program, which is outlined below, is intended to assist those students who are selected to proceed to the next level of Science Fair competition. The main purpose is to help these students improve their projects as well as their knowledge of the subject in preparation for the regional Science Fair competition. Information on the mentoring program is found in Appendix G.

Recruiting Mentors

The first task in the mentoring program is to identify mentors for the students. It is best if one mentor can be matched to a single student. Therefore, the number of mentors needed must equal the number of students in the program. However, it is possible that some mentors, particularly retirees who have ample spare time, can mentor several students. Usually, mentors can be identified from the same sources as the judges and, in fact, judges will often agree to act as mentors.

You may want to consider asking a few more students to join the mentoring program than the number actually authorized to participate in the regional fair. The purpose is to expose a larger number of students to the concept of mentoring; also, because the demands of the mentoring program are rigorous, some students will reconsider their commitment to the program and drop out. In fact, at Washington Middle School, where this type of program was developed and first implemented, about 30% of the students dropped out of the mentoring program. The remaining students were all eligible to attend regional. Realize, however, that Regional accepts only a specific number of exhibitors; make it clear to the students that only an authorized number will be able to compete.

After the mentors are recruited, match them to students according to the mentor's expertise and the type of project.

Arranging a Kick-off Meeting

Initiate the mentoring program with a meeting involving the students, their parents, and the mentors. At the meeting, the Mentoring subcommittee officials and teachers should present some guidelines about mentoring including the importance of commitment and follow-through. After the introductory comments, hand out a packet of instructional information about the mentoring program and the schedule to each mentor and student. Both the mentor and the student should be encouraged to stay after the meeting, introduce themselves to each other, and arrange for the time and place for the next meeting.

Promoting Mentoring Opportunities

If possible, arrange for the school to be opened each weekend, preferably Saturday morning, to allow the mentors and the students to use the facilities. This allows mentors and students an opportunity to meet regularly at a specific time and place. It also allows the science teaching facilities, such as laboratories, to be available to the students.

About two weeks before the fair, invite all of the mentored students to the school on a Saturday to participate in a group effort to develop backboards. The purpose of this activity is to provide all of the materials, tools, and expertise to create well-designed Science Fair display backboards. The materials may include letters for creating titles and professionally constructed backboard display frames. These frames can be constructed of wood and are designed to easily accept cardboard inserts that contain the display. Two or three of these frames can be connected to form a Science Fair display. The creation of these backboards is an excellent opportunity for those parents or community volunteers who want to help the SFVSC, but do not have a technical background. Other tools at the student's disposal may include computers to create graphics as well as hand tools for lettering and cutting paper. Mentors and teachers provide the guidance on constructing the layout.

During the final week before the fair, invite the students and mentors to the last mentoring session in which mock interviews are conducted. In these sessions, mentors simulate judging interviews with the students and help them improve their verbal presentations. The mentors should concentrate on interviewing students other than the ones with whom they were involved.

Information for use in conducting the mentoring program is found in Appendix G.

Soliciting Contributions for the Science Fair

An important activity of the SFVSC in general—and the Logistics subcommittee in particular—is to solicit funds to support the Science Fair. In most cases, schools will allocate funds for the Science Fair and these are usually adequate for the fair's essential operational activities.

However, enhancing and broadening the school's Science Fair activities may require additional funds. An additional source of funds in the school community is the parent-teacher organization (PTO). PTOs typically have a budget to support school activities like the Science Fair. To access these funds, check with the PTO president about the proper procedure for requesting support. SFVSCs may also pursue their own fundraising by selling related materials at its workshops (see "Parent/Student Orientation Workshop" in Chapter 7).

The business community is another source of funding. Many businesses regularly contribute to community activities, and educational institutions are often favored recipients. Businesses that specialize in technical work are especially disposed toward supporting Science Fairs.

The best way to solicit support from the business community is to call the business and set up a meeting. At the meeting, the SFVSC representative should present a very brief overview of the Science Fair program at the school and how SFVSC supports it. Follow with a short description of the SFVSC goals and financial needs, which should be presented very quickly and concisely (one to two minutes maximum). At this point, request financial support.

Formally recognize any contributions with a letter and phone call expressing appreciation for the gift and describing how the gift was used. For large contributions, special recognition should be given including noting the contribution in the school newsletter, announcing it at the Science Fair awards ceremony, or awarding a special gift such as a plaque to the donor.

It is often possible to receive annual contributions from some organizations. Many large companies maintain a budget for philanthropic activities. It is important to remember that it may take several years of soliciting for a school to become a regular recipient of this money. To achieve this, SFVSC officials should maintain regular, professional contact with the company and show appreciation for any contribution or in-kind service the company can provide. Bray (1981) provides some additional guidance about fundraising.

Maintaining Vitality of the SFVSC

One of the most important activities of the SFVSC is to nurture the growth of the organization, both collectively as a committee as well as individual members.

Encouraging Committee Growth

One way to encourage the collective growth of the committee is to develop a sense of team spirit among the members. Keeping the focus on the committee's goals and its accomplishments and celebrating these accomplishments as a group is an excellent way to encourage team spirit. Pizza parties, picnics, and other social gatherings can be used to celebrate the success of the group. For example, a small party can be held as a reward for SFVSC members after a successful Science Fair workshop.

Encouraging Individual Growth

The committee's collective growth depends heavily on the motivation and talents of its members. These talents are best developed by offering each individual a job that is not only commensurate with his or her skills, but is also challenging and exciting. It is important to recognize that all members bring certain skills to the committee, and these skills should be identified and utilized. Moreover, each individual's skill level will also increase as he or she assumes different, and sometimes more difficult, jobs. This desire for growth and development, which is present to some degree in all people, should be encouraged.

For example, a young community volunteer may agree to help mentor students. You may want initially to give this young person a limited task, such as mentoring a single student, and then insure the young mentors success by offering help and guidance throughout the effort. Being successful will increase the young person's confidence, which in turn may encourage him or her to aspire to jobs of greater responsibility and importance. You should also recognize that every committee member possesses this type of growth potential.

Showing Appreciation

One of the more important aspects of the SFVSC management is to maintain a high level of motivation among the members. Since the SFVSC members are volunteers, the only rewards available for encouraging motivation are **recognition** and **appreciation**. However, the importance of these "rewards" cannot be emphasized enough. The SFVSC leaders should continually express interest in each member's contribution and generously express appreciation for his or her efforts. As individuals attain certain milestones or complete projects, their work should be recognized with a public "thank you." For example, if an individual on the Judging subcommittee develops a new and more effective method for organizing the judging consensus, you may want to describe this individual, along with the accomplishment, in the school's newsletter. Very significant accomplishments should be rewarded with a plaque presented in public or a public letter of appreciation.

The value of individual recognition cannot be understated. In most cases, it can significantly improve motivation and growth potential. When recognition is lacking, volunteers often interpret it as a lack of interest in their activities, which can lead to discouragement, resentment, and disinterest. In fact, lack of appreciation and recognition is probably the most significant cause of volunteer turnover. Successful leaders of volunteer organizations have found that showing appreciation and recognition of individuals is the most important part of their job.

7. SFVSC Workshops and Meetings

This chapter describes workshops and meetings that supplement the general organizational activities. The workshops/meetings include:

- Science Fair Promotional Gathering
- Parent/Student Orientation Workshop
- Teacher's Science Fair Fundamentals In-Service Training
- Pre-Fair Mentoring Workshop
- Mentoring Hotline
- Judging Fundamentals Training Workshop
- Post-Fair Mentoring Workshop

Materials for these activities are found in Appendixes D through J.

Science Fair Promotional Gathering

Taylor Middle School developed this promotional event, which was dubbed the "Science Fair Blast-Off." The meeting should be held early in the year; its purpose is to inform parents about the goals of the Science Fair and to discuss some of the important dates. The meeting should be an informal event with plenty of refreshments and opportunity for interaction between parents, students, and teachers. An example of a planned activity at this gathering is to ask previous Science Fair winners from the school to present their winning projects. Teachers may also present information on the educational value of participating in the Science Fair.

Parent/Student Orientation Workshop

The orientation workshop, which can follow the promotional event, was developed by Washington Middle School and also successfully applied at Taylor and St. Charles schools. The purpose of the workshop is to help inform both students and parents about the fundamentals of the Science Fair and provide materials that can be useful in creating a Science Fair project. This workshop is especially beneficial to students who are about to engage in their first Science Fair and their parents. (In many schools sixth graders are the first students to participate in the Science Fair because grades K through 5 participate in a non-competitive invention convention.) In general, aim the workshop at those students who are not disposed toward science and who traditionally view the fair as a difficult, confusing, and burdensome process.

Organize the workshop around a group of information stations, each of which provides handout information on a specific Science Fair topic and is manned by an individual who is knowledgeable in the subject. The technical experts can include science teachers, parents, and community volunteers from local professional and civic organizations who are knowledgeable in the subject area. The workshop may contain the following stations:

- How to select topics for projects
- How to create a backboard display and report
- Explanation of the scientific and engineering method
- Overview of the judging process.

A general station can provide information on the school's Science Fair, including important dates and where to purchase science experiment materials. If so desired, blank Science Fair backboards can also be sold at this station, with the profits a source of revenue for the SFVSC. Other materials, such as Science Fair books, can also be sold.

The SFVSC should heavily promote the workshop by handouts to students, flyers that are sent home to parents, notices on school bulletin boards, and daily announcements over the intercom. The best time to hold the workshop is immediately after a school day. The best place for the event is a large open room such as a cafeteria or gym.

The workshop might begin with a short introductory period in which all of the initial attendees gather and listen to some brief comments by the principal and some of the SFVSC members. At this time the technical experts who will man the various information stations can be introduced. Promotional videos about the Science Fair, such as the one developed by Menicucci and Eley (1991) can also be shown. (To obtain a copy of this video, contact the Northwest New Mexico Regional Science Fair Office, (505) 277-4916.)

Each information station should be (1) manned by a technical expert, (2) located separately (i.e., the stations shouldn't be grouped together), and (3) equipped with a table with handout materials. The workshop should be open to all of the school's Science Fair students and their parents. The attendees are free to come to the workshop at any time during its 3-hour duration, stay for as long as desired, and roam from station to station, spending as much time as necessary at each one. Provide refreshments, including coffee, soft drinks, and cookies, throughout the workshop.

Often a large majority of the attendees will arrive at the workshop within the first one-half hour and attend the opening talks and presentations. Because of the large number of attendees at the beginning of the workshop, there may be concern that some stations will be overcrowded and unable to properly attend to questions as parents and students compete for the attention of the station's technical expert. However, the free form of the workshop will help to mitigate the problem because the attendees will tend to migrate to the less crowded stations, thus the loads on the stations will be somewhat self leveling.

If possible, conduct a formal survey of the workshop to assess the successes and problems. The survey can be a simple one page document that asks about the usefulness and effectiveness of the workshop and solicits comments about how the workshop can be improved. Give the survey to each attendee as he or she arrives at the workshop and instruct them to turn the surveys in when they leave. In addition to the survey, also note any informal verbal comments about the workshop. These comments can supplement the data recorded in the survey.

Information relating to the organization of this workshop is found in Appendix H, including handout packets for the information stations that were developed by the St. Charles School SFVSC. The publication by Fredericks and Asimov can also be used as an important source of information for the handout materials (Fredericks and Asimov, 1990).

Teacher's Science Fair Fundamentals In-Service Training

A teacher's in-service training, which was developed at Washington Middle School, can be conducted to help orient teachers to the Science Fair process. An important purpose of the training is to develop consistency in the educational methods used by the science teachers regarding the Science Fair. This is especially important in schools with a large number of science teachers.

This 30- to 60-minute workshop is intended primarily for the new and/or inexperienced teachers, but can be a valuable refresher for experienced teachers as well. The meeting can begin with a short presentation by an experienced individual, preferably one of the school's science teachers, about the fundamentals of a Science Fair.

After the presentation, devote the bulk of the workshop to an interactive discussion about applying the scientific or engineering method. For example, one exercise might be to distribute different brands of chewing gum to the workshop attendees and then ask them to make observations about the gum and discuss the differences among themselves. The workshop monitors can prompt the attendees to discuss hypotheses about what makes the gums different and how their hypotheses can be tested. This graphical, hands-on exercise helps the attendees to understand better the fundamental process involved in a Science Fair project. It also helps to generate enthusiasm among the staff for the Science Fair.

Information materials relating to this in-service training can be found in Appendix I.

Pre-Fair Mentoring Workshop

The pre-fair mentoring workshop was developed at Taylor Middle School and is intended to help students as they prepare their projects for the school's Science Fair. This is an important workshop because many students develop problems with their science experiments or engineering projects shortly after they have begun work. If the problems are not resolved, they can lead to a poorly developed project that does not compete favorably in the Science Fair. Moreover, these problems can often generate frustration with the process itself that has long-term effects.

One of the most common problems students encounter in science projects is in hypothesis testing. In most situations, students will design a scientific experiment with the intent of showing data that support the hypothesis. Frequently, however, the data collected by the student disproves the hypothesis. Although this is normal in professional research circles, it is disconcerting to most students. Professional intervention at this point can be instrumental in helping to maintain the student's enthusiasm by demonstrating how the information can be positively presented and reassuring the student that the situation is indeed normal.

Hold the Pre-Fair Mentoring Workshop after most of the students have begun their projects but several weeks before the school fair so that there is sufficient time to redirect the project if necessary. The workshop's organization is similar to the orientation workshop. The workshop can be held for several hours following the close of school and may include many of the same stations as in the orientation workshop. Some new stations may address hypothesis testing, data collection, statistical analysis, and project presentation.

Encourage both parents and students to attend. As in the orientation workshop, teachers, parents, and community volunteers can serve as technical experts for each station.

The workshop should be designed to respond to specific questions and problems that students are having at the time. Therefore, organize the information stations to emphasize group interaction between the technical expert and the attendees. For example, instead of each station containing a table of information, the station should be a gathering place, with the technical expert at the center discussing problems with the attendees. Some of the stations may include:

- Collecting data
- Analyzing data
- Testing hypotheses
- Presenting results
- Review of the scientific and engineering methods
- General information

Keep in mind that volunteers at the general information station will be responsible for answering a variety of questions, including some that may surprise you. For example, even though this workshop is held well into the year, some students may not have begun their projects and may want information about how to choose a project. Also, parents may want information about schedules, rules, and regulations.

In planning this type of a workshop, there is frequently concern that the attendees at each station will become unmanageable because the numbers of questions and problems could overwhelm the technical expert. Another concern is that many of the attendees could become bored and discouraged waiting to air their particular concerns. However, in actual experience at Taylor Middle School, neither problem materialized. Because many of the attendees have problems and concerns that are similar to the ones under discussion, working on a solution to a specific problem often applies to others in the group. In fact, many times the parents and students who attend the stations will simply listen to the discussion for some time, take notes, and leave without a question or comment.

It is advisable to survey workshop's attendees to assess the workshop's effectiveness so that it can be improved the following year. A survey form similar to the one used for the orientation workshop is recommended.

A Mentoring Hotline, which was developed at St. Charles, is intended to serve the same basic function as the pre-fair mentoring workshop, but it operates differently. Therefore, it may complement or replace the workshop.

Mentoring Hotline

The Mentoring Hotline allows students to contact one of a group of mentors to discuss a specific problem. If warranted, the mentor and student can arrange to meet. To create the hotline, the Mentoring subcommittee should develop a list of potential mentors. The list should identify the name of the mentor, his/her expertise, and the times and dates he/she would be available to consult. One person should act as the point of contact for the mentoring, which involves directing the students to the appropriate mentor.

For example, students who desire help can call the point of contact and explain their need. Based on the information from the mentor list, the point of contact will identify an appropriate mentor and then give the mentor's name to the student, who can then contact the mentor directly. The purpose of this arrangement is to help insure that a mentor with appropriate expertise is matched to the student's needs and to prevent any one mentor from being overworked. To minimize the burden on the mentors, queries to the hotline can be restricted to specific times such as 7 pm to 9 pm, Mondays through Thursdays. However, once the mentor and the student are working together, they can arrange to meet and/or talk whenever it is mutually convenient.

Advertise the Mentoring Hotline in the science classes, bulletin boards, special handouts to students, notes to parents, and in the school newsletter. Initiate the hotline about a month or two before the school fair and maintain it for as long as it remains useful.

As with the workshops, conduct some formal assessment of the effectiveness of the hotline.

Judging Fundamentals Training Workshop

Normally, the judge team contains a mixture of experienced and inexperienced judges. The experienced judges often provide sufficient on-the-job training for the others. As a consequence, the only required training is a brief judging orientation just prior to the Science Fair.

However, if many of the judges have no previous judging experience or if a large number do not have science or engineering backgrounds, it may be advisable to hold a special workshop to train and inform these individuals about the fundamentals of Science Fair judging. Such an event was developed at Taylor Middle School.

Conduct the judge training and orientation workshop about a week before the fair and encourage all of the judges to attend, especially the inexperienced ones. It may be best to organize the workshop as an informal session that includes the presentation of judging theory and practice along with some dialogue about judging techniques. If possible, feature a professional researcher with experience in judging. This speaker should discuss the fundamentals of judging, including how to apply the judging criteria, how to conduct interviews, how to deal with sensitivities of children, and the fundamental considerations for a productive caucus. This individual should also answer questions from the attendees.

Role playing can be especially valuable to illustrate judging techniques. An excellent method is for the speaker to assume the role of a Science Fair student. It is beneficial if some actual projects can be used as examples. The attendees can take turns interviewing and judging the project. During this exercise, the coordinator can help identify the positive points and suggest improvements. If several sample projects are used, the role playing can include some practice in scoring and caucusing techniques.

Conclude the workshop with a discussion about the judging process that will be used at the school fair. Also remind the judges about the time and place of the fair, whether refreshments will be available and what kind, and the importance of finding a suitable replacement if a judge cannot fulfill his/her commitment.

Post-Fair Mentoring Workshop

The post-fair mentoring workshop was developed at Taylor Middle School. It is intended to help improve the quality of those projects selected to participate in the regional level of competition. In contrast to the mentoring program developed by Washington Middle School that provided intensive, individualized mentoring, this workshop is a single event in which technical experts review the projects, talk with the student, and suggest improvements. Although continued interaction between the mentors and students is not promoted, neither is it discouraged.

Hold this mentoring workshop shortly after the school Science Fair so that the students will have the maximum time to implement any suggested changes and/or improvements to their projects before entering the regional Science Fair. Invite all students selected for the regional competition and any alternates. Parents should also be strongly encouraged (or required) to participate in the workshop. The purpose for requiring the presence of the parents is to minimize miscommunication between the mentor and the student. The mentors can be recruited from the same organizations as the judges and, in many cases, may include individuals who judged at the school's fair.

Conduct the mentoring in a group setting in which the students set up their projects for review by assigned mentors. During the workshop, the students remain with their projects and are expected to discuss the details of the project with a mentor. The best place for the workshop is a large room with tables for the projects and enough chairs to allow both the student and mentor to sit and discuss the project. A cafeteria or library is often suitable.

Each mentor can handle up to two or three projects during the one- or two-hour mentoring event. There are two techniques for matching the students and the technical experts.

The first technique involves assigning mentors to certain projects, which insures that all of the students will be interviewed. The student assignment can be given to each mentor as he or she arrives at the workshop. Assigning mentors to students is particularly useful if the number of students exceeds the number of mentors. In this case, the assignments allow the human resources to be carefully managed. For example, a mentor could be assigned to three students, with 45 minutes allotted for each interview. Each of the three students could be asked to arrive at the workshop in sequential, 45-minute intervals, thus maximizing the mentor resources and minimizing the waiting time by the students. However, this technique does have some disadvantages. For example, a mentor may be assigned to a project that does not exactly match his or her expertise.

The second technique is to let the mentor select the projects he or she wants to mentor. The advantage is that the technical expert will probably select those projects that most closely match his or her expertise/experience. However, to insure that all of the students are interviewed, a workshop coordinator must monitor and, if necessary, direct some of the selections. This technique works best when the number of mentors equals or exceeds the number of students.

During the workshop, the mentors should spend as much time as necessary with his/her assigned students discussing improvements to the project or helping the students understand better the scientific or engineering principles upon which the project is based. The mentors, most of whom will probably be experienced judges, should also help prepare the students for the rigors of the regional competition by conducting mock judge interviews.

8. Self-Assessment and Planning for Next Year

The SFVSC should assess the progress in the Science Fair process during the school year. The purpose of this assessment is improve the process for the following year. One of the best assessment techniques is to survey the community. Appendix D contains a sample survey and cover letter. It also contains some guidance about how to analyze the data.

After the data have been analyzed, use the results to develop the SFVSC's plans for the following year. Specifically, any problem areas should be corrected. Also, any successes should be repeated with little or no modification.

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Appendix A: Organizational Materials for the Science Fair Volunteer Support Committee (SFVSC)

SAMPLE COMMUNICATION BETWEEN SFVSC AND PTO

Courtesy of St. Charles Borromeo School

SAMPLE SFVSC SOLICITATION FOR A PTO MEETING

Hello, my name is [insert name]. I am a parent in the school and I am representing the Science Fair Volunteer Support Committee. I would like to tell you about our activities.

The Science Fair Voluneteer Support Committee is intended to identify and organize community resources that can help a greater number of students win prizes and have fun at the Science Fair. It is also designed to help our science teachers organize the fair.

Parental involvement is the core of this program. Sandia National Laboratories, which developed this program, has provided a manual to help us organize our Science Fair Volunteer Support Committee. This committee will provide group workshops about the Science Fair process, judging, and ways that parents can assist students to prepare their projects.

The Science Fair Volunteer Support Committee is also planning for the judging of the Science Fair that is scheduled for [insert date]. If you have a technical background, we need your help to judge. If you know someone with a technical background, especially retirees, that would like to help, please give us their names.

We also welcome any parents that want to serve on our committee. You do not need a science background to help. You can leave a message at the school office.

Thank you.

Date: June 10, 1992

To: Phillip Lee
President, St. Charles Home and School Association

From: Kathy Aragon
St. Charles Science Fair Volunteer Action Committee

Dear Phillip,

The St. Charles Science Fair Volunteer Action Committee (SCSFVAC) would like to continue our work that we started last year. We hope to work through the summer and plan for next year's activities. As an ad-hoc committee, we feel it is important to let the Home and School Association know our agenda for this summer.

The committee's goals for this summer follow:

1. Define tasks.

   There are three sub-groups in this committee - judging, mentoring, and logistical support. We hope to complete a time-line chart showing a list of tasks for each sub-group. The time-line chart will also contain the estimated time to complete each task. This task list will make it easier to delegate responsibility, so the workload will not fall on a few member's shoulders.

2. Develop a budget.

   Last year the committee provided hand-outs for the workshop, trophies and ribbons for the winners, and additional tables for the project displays. The money came from the school's operating budget. As a Home and School ad-hoc committee, we will ask the association for the needed funds to support our activities. The attached sheet lists the expenditures for the 91/92 school year. We don't anticipate the same funding for this year, because we probably will not have to rent tables, since Brother Peter has since purchased new tables.

3. Solicit additional members.

We would like the names of any parents who indicated a desire to help with the Science Fair on the volunteer sign-up sheets that were returned to the school. We want to contact them early this summer and request their help. It is very important that we know what our resources will be, in order to have each task assigned to a volunteer before the school year begins.

4. Sponsor a kick-off meeting.

Once the new members are identified, we will sponsor a kick-off meeting to introduce the new volunteers to the committee, its charter, and scope of operations. We want this committee to work in an atmosphere of camaraderie and good will. The Science Fair itself only takes place one day out of the year, but the committee is literally involved during the whole school year. It is important that we foster a close working relationship within the committee, because we will be spending a lot of time working together.

5. Conduct additional meetings, as needed.

The current members of the committee unanimously agreed that we need to become involved earlier in the school year. This means we must meet throughout the summer to plan for the next school year.

On behalf of the current members of the SCSFVAC, I would like to thank you for the good words you spoke at the May Home & School meeting regarding our role as a standing committee. As a group, we are committed to supporting the Science Fair as part of the school's core curriculum, therefore we will continue the work started last year, whether we remain an ad-hoc committee, or become a standing committee.

If the SCSFVAC becomes a standing committee, we can be assured of continuity in the membership, regardless of who is involved from year to year. This continuity is important, because of our active involvement with the science teacher and her curriculum. As I've mentioned before, the work of this committee lasts for nearly the duration of the school year, and planning for a new school year can begin earlier, if we preserve our continuity.

The SCSFVAC was very fortunate to have Sandia National Laboratories consult and mentor our efforts last year. We also had the unique opportunity of involvement by a community organization - the Kiwanis Club. As a direct result of the commitment to our efforts, by these two organizations, our efforts as a committee were very successful. The success of the committee may be judged by responses to two surveys that were conducted: the first was compiled during the student/parent workshop in December, 1991, and the second was sent to all sixth, seventh, and eight grade parents in May, 1992. However, Sandia's participation has ended, and we must accomplish the same tasks next year, without the guidance and mentoring we enjoyed last year.

I feel very positive that we can continue our successful efforts, since we, as a committee, have learned valuable lessons, and have gained experience in staging an effort such as ours. Incorporating into the Home and School will also bolster our efforts, and certainly our spirits.

Sincerely,

Kathy Aragon

SAMPLE SFVSC BUDGET

Courtesy of St. Charles Borromeo School

St. Charles Science Fair Expenditures
for School Year 1991/1992

1.	Table Rental	200.00
2.	Trophies	100.00
3.	Copies of handouts	100.00
4.	Misc. (Donuts, coffee for judges)	10.00
	TOTAL :	410.00

EXAMPLES OF MINUTES OF SFVSC MEETINGS

Courtesy of Taylor Middle School

TAYLOR SCIENCE FAIR MEETING NOVEMBER 21, 1991

Minutes taken by Irene Lueckenhoff

Welcome by Coordinator Jan Lewis

Individuals present:

Elizabeth Cochran	Pauline Gutierrez
Dan Irick	Gary Carlson
Grant Bloom	Jan Lewis
Col. John Miller	Irene Lueckenhoff
Dave Menicucci	Joyce Sitten

Report from Sandia Representative Dave Menicucci:

Dave reviewed the purpose of the Science Advisory Program. It is to assist Taylor in putting together an internal Science Fair Organization. He emphasized the need to document specifics of our program for future use.

Dave introduced Gary Carlson from Sandia who will help Taylor with technical aspects of Science Fair.

Colonel John Miller, representative from Kiwanis Club, will solicit help from retirees.

Science Fair Workshop Procedures:

Dave and Jan Lewis jointly explained the concept of a Science Fair Workshop. It would involve a period of time after school hours when trained individuals help to answer questions related to various aspects of the Science Fair.

Tentative workshop stations include:

Display	Protocal
Judging	Project Selection & Preparation
Engineering	Assistance for students with special needs
Scientific Process	Research

Jan will get preparation packets to individuals manning stations and extra information packets will be housed in the library for check-out.

A brief hand-out will be available in each station as well as one copy of detailed information for viewing at the station only.

Workshop date is not finalized. Recommended dates are December 10, 11 or 12th. Time period will be 3 hours - after school from 3:15 to 6:15.

A snack will be provided for those attending workshop.

Science Fair Logistics:

Students will need to fill out a Science Fair Registration Form for record keeping and also to phone students regarding current information.

Written reminder will be sent home with students on the day prior to workshop.

Dave suggested we figure out budget based on determined needs. Dan Irick then volunteered to chair a Budget Committee. This committee will present needs to Colonel Miller of the Kivanis Club. They have about $100 to donate upon official request.

We need to think of whom we can approach for further financial assistance.

Pauline Gutierrez volunteered to chair a Logistics Committee to address such topics as workshop and Science Fair organization, food, calling, awards etc.

Elizabeth Cochran's secretary will type any necessary information.

Science Fair - General Information:

$200 has been donated to Science Fair by Taylor PAC.

School will pay for table rental.

Display boards will be available for purchase. Cost will be approximately $6.50.

Future Science Fair Related Dates:

Next meeting to finalize workshop is set for December 3rd at 7:30 p.m.

Second workshop will be held in early January to bring in projects for mentoring.

Gary Carlson mentioned the possibility of another workshop following local Science Fair judging.

TAYLOR SCIENCE FAIR MEETING DECEMBER 2, 1991

Minutes taken by Irene Lueckenhoff

Welcome by Coordinator Jan Lewis

Individuals present:

Elizabeth Cochran	Linda Banker
Joyce Sitton	Irene Lueckenhoff
Dan Irick	Dave Stryker
Becky Pate	Pauline Gutierrez
Gary Carlson	Dave Menicucci
Dave Ring	Jan Lewis
	Mr. Mulder

Report from Budget Committee:

Dan Irick reported that the committee estimated a Science Fair budget of $300. Copying costs were estimated at $150 and the remainder for food, badges, ribbons, awards, etc.

A formal letter was written to Kiwanis Club and signed by Mr. Mulder.

FINALIZED SCIENCE FAIR WORKSHOP INFORMATION:

Registration forms to be sent home are in teachers' hands today.

PAC will meet tomorrow at 8:45 a.m. to approve money for display board ordering.

Final Workshop preparation meeting will be held on Tues., Dec. 10 at 7:30 p.m.

Workshop will be held on Thurs., Dec.12 from 3:15 to 6:15 p.m. Stations will be manned by the following individuals:

Gary Carlson	-	Scientific Method
Dan Irick	-	Engineering
Pauline Gutierrez	-	Research
Elizabeth Cochran	-	Display
Ron Pate	-	Project Selection
Dave Ring	-	Judging
Adrienne Podlesny	-	Protocal
Sandy Rhinehart	-	Special Needs

Dave Menicucci will act as a floater. Col. Miller will be asked to send additional helpers.

Each station will be located in a seperate classroom. Workshop will be launched in the school cafeteria.

Dave Menicucci will make a brief introduction. Adrienne Podlesny will present an overview.

Science Fair video will be shown and then run continuously during workshop.

Irene Lueckenhoff will solicit snack donations and set snacks up in cafeteria.

There will be a sign-in sheet for students at each station. Teachers may consider giving extra credit to students who attend workshop.

Linda Banker will make up a sign-in form.

Jan Lewis handed out information packets to those who will man stations.

Gary Carlson will ask his son to be present at the workshop, representative of a student having gone through the process.

Joyce Sitton needs to know what pages of the handbook need to be run off for hand-outs. Mr. Mulder suggested we use the Taylor copier.

Jan will write up motivational announcements to be read over PA system for the next few days. Jan and Joyce will place Science Fair Workshop information in the display case.

SCIENCE FAIR CONSIDERATIONS:

Judging - Dave Ring has 14 judges lined up and is planning to get 20.

Science Fair projects are due on Feb. 18th. Judging will take place on Feb. 19th and 20th - tentative time 4:00 to 7:00 p.m. Taylor students will view projects on Feb., 21st.

Dave Ring wanted to know how we were going to group projects. It was decided that we will not categorize for this judging. We would later work with winning individuals to help them target in on available awards at regional level. Jan will go down to Regional Office for list of available awards.

John Hockert is working on a Judge's Manual. It will be finished after January 1st. There will also be a training session after January 1st.

Food - No final decision was made regarding food to be served. Pauline Gutierrez and committee will discuss matter further, possibly consider potluck for both evenings.

AWARDS - Pauline reported that the estimated cost for pins would be $4.75. Buttons would cost about $.40. Mr. Mulder informed us that we could use the school button maker.

Buttons and ribbons can also be made by the APS Graphics Department.

Dave Menicucci will print a master participant certificate.

DISPLAY BOARDS - Mr. Mulder gave Jan information on a company that might send boards in time to sell at Workshop.

Students will at least be able to order them at Workshop. Cost will be $6.50.

Teachers will submit a list of students who are unable to purchase boards.

BANNERS - Signs for Workshop will be printed out by Linda Banker. She will also make any necessary signs for Science Fair.

TAYLOR SCIENCE FAIR MEETING December 10, 1991

Minutes taken by Irene Lueckenhoff

Individuals present:

Joyce Sitton	Linda Banker
Jan Lewis	Irene Lueckenhoff
Chuck Easterling	Mimi Tafoya
Col. John Miller	Dave Menicucci
Ron Pate	Elizabeth Cochran

FINALIZED SCIENCE FAIR WORKSHOP BUSINESS:

Dave Menicucci will bring videotape and make introductory speech. Jan Lewis will welcome students. Adrienne Podlesny will present an overview. Mr. Johnson will then introduce Taylor Science Dept.

Linda Banker has made banners for each room and labels for each station.

Rooms for workshop use will be 118, 208, 209, 304, 308, 309, 406.

Dave mentioned that the most popular station will be project selection. There is need for additional help and lots of handouts. Colonel Miller volunteered to assist in this station.

Gary Carlson will bring in his son's winning project to be displayed in the cafeteria. Jan's daughter's project will be displayed in special needs station.Katie's will be in the display station.

We have about 54 display boards. We will have a sign-up for purchasing boards. We will also have a sign-up sheet for purchasing headings. The cost is estimated at $.35.

UNFINISHED WORKSHOP BUSINESS:

A written reminder was supposed to have gone home with students today. Mr. Mulder will check on matter.

Colonel Miller needs to send a letter stating what the Kiwanis money donation will specifically be used for in order for this committee to keep money in Taylor School account.

We will need a large portable screen for workshop presentation.

Ron Pate needs copies of the list of suggested Science Fair Projects for his station.

Mr. Mulder requested that we find someone to walk the halls during workshop. Elizabeth Cochran's son may be available to do that.

We need to change Room 118 as a station if possible.

Linda Banker will make a banner for Monzano Sunrise, Northwest Club of Kiwanis International.

SCIENCE FAIR INFORMATION:

Channel 27, Public Access Television, will be called for coverage.

Dave has written a press release to be sent to the newspaper.

We need to keep Science Fair notices going out to students who rotate out of Science classes.

Colonel Miller needs to know who we need of his members.

We will contact program manager at KMNE.

GENERAL INFORMATION:

Students needing assistance with graphics may approach Lanore Durrett in the Art Dept.

The Science Fair Handbook can be recopied. Might have a sign-up sheet and sell for $7.95.

Thank you notes will be sent to individuals making contributions. A note will be sent to Javier Duran of Jewel-Osco for food donations.

Linda mentioned that Intel contributed $17,000 to purchase science kits. We should publicize Science Fair and find sources of support for Taylor science program.

We need to invite Ms. Sparlin in Health to be involved. She works with about 130 students.

Next organizational meeting is scheduled for Tuesday, January 7th at 7:30 p.m.

Mentoring workshop may possibly be held on the 3rd Thursday in January from 3:15 to 6:15 p.m.

Appendix B: Description of a Database Management System for Parent and Community Volunteers

This appendix describes the data form that is used to gather information about parent/community volunteers who want to assist the school in the Science Fair process. Information is also provided on how the information can be taken from the form and organized on an Apple computer system called APPLEWORKS. The computerization of information allows the individual records to be sorted easily so that people with specific talents and/or expertise can be easily identified. It also helps maintain a historical information base that can be used by the school from year to year.

The best time to gather information about parents is at the school's registration. At that time, parents can be asked to complete a data form. The first parent-teacher organization (PTO) meeting of the year, which is often well attended, is another opportunity to gather information.

Gathering information about community volunteers is more difficult because they have no official connection to the school. However, as community volunteers are identified and become involved in the school's activities, they should be added to the database.

Instructions for Initially Setting Up a Data Base Using an Apple Computer and Appleworks 3.0

1. Insert Appleworks Start-up disk and turn machine on.

2. When program asks for date, enter correct date in correct format.

3. Program will display the Main Menu. The data base program (along with the word processing program) is on the reverse of the start-up disk so remove the disk, turn it over and re-insert disk.

4. At the Main Menu you will decide if you are creating a new file or using an already existing file. Since this data base will be a new file, select "Make a New File" by using the arrow keys to highlight "Data Base". Highlight "From Scratch" and then hit Return. You will be asked to give it a somewhat descriptive name so when the file is saved on the disk you will know what it contains by its name.

5. At this point you should have a blank form for the data base on the monitor. If not, hit Esc and it will return you to the Main Menu and you can begin again. At the blank form, position the cursor at the beginning of the word "Category 1" and press Apple-delete to erase that word. This will allow you to create your own category titles.

6. The category titles should include all the information you are trying to track, such as name, address, telephone #, types of committees that individual has agreed to serve on, etc. Take time to consider all possibilities before starting to type, because it is easier to make changes at this time than after you have begun to insert names. Put the most important categories first such as name, address, telephone. A sample of suggested file categories is included in this section of the manual. You may have up to 30 category titles, but it is better to limit the total to 10-12 so the data base does not become so large that it is difficult to use. A very large data base with more than 300 entries may not fit on one 5 1/4" floppy disk. You will have to use a 3 1/2" disk or save the file under two separate file names such as "Volunteers.A-M" and "Volunteers.N-Z", or some similar logical break.

7. Once you have created all the necessary category titles, hit ESC. You will then be able to begin entering information into the data base.

8. Once you have completed all of the entries, save the file on a data disk which has been formatted according to the instructions in the Appleworks Reference manual under the section "Formatting a Blank Disk".

9. You will also want to consult the Reference manual to work with and manipulate the data you have just entered. The manual can be somewhat confusing to use when you are just beginning. Use sticky pads or paper clips to mark important sections, take notes, and make ample use of the Table of Contents and the Index. It gets better with experience. Some areas to investigate include:
   - Inserting/deleting categories
   - Single and multiple record layout
   - Changing the layout
   - Modifying an entry in the data base
   - Moving and copying records
   - Searching for specific records
   - Arranging records in a specific order
   - Printing a table report
   - Printing a label report or address labels

EXAMPLE OF DATA BASE ENTRY
TO IDENTIFY VOLUNTEERS FOR PTO

Courtesy of St. Charles Borromeo School

EXAMPLE OF DATA BASE ENTRY
TO IDENTIFY VOLUNTEERS FOR PTO

File: VOLUNTEERS.92
Report: Full Record Page 1
Selection: OTHER contains SC.FAIR

LAST NAME: JONSON
FIRST NAME: ANTHONY
MIDDLE NAME:
GRADE: 7 A
CHILD ST. NAME: 125 23RD ST. NW APT. A
CHILD CITY,STATE: ALBUQ., NM
CHILD ZIP: 87105
CHILD PHONE: 736-2454
BILL LAST NM: JOHNSON
BILL FIRST NM: GEORGE & KIM
TELEPHONE #: 827-8099 WORK
FATHER OCCUP.: UPHOLSTERY
MOTHER OCCUP.: BOOKKEEPER
1-TCHR SUPP.: SUPPLIES
2-EXTRA ACAD.: ACADEMIC COMPETITIONS
3-FUNDS: MAGANIZE, PUBLICITY
4-SCH/OFFICE.: TYPING, PTO COMMITTEES
5-AFTER SCH.:
6-OTHER: TOOLS, ACCOUNTING, SC.FAIR
HOURS WORKED:

PARENT PARTICIPATION FORM
1991 - 1992 SCHOOL YEAR

The parents of our students all work at a variety of jobs and each one has skills that can translate from the home or work place to the school. Making St. Charles a successful school requires the help of parents who can contribute primarily their time, or $25.00 worth of needed materials, or $25.00 in check or cash.

Please list your occupation below and check the lists given in which areas you could make a contribution. If you are unable to contribute the equivalent of at least 5 hours per year because of other commitments, there is a parent participation fee of $25.00. Your contributions will be recorded at the end of each month and families who have not completed the equivalent of at least 5 hours by the end of February (next year) will be billed for the participation fee.

Your support is very valuable to the school, so please consider where you can realistically help out. If you have other possibilities not listed, please write them in below. Thank you.

CHILD'S NAME ____________________ MOTHER'S NAME ______________

Address ______________________ Occupation ______________

City/State/Zip ________________ FATHER'S NAME ______________

Telephone _____________ Occupation ______________

I would be able to work with the following group/groups if called:

TEACHER SUPPORT

_____ Collecting/organizing classroom supplies
_____ Classroom aide
_____ Room Parent
_____ Teacher morale
_____

EXTRA ACADEMIC AREAS

_____ Science Fair
_____ Academic Competitions
_____ Invention Convention
_____ Computers in class

FUNDRAISING

_____ Magazine Drive
_____ Halloween Carnival
_____ Mayfest
_____ Publicity for Events
_____ Soliciting Supplies/Prizes
_____ Other Ideas

SCHOOL & OFFICE SUPPORT

_____ Typing/General Office
_____ Phones/Messages/Errands
_____ Playground Duty - Recess (A big need)
_____ Cafeteria Duty (A big need)
_____ Traffic--A.M. or P.M.
_____ Newsletters
_____ Other Home & School Committees

AFTER SCHOOL ACTIVITIES

_____ Drama/Dance
_____ Chorus/Music for Mass
_____ Math/Science Club
_____ Computer Club
_____ Chess Club
_____ Athletics
_____ Dances (6th, 7th, 8th)

OTHER AREAS IN WHICH YOU MIGHT HELP

____

ARE THERE OTHER SKILLS AND ABILITIES YOU CAN PROVIDE?

_____ Plumbing _____ Electrical _____ Painting
_____ General Construction _____ Handy with Tools
_____ Access to Special Tools _____ Interior Decorating
_____ Surveying _____ Computers _____ Medical/Nursing
_____ Accounting _____ Engineering _____ Counseling

Access to reduced prices for Xeroxing or other supplies, please specify:

________________ ________________

Appendix C: Sample Presentation of the Science and Engineering Fair Self-Help Development Program

SCIENCE AND ENGINEERING FAIR
SELF-HELP DEVELOPMENT PROGRAM

FOR
ELEMENTARY, MIDDLE, HIGH SCHOOLS

OUTLINE OF TODAY'S TALK

* Educational Philosophy of parent involvement in schools
* Describe the Science Fair Self-Help program
* Discuss how to apply the program
* Question & answer; discussion

PARENT/COMMUNITY INVOLVEMENT WORKS

Parental and Community involvement in schools has been proven to be effective in improving educational quality

WHAT IS IMPEDING PARENTAL INVOLVEMENT IN SCHOOLS

1. **ECONOMICS: Two-parent working families make parent-school interaction difficult.**

2. **INSTITUTIONAL: Schools have tended not to encourage parental involvement in education through fear of liability, improper management of volunteers, etc).**

3. **SOCIETAL: Many people today seek a single-point solution for problems. Schools are easy targets.**

WHAT IS IMPEDING COMMUNITY INVOLVEMENT IN SCHOOLS

1) Schools overlooked the potential of this resource.

2) Community sees no avenue to become involved.

THIS SITUATION IS NOT NATURAL FOR PARENTS

Parents will assume educational responsibility and involve themselves in the educational process

IF

they are properly motivated and encouraged

THIS SITUATION IS NOT NATURAL FOR COMMUNITY VOLUNTEERS

1) Community volunteers have always supported education

2) Many civic groups are dedicated to serve education (Kiwanis, Lions, Civitans).

3) Retirees are especially motivated to assist in schools.

4) Community volunteers represent a huge pool of talent.

MOTIVATIONAL FACTORS FOR COMMUNITY - PARENT/SCHOOL INTERACTION

* Volunteers' efforts must be meaningful
* Volunteers' efforts must directly relate to the children's education (collectively or individually)
* Volunteers' efforts must be appreciated

SANDIA'S SCIENCE FAIR SELF-HELP PROGRAM WAS DESIGNED TO BUILD PERMANENT SOLUTIONS TO PROBLEMS

* Need for improved school science fair process is clear:
  - Teachers overworked/discouraged
  - Resources appear scarce
  - Parents and community not meaningfully involved
  - SF students not properly guided

* Shares the development risks with the school community:
  - Program is driven by the school community
  - Requires parent, teacher, community volunteers
  - Sandia supplies some supporting materials and documents

* The program focus is on developing a permanent Science Fair Support Program in the school
  - It helps develop a support commitee based on internal resources.
  - It promotes continued growth of the support process.
  - It builds community spirit and enthusiasm.

SELF-HELP PROGRAM OBJECTIVE

TO PERMANENTLY IMPROVE THE QUALITY OF THE SCIENCE AND ENGINEERING FAIR EXPERIENCE FOR STUDENTS, PARENTS, AND TEACHERS

THE SELF-HELP PROGRAM:

- Was conceptualized at Sandia (D. Menicucci)
- Funded through Sandia's Educ. Outreach Program
- Is affiliated with the Northwest New Mexico Regional Science and Engineering Fair
- Was implemented on a trial basis at Washington Mid School, St. Charles, and Taylor Mid School (Results published in SAND92-1442)
- How-to manual describes some ideas on how to develop the self-help program in schools.

PROGRAM ADVANTAGES

Teacher:	Less organizational work; more time to teach science; more successful students
Parents:	Better science education; students directed into productive and rewarding activity
Student:	More competitive projects; improved learning; more rewards and fun
Adminis:	Improved science education program; happy students, teachers, parents; recognition for school
Sandia:	Accomplishes the DOE educational outreach mission

HOW DOES IT WORK?

1. Identify school science fair tasks/schedule
2. Sandia Self-Help "How To" Manual helps organize school community and volunteers (Science Fair Volunteer Support Committee (SFVSC))
3. Sandia Self-Help "How To" Manual helps train SFVSC on judging, mentoring
4. SFVSC assigns resources to the tasks
5. SFVSC performs tasks
6. SFVSC celebrates the successes

TEACHER/ADMIN. ROLE IN THE PROGRAM

* Commit to excellence in science education as well as the science and engineering fair
* Provide direction and guidance to the SFVSC; identify needs to the support group!
* Provide internal educational materials and guidance

PARENTS' ROLE IN THE PROGRAM

* Identify and involve interested parents to form a SFVSC (everyone can help regardless of background!)
* Organize SFVSC efforts through the H&S/PTO; Provide all of the support to run the fair
* Assist in judging and mentoring as needed (primarily parents with technical backgrounds)

COMMUNITY VOLUNTEER'S ROLE IN THE PROGRAM

* Help organize the SFVSC
* Provide resources to the school
* Assist in judging and mentoring as needed.

SANDIA'S ROLE IN THE PROGRAM

* Provide published materials on program organization
* Provide professional science/engineering consulting

THE THREE MAJOR ELEMENTS OF THE SCIENCE FAIR VOLUNTEER SUPPORT COMMITTEE

* LOGISTICS: Organize the science fair (gym, forms, prizes)
* JUDGING: Organize the judging effort (define procedure, identify/qualify judges, invitation and thank-you, etc)
* MENTORING: Organize the student mentoring effort (identify/qualify professional mentors, match students to mentors, etc.)

SAMPLE SCHEDULE

SCIENCE FAIR ACTIVITIES AND TASKS FOR THE SCIENCE FAIR VOLUNTEER SUPPORT COMMITTEE (SFVSC)

DATE	SCHEDULED ACTIVITY	SFVSC TASKS AND ACTIVITIES
Sept	Students select projects	Sandia's "How-To" manual used to help organize volunteers into a volunteer support committee; assign tasks
		Sandia's "How-To" manual used to help train SFVSC
		SFVSC plans school fair: – Logistics – Judging – Student mentoring
Oct	Students begin work	Guide students about science/engineering and science fair (e.g., SFVSC sponsors a student science fair workshop)
		Organize and contact judges
		Organize school fair (i.e., reserve gym, move tables, get awards, make judging forms, etc.)
Nov	Students continue work	Provide mentors as required
Jan	Students complete projects	Mentors help students finish; present results
Feb	Students to sch fair	Operate school fair
Mar	School winners go to regional fair	Provide mentors to school winners to prepare for regional
Apr	Regional winners go to state fair	Provide mentors to winners to prepare for state
May		Measure success; rewards volunteers; celebrates

LIST OF IMPORTANT TASKS WITHIN THE SCIENCE FAIR VOLUNTEER SUPPORT COMMITTEE

LOGISTICS SUB-COMMITTEE:

1) Overall SFVSC coordinating
2) Typing letters, completing forms, etc.
3) Arranging/organizing the science fair room (move tables, pick up ribbons, prizes)
4) Making signs and posters that provide directions
5) Arranging for refreshments during fair
6) Running to fetch students during the fair
7) Fund-raising
8) Generally assisting teachers as needed
9) Coordinating volunteers (organize and contact volunteers, insure that all volunteers are recognized and thanked, etc.)

LIST OF IMPORTANT TASKS WITHIN THE SCIENCE FAIR VOLUNTEER SUPPORT COMMITTEE

JUDGING SUB-COMMITTEE:

1) Judging coordinator (judging sub-committee chair)
2) Judge organization (contact and qualify judges, assign judges to projects, develop and maintain list of judges, etc.)
3) Judging organization (develop and document judging procedure, train judges on proper procedures, organize scoring including check-in table, judge score verification, tally sheets, create judging forms, etc.)
4) Assisting in selecting students to proceed to regional (help organize a review committee to review projects and scores, develop a procedure to select representatives, document process)

LIST OF IMPORTANT TASKS WITHIN THE SCIENCE FAIR VOLUNTEER SUPPORT COMMITTEE

MENTORING SUB-COMMITTEE:

1) Mentoring coordinator (Mentoring sub-committee chair)

2) Mentor organization (contact and qualify mentors, develop and maintain list of mentors, etc.)

3) Mentoring organization (develop mentoring procedure, train mentors on proper procedures, assign mentors to student(s), organize group mentoring, document events and progress)

REMEMBER TO MEASURE THIS PROGRAM'S PROGRESS

1. Survey participants (parents, teachers, students)

2. Compare student's science fair performance with previous years.

3. Other ways defined by the SFVSC

Appendix D: Sample SFVSC Surveys

This appendix contains two sample surveys. The first is for assessing the needs of the school and is intended to be used at the beginning of the school year to help guide the SFVSC in developing its goals for the year.

The second survey is for assessing the performance of the SFVSC. It is intended to be used at the end of the school year to help provide information about (1) the performance of the various Science Fair activities that were developed and conducted by the SFVSC and (2) what problems may remain to be addressed.

This appendix also contains some guidance about how to analyze data from these surveys.

SAMPLE Science Fair NEEDS SURVEY

Sample cover letter for the survey:

Dear parent, student, teacher:

This year a group of parents and community volunteers at [insert name of school] have organized a committee whose purpose is to assist in all aspects of the Science Fair. Before this group begins its work, it would like to know your opinion about some of the problems areas in the Science Fair process so that these can be addressed.

Attached is a survey asking for your opinion about the Science Fair process here at [insert name of school]. Your responses are important so that the committee can address the needs of the school community.

Please complete the survey by [insert date] and return to [insert name of responsible individual].

Please also note that the committee would like your help. If you could volunteer your time to help the students at our school, please indicate your interest on the survey. Note that you DO NOT need a science or engineering background to be helpful.

Sincerely

[insert name of SFVSC representative]

Sample Survey of Science Fair Needs at [insert name of school]

1) What is your position at the school?

Admin/teacher parent student

2) Do you believe that the school's Science Fair process needs improvement?

yes no no comment

3) If you answered yes to #2 above, please list the areas of improvement below:

____

____

____

4) The Science Fair support group is planning some workshops to help students/parents learn about the Science Fair and to help students prepare their projects. If you have any ideas about how these workshops should be conducted or other workshops that should be conducted, please explain them below:

____

____

____

5) Please list any other ideas about the Science Fair below:

____

____

____

6) If you can help support the efforts of this support committee, please write your name, address, phone number, background, and occupation below. YOU DO NOT NEED A SCIENCE/ENGINEERING BACKGROUND TO HELP:

____

____

____

SAMPLE SURVEY OF EFFECTIVENESS OF THE SFVSC

Sample cover letter for the survey:

Dear Parent/Student/Teacher/Community Volunteer:

This year a group of parents and teachers at [name of school] initiated a new program to assist in all aspects of the Science Fair including sponsoring workshops, organizing the judging, helping students to develop better projects, and conducting the fair. The group was called the Science Fair Volunteer Support Committee (SFVSC).

The attached survey asks for your opinion about the effectiveness of the SFVSC. Your responses will be used to improve the Science Fair program. Please return the survey to [insert name of individual] by [insert date].

Sincerely,

[Insert name of SFVSC representative]

Science Fair Volunteer Support Committee at [name of school]

Sample Survey of Parents, Students, Teachers, and Community Volunteers

(For each question, please circle your answer.)

1) What is your position at the school?

Admin/teacher   parent   student   community volunteer

2) Did you believe that the school's Science Fair process needed improvement before the SFVSC was initiated?   yes   no   no comment

3) How much did the SFVSC assistance improve the process at the school?
greatly improved   somewhat improved   slightly improved   no change

4) How would you rate the major elements of the SFVSc activities?

Logistics (organizing the fair-gym, forms, prizes, etc.)
excellent   v. good   good   fair   poor   v. poor
comments:

Judging (organizing and conducting the judging)
excellent   v. good   good   fair   poor   v. poor
comments:

Mentoring (organizing and conducting the mentoring (tutoring) of students
excellent   v. good   good   fair   poor   v. poor
comments:

4) How would you rate the effectiveness of these workshops/programs:

Student/parent orientation workshop
excellent   v. good   good   fair   poor   v. poor
comments:

Pre-fair mentoring workshop
excellent   v. good   good   fair   poor   v. poor
comments:

Mentoring Hotline

excellent v. good good fair poor v. poor

comments:

Post-fair mentoring workshop

excellent v. good good fair poor v. poor

comments:

[Insert name of other programs/workshops]

excellent v. good good fair poor v. poor

comments:

5) What improvements are needed to make the SFVSC more effective in meeting your needs?

____

____

____

____

6) Please provide any other comments or suggestions about the Science Fair.

____

____

____

____

A GUIDE TO ANALYZING SURVEY RESULTS

After the surveys are returned, the results should be carefully analyzed. Before any analysis, the surveys should be visually inspected. Surveys that are substantially incomplete (i.e., greater than 75% blank) as well as those that contain profane comments should be removed. The responses on these surveys probably indicate that the respondent is not serious about the Science Fair or the survey.

The next step is to segregate the surveys into four groups, each representing one of the constituents (i.e., administration/teacher, student, parent, community volunteer). Thus the responses of each of the groups can be analyzed separately and compared to the others. This comparison may provide an insight about how the SFVSC has served each of the constituent groups.

The analysis can begin by reviewing the verbal comments from each of the groups. To do this, list all of the comments that are provided. Note how many times a specific comment or comments are repeated. Then rank order the comments with the most frequently repeated one at the top of the list. These are the comments that should be given the most attention.

The other questions, which require a yes/no or multiple choice response, can be quantified by tabulating the responses to each question from each of the constituent groups. The results can be placed in a table. However, in most cases the total number of responses from each of the constituent groups may vary significantly. If the opinions from each of the groups is considered equal, then these totals alone are not very useful. The problem with using the raw totals is that any subsequent numerical analysis of the numbers will be biased in favor of the constituent groups with largest number of responses. Even a visual inspection of the numbers will tend to be biased by the large numbers.

To solve this problem, convert the raw totals for each question to percentages. For example, consider the following total number of responses to a multiple choice question: excellent/outstanding (23 responses), fair/good (39 responses), and poor/unacceptable (11 responses). The corresponding percentages are computed by dividing the totals for each category of responses by the total of all the responses. The result would yield the following percentages: excellent/outstanding (32%), fair/good (53%), and poor/unacceptable (15%). The total percentage should equal 100% for each question. The percentages for each question for each constituent group can be averaged to provide a composite percentage for all the groups of responders. These data can be tabulated and can be used by the SFVSC to identify trends and feelings within the constituent groups as well as overall.

Appendix E: Resource Materials for the SFVSC Logistics Support Activities

EXAMPLE OF A SURVEY AND ANALYSIS FOR SCIENCE FAIR ORIENTATION WORKSHOP

Courtesy of St. Charles Borromeo School

SAMPLE EVALUATION FORM
FOR PARENT/STUDENT ORIENTATION WORKSHOP

In hopes of making improvements, please evaluate the Science Fair Workshop.

I found the information to be (check as many as you feel are appropriate):

_________ Somewhat helpful
_________ Very helpful
_________ Informative
_________ Easy to understand
_________ Well presented
_________ Confusing
_________ Interesting, but not very useful
_________ Other

What additional information would have been helpful?

SUMMARY OF COMPLETED WORKSHOP EVALUATIONS

St. Charles Science Fair Workshop - December 3, 1991

1. 34 responses returned by parents prior to the workshop stating they would attend.

2. 56 families actually attended the workshop.

3. Number of children in the following grades who had a parent(s) attend:

   5th grade - 3
   6th grade - 28
   7th grade - 16
   8th grade - 14

4. 19 evaluation forms returned.

   3 - SOMEWHAT HELPFUL
   14 - VERY HELPFUL
   15 - INFORMATIVE
   9 - EASY TO UNDERSTAND
   12 - WELL PRESENTED
   1 - CONFUSING
   1 - INTERESTING, BUT NOT VERY USEFUL
   3 - OTHER
   7 - Comments

   "It might have been nice to have had a short presentation about the various aspects, i.e. topic selection, scientific or engineering method, presentations, written reports, etc., before going out to the tables. Perhaps that would have stimulated areas of questions that could have been explored more fully at the tables."

   "The presenters were very helpful."

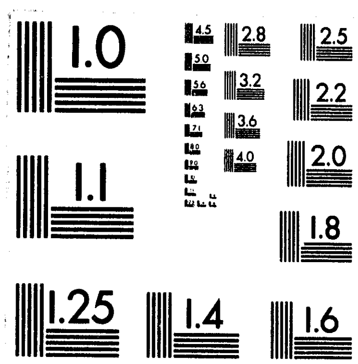
   "Written materials were already gone by the time we got in at 4:30 p.m."

   "There were not enough handouts for all the students who were signed up to participate."

   "Have enough handouts for everyone."

   "You need to assure there are enough handouts for all participants to take home."

   "Needs to be for all grades 1st through 8th."



1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

SAMPLE SFVSC COMMUNICATION

Courtesy of Taylor Middle School

COPIES OF NOTICES OF SCIENCE FAIR EVENTS

Science Fair news for staff:

Students representing Taylor at the Regional Science Fair at UNM on March 19-21 are:

6th Grade: Andreas Garcia, Jonathon Ring, Jill Peterson, Joel Bristol, Kyndra Abeyta, Rebekah Lippis, Eric Pate, Anna Stryker, Lisa Donald, Jeremiah Phillips, Jennifer Webb, Kristina Guist, and Louie Tafoya.

7th Grade: Katherine Brown

8th Grade: Jesse Johnson, Mitzi Brockman, Andrew Hockert, Elyssa Jaeger, Gordon Nelson

Alternates will be Brian Haverly 6th, Katie Easterling 7th, and Kim Krause 6th.

Tonight is an open house and awards ceremony for the science fair. Everyone is invited to attend and view the projects, and to see those students representing Taylor receive their ribbons. Tonight's open house will be from 7 to 8 pm.

Student visits will be scheduled through the science classes on FRIDAY. Special Education teachers please see David Thurlo to arrange times for your students to visit. It is suggested that classes coming to the fair have assignments related to their visit.

Students listed above will need their teacher's permission to remain with their projects Friday to answer questions and protect their work from idle hands. All missed work must be made up.

All students with projects must remove their projects from the gym beginning at 2:40 Friday. If for some reason a teacher doesn't want to release a student, please have the student designate someone else to remove the project at that time.

Thanks for your continued cooperation and support of the science fair.

--- REMINDER --- REMINDER --- REMINDER ---

The Taylor Middle School SCIENCE FAIR WORKSHOP will take place on Thursday, December 12, 1991 in the school cafeteria from 3:15 to 6:15pm.

Valuable information and handouts will be available to help your and your child/children prepare an outstanding project.

Science Fair backboards will also be available for purchase for $6.50 each. (Price reductions may be available for disadvantaged families. Contact: Jan Lewis for details at 898-7419.

--- REMINDER --- REMINDER --- REMINDER ---

The Taylor Middle School SCIENCE FAIR MENTOR WORKSHOP will take place on Thursday, January 16, 1991 in the school cafeteria from 3:15 to 5:30pm.

Technical professionals will be on hand to answer questions about student's projects and to suggest how the student's project can be improved.

PROMOTIONAL JINGLES

MON.

BRING YOUR FOLKS AND START OUT RIGHT,
AT TAYLOR SCHOOL ON THURSDAY NIGHT.
A WORKSHOP FOR THE SCIENCE FAIR,
DROP ON IN WE'LL, SEE YOU THERE!

TUES.

PARENTS AND STUDENTS THAT'S THE SCHEME,
AT TAYLOR'S WORKSHOP WE'RE A TEAM.
WE WILL HELP TO GET YOU THERE,
YOU'LL MAKE IT BIG AT THE SCIENCE FAIR!

WED.

EXTRA CREDIT'S WHAT YOU'LL GET,
REMIND YOUR PARENTS AND YOU'RE ALL SET;
TO GET TO WORK FOR THE SCIENCE FAIR.
BRING YOUR IDEAS, WE'LL SEE YOU THERE!

THURS.

PICK A PROJECT AND FIND OUT HOW,
FOR SCIENCE FAIR THE WORK STARTS NOW!

SCIENCE FAIR WORKSHOP IN THE CAFETERIA THURS. DEC. 12
PARENTS AND STUDENTS CAN DROP IN AND LEAVE AT ANYTIME
DURING THE WORKSHOP HOURS OF 3:15 TO 6:15 PM.

Sample workshop notice sent home to parents

S C I E N C E   F A I R   N E W S   B U L L E T I N

To: All Science Fair Students and Parents

From: Science Fair Volunteer Support Committee
Our first major event of the year will occur on [insert day, time, and date]. The Science Fair Volunteer Support Committee will sponsor a Science and Engineering Fair Workshop for parents and students. The workshop will help explain the important elements of the fair including the important dates, how to select a project, how to apply the scientific and engineering methods, how to prepare the backboard display, how to write abstracts and reports, and how to prepare for judging.

The workshop begins at [insert time] and ends at [insert time]. There will be some brief introductory comments from [insert name of speaker] from about [insert time] to about [insert time]. The remaining time will be open for parents and students to browse through the information stations and pick up free materials and guidebooks. Parents and students are free to arrive or leave the workshop at any time between [insert time] and [insert time].

Again, the workshop is on [insert day, time, and date] starting at [insert time].

We're looking forward to seeing you there. Thanks.

Sincerely,

[insert name of SFVSC representative]

SAMPLE MATERIALS USED BY SFVSC TO ORGANIZE SCIENCE FAIR

SCHEDULE OF SCIENCE FAIR ACTIVITIES

A. Set Up Time / Place / Date
Judges — Pre

1. Find judges
2. Type form letter
3. Xerox form letter
4. Head letter
5. Develop Judge Info Packet
   (a) Agenda
   (b) Survey
   (c) Judging criteria
6. Type and put Judge Info Packets together
7. Xerox all Judge Info Packets
8. Fold all materials
   (a) Invitation letter
   (b) Agenda
   (c) Survey
   (d) Judging criteria
9. Address envelopes
10. Stuff envelopes
11. Mail envelopes
12. Keep track of returned forms
13. Send Thank-You notes
   (a) Buy cards
   (b) Write on cards
   (c) Mail cards

B. Judging
1. Sign-in sheet
2. Coffee, donuts, juice in morning and throughout
3. Judge packets
   (a) Map of project locations
   (b) List of projects to be judged
   (c) List of judging criteria
   (d) Tally sheet
   (e) Clipboards and pencils
4. Luncheon $
   (a) Food
   (b) Drinks
   (c) Paper goods
   (d) Setup
   (e) Cleanup

5. Have students ready to be runners
6. Have paper and pencil (or form) for students to get needed students
7. Tally the tally sheets
   (a) List all winners 1 — 5 by student's name
8. Place ribbons on projects

C. Teacher Information
1. Let teachers know about Time / Place / Date
2. Workshop for Scientific Method
3. Binders for Science Fair / Invention info
4. Forms for teacher to return
   (a) Category Count
      (1) Typed
      (2) Xeroxed
      (3) Delivered
      (4) * Returned and tallied
   (b) Students'Entry Form
      (1) Typed
      (2) Xeroxed
      (3) Delivered
      (4) * Used to set up and find students
5. Awards
   (a) Awards — participation certificates
      (1) Xeroxed
      (2) Delivered
   (b) Extra participation ribbons
      (1) Ordered
      (2) Delivered
   (c) Ribbons
      (1) Ordered
      (2) Picked up
      (3) Placed on projects

D. Other Jobs
1. Gather tables
2. Set up tables
3. Set up category signs
4. Pin up signs
5. Set up Projects in correct category
6. Number each project
   (a) Make number cards
   (b) Place cards on projects and premark
7. Monitor students in area
8. Set up schedules for
   (a) Setup
   (b) Judging

(c) Parent viewing
(d) Students and faculty viewing

9. Gather judge score sheets
10. Record points
11. Record regional considerations
12. Distribute ribbons
13. Set up for parent viewing
    (a) Coffee, cookies, etc.
    (b) Present awards (must have master list)
    (c) Print, xerox fliers and deliver
14. Clean up after awards
15. Distribute blue ribbons
16. Distribute lost ribbons
17. Prepare list of winners for
    (a) Announcements
    (b) Newsletter
18. Gather need clipboards
19. Return need clipboards
20. Ask for table (from teachers)
21. Gather tables (from teachers)
22. Set up tables
23. Return tables
24. Buy
    (a) Name tags
    (b) Food / drinks / paper goods
    (c) Pins
    (d) Color-coded dots
25. Prepare packets for regionals
    (a) Form — students general information
    (b) Form — abstract
    (c) Letter of acceptance
    (d) Complete all information
    (e) Mail all information
26. Decide who goes to regionals
27. Set up mentors — teachers — students
28. Get projects to regionals
29. Set up deadline schedules

This form will give me an idea as to how many tables will be needed per category, and how many total entrants there are.

SURVEY OF PROJECTS

Teachers, please mark down the total number of projects in each category. Return to Rhonda by Friday December 6, by noon. Thanks.

INVENTION CATEGORIES

Number of

_________ 1. Machinery

_________ 2. Personal Hygiene

_________ 3. Toys

_________ 4. Clothing

_________ 5. Travel — Recreation
Transportation

_________ 6. Office / School Supplies

_________ 7. Solar

_________ 8. Music

_________ 9. Household Projects

_________ 10. Pets

_________ 11. Plants

_________ 12. Medicine

_________ 13. Entertainment

_________ 14. Lens

_________ 15. Architecture

_________ 16. ? _________

_________ 17. ? _________

_________ * Total

SCIENCE FAIR CATEGORIES

Number of

_________ (1) Behavioral and Social Sciences

_________ (2) Biochemistry

_________ (3) Botany

_________ (4) Chemistry

_________ (5) Computer Science

_________ (6) Earth and Space Sciences

_________ (7) Engineering

_________ (8) Environmental Sciences

_________ (9) Mathematics

_________ (10) Medicine and Health

_________ (11) Microbiology

_________ (12) Physics

_________ (13) Zoology

* Total

Teacher's Name _________________

Prep Period _________________

Room No. _________________

Total Number of Inventions _________________

Total Number of Science Projects _________________

This form will give me a count of how many Quality projects need to be judged. It will also be a record for possible Regional Qualifiers. Last, but not least, the categories will be matched up with judges with that expertise.

SURVEY OF TEACHER'S LIST OF PROJECTS TO BE JUDGED

THE BEST SCIENCE FAIR ENTRANTS
(to be premarked for judges).

Teacher's Name ______________________
Room Number ______________________
Prep ______________________

*Please return to Rhonda by Friday, December 6.

Student's Name	Category	Title of Project
1)		
2)		
3)		
4)		
5)		
6)		
7)		
8)		
9)		
10)		
11)		
12)		
13)		
14)		
15)		

This form will be posted behind each project (top right side). A class schedule is needed so that the judges can talk to students if they need to.

INFORMATION TAG FOR EACH PROJECT

*Please xerox as many of these as you need for your classes.

NAME: ______________________________

CATEGORY: ______________________________

PROJECT TITLE: ______________________________

CLASS SCHEDULE

CLASS	ROOM NUMBER
1)	
2)	
3)	
4)	
5)	
6)	
7)	

Grade: 6, 7, 8

SAMPLE CONSENT AND ENTRY FORMS

SAMPLE PARENTS' CONSENT FORM

Project Title ____________________

Student Name ____________________

TO HAVE YOUR ENTRY ACCEPTED FOR THE [insert name of school] SCIENCE AND ENGINEERING FAIR, THE FOLLOWING STATEMENTS MUST BE SIGNED.

A. The project described above, which I propose to enter in the Science Fair, is my own work and has been completed by me according to the rules of the science fair.

B. I understand that although [insert name of school] will take all reasonable precautions to safeguard my project, the project is entered at my own risk and [insert name of school] is not responsible for loss or damage to my project or any of its parts.

C. I agree to leave my project in place until [insert date] and to remove it by no later than [insert time] on [insert date]. If it is not removed by the designated time, I authorize that it be disposed of properly.

____

Signature of Student

My son, daughter, or ward whose name appears at the top of this form and who has signed the statement above has my permission to participate in the [insert name of school] Science and Engineering Fair in accordance with its rules and regulations.

____

(date)

____

Signature of Parent of Guardian

Note: This form was adapted from that found in The Complete Science Fair Handbook, published by Scott, Foresman and Company.

SAMPLE SCIENCE AND ENGINEERING FAIR STUDENT ENTRY FORM

To be returned before:____

Student Exhibitor Information
(please print or type)

Name:____
Last First

Age:________ Grade:________ Homeroom:___________

School:____

Home Address:

____

____

Telephone:____

Suggested Classification of Project (Check one category):

___Biochemistry
___Botany
___Chemistry
___Computer Science
___Earth and Space Science
___Engineering
___Environmental Sciences
___Mathematics
___Medicine and Health
___Microbiology
___Physics
___Zoology
___Other:

Note: This form was adapted from that found in The Complete Science Fair Handbook, published by Scott, Foresman and Company. Copyright 1990 Anthony D. Fredericks and Isaac Asimov.

Student Project Information

Title of project:____

Brief description of project:

____

____

____

____

____

____

____

Electrical outlet required: ___ Yes ___ No

Display table required: ___ Yes ___ No

Special setup or arrangements required: ___ Yes ___ No
(If yes, please describe):

____

____

____

____

____

____

____

Appendix F: Resource Materials for the SFVSC Judging Activities

COPIES OF SFVSC MATERIALS RELATING TO JUDGING

Courtesy of Taylor Middle School

GUIDELINES FOR JUDGE INTERVIEWS

The interview is perhaps the most educational aspect of the science fair. Purposes of the interview are: to stimulate the student's thinking; to suggest means of improving his work (and working habits); to point out mistakes; to open up a feedback channel from the judge (who is most likely a specialist in a given field) to the advising teacher (and thus indirectly to contribute to an improvement of science education). It may also be an illuminating experience for the judge himself.

Typical questions for judges:

How well does the student know and understand the basic principles behind his project?

Where, or from whom, did he get the idea for his exhibit?

Does he understand the significance of his conclusions?

Do the conclusions follow from his work?

In undertaking the project, did he have a clear purpose in mind, and one that was within his means?

How much time did he spend on the project, and when did he start it?

Does he understand how his apparatus works?

How much help did he have in building it? (Remember, getting help is <u>not</u> a negative point)

What was the source and cost of parts?

Did he write his report himself?

Did he collect and study supplementary references?

Note: Work with the student to make sure you understand what the student really knows about his/her project.

If answers to questions like these are satisfactory, the student has succeeded.

Project # ____________

TAYLOR MIDDLE SCHOOL SCIENCE FAIR
JUDGES' RATING SHEET

Project Title ____

Numerical Ratings

Category / Rating	Unsatis-factory (2)	Poor (4)	Average (6)	Good (8)	Excellent (10)	Weighting Factor	Total Score
Creative Ability	_____	_____	_____	_____	_____	x 3 =	_____
Scientific Thought/ Engineering Goals	_____	_____	_____	_____	_____	x 3 =	_____
Thoroughness	_____	_____	_____	_____	_____	x 1.5 =	_____
Clarity and Dramatic Value	_____	_____	_____	_____	_____	x 1.5 =	_____
Technical Skill	_____	_____	_____	_____	_____	x 1.0 =	_____
Total Score							_____

==

Comments

Creative Ability ____

____

____

Scientific Thought / Engineering Goals ____

____

____

Thoroughness ____

____

____

Clarity and Dramatic Value ____

____

____

Technical Skill ____

____

____

Judging Team ____

____

Project # ____________

TAYLOR MIDDLE SCHOOL SCIENCE FAIR — JUDGES' ENLISTMENT

Times Needed: **7 pm Thursday, February 13 — Training Session**
___ pm (exact hours TBD) Tuesday, February 18
___ pm (exact hours TBD) Wednesday, February 19

NAME	BACKGROUND	EXPERIENCED? (YES/NO)	TELEPHONE NUMBER
Grant Bloom	Sandia Labs		
* Bob Clark	Sandia Labs	Yes	844-6332
Rudy Jungst	Sandia Labs	Yes	844-1103
Garth Corey	Sandia Labs	Yes	845-4596
Wendy Cieslak	Sandia Labs	Yes	844-8633
Paul Butler	Sandia Labs	Yes	844-7874
Ron Guidotti	Sandia Labs	Yes	846-1678
Troy Cowan	DoD		255-6101
Patty Mansker	Sandia Labs	No	844-9113
Bill Schaedla	Sandia Labs	No	845-8528
John Hockert	Physicist	No	881-9228
Al Jacobson	Sandia labs	Yes	844-8462
Dave Tapscott	Sandia Labs		844-8017

February 4, 1992

MEMO TO: Prospective Taylor Middle School Science Fair Judges

FROM: Dave Ring, Member, TMS Science Fair Committee

SUBJECT: JUDGING MANUAL, SCORING SHEETS, DATES, TIMES, ETC.

This memo is intended for all persons who have agreed to serve, following recruitment by myself or others, as judges at the Taylor Middle School Science Fair, Feb. 18-19, 1992. IF YOU RECEIVE THIS NOTE AND YOUR PLANS HAVE CHANGED IN THIS REGARD, PLEASE CALL ME A.S.A.P. AT 898-1327 TO SO INDICATE.

The judging manual and sample scoring sheet you are receiving with this note are, I hope, largely self-explanatory. Please be reminded that, for those who need and/or wish to receive training as science fair judges, this training session will be led by Mr. Ron Guidotti of Sandia Laboratories, an experienced NM State Science Fair judge, at Taylor Middle School, in the Library, on Thursday evening, February 13th, beginning at 7:00 PM.

There will be three "rounds" of science project judging during Feb. 18-19 at Taylor Middle School. The first will be held during the school day on Tuesday, Feb. 18, and will be conducted by Taylor faculty and Honeywell Corp. personnel recruited by Mr. David Thurlo. The second will be held Tuesday afternoon-evening, Feb. 18, from 4 to 8 PM, conducted by Sandia Labs personnel and other individuals recruited by myself and by Kiwanis Club members recruited by Col. Miller. All judges will use the same scoring sheet, and will do numeric scoring with no students present. We will try to form the judges into "teams" of 3 or 4 and ask each team to evaluate 15 to 20 projects. A snack supper will be served to judges ("on the run") sometime during the afternoon-evening session ("snack supper" also available on Wed.)

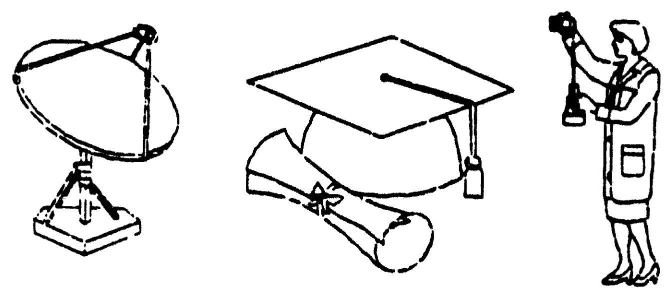
After Tuesday's two "qualifying" rounds, Mr. Thurlo and myself will add up the numeric scores and thereby determine the "top 40-plus" projects. Those students will be contacted and asked to be available, with their projects, for interviews on Wednesday, Feb. 19th, during the 4 to 8 PM time period. The afternoon-evening judges from the prior day, i. e., those from Sandia, Kiwanis, and a few additional individuals, will conduct a third round of judging, including interviews, of these students and their projects. Of course, judging "teams" will be switched, so that a team which evaluated a given project on Tuesday will not do that same project on Wednesday. The same scoring sheets will be used for this "final" round of judging, and Mr. Thurlo and myself will use these scores, in combination with the prior two scores, to determine the "top 18" projects, and a few alternates, that will be invited to compete at the regional level. (It may be that one or two students who qualify for the Wednesday round of judging cannot stay after school on Wednesday for interviews. If so, Mr. Thurlo will see to it that 3 or 4 Taylor faculty members conduct a team interview with those students during the school day in order to produce a third-round score.)

If anyone has questions, the best opportunity to raise such will be at the training session on Thursday evening, Feb. 13th. If you can't make that session and have an important question, please call me. I want to thank you, in advance, for your willingness to serve Taylor Middle School in this way.

--Dave Ring

JUDGING GUIDE

TAYLOR MIDDLE SCHOOL SCIENCE FAIR



Albuquerque, New Mexico

CONTENTS

Introduction

The success or failure of any science fair depends to a large extent upon the quality of the judging. Therefore, it is vitally important for each judge to understand the duties and obligations of judging and the standards by which Taylor Middle School science fair projects are to be judged. This guide outlines these duties, obligations, and standards. Your first duty as a science fair judge is to read this guide carefully in preparation for the judging. If you have any questions or concerns about any aspect of these guidelines, it is your duty to raise question or concern at the orientation for judges prior to the judging session.

The Taylor Middle School Science Fair is a competition based upon the quality of projects done by the students, the results of which are presented through exhibits at the fair. The objectives of the Taylor Middle School Science Fair are fourfold: (1) to stimulate an active interest in science and engineering among the students; (2) to provide students with a non-traditional educational experience through the preparation, exhibition, and evaluation of their projects; (3) to give public recognition to the students for work that they have done; and (4) to provide a equitable method of selecting student science fair projects to represent Taylor Middle School at the regional and state science fairs. As a science fair judge, your efforts make a significant contribution to the achievement of each of these objectives of our science fair. The purpose of this guide is to assist you in helping the Taylor Middle School Science Fair achieve its objectives.

The subsequent sections of this guide describe the general judging process, the judging criteria, and the recording of rating information. Details concerning the layout of this year's science fair, judging schedules, and other administrative information are provided in a separate document.

General Judging Process

The general judging process consists of: (1) judges' orientation session, (2) prejudging activities; (3) survey of the entire science fair; (4) survey of the exhibits to be judged by your team; (5) examination of the exhibits to be judged by your team; and (6) interviews. Each of these parts of the judging process is described below.

Judges' orientation session: This session includes a review of this judging guide, a presentation of the layout of the exhibits and any judges' areas, a trial workshop in which several example exhibits are judged using this guide, and an opportunity for the judges to ask questions and to resolve any concerns related to the judging process. The purpose of this orientation session is to help ensure that the judging of exhibits is consistent and fair. In addition to reminding the judges of the process and criteria to be used for judging, this orientation is intended to help the judges to interpret and to apply the judging criteria in a consistent manner. All judges must attend the orientation session in order to be permitted to serve as science fair judges.

Prejudging activities: These activities include the assignment of judges to teams, the determination of which exhibits each team will judge, and any other administrative activities that must be accomplished prior to the start of the judging. The judging of exhibits is conducted by teams of at least two judges, depending upon the availability of judges and the number of exhibits. Judges are grouped into these teams based upon their technical backgrounds and interests and upon the types of exhibits to be judged. Because it is physically impossible for each judging team to evaluate all of the projects, teams are assigned to evaluate specific projects. These assignments are made based upon the technical background and interests of the team members, with appropriate adjustments to equalize the workloads of the judging teams. The objective of the assignments of individuals to judging teams and of the selection of the exhibits to be judged by each team is to ensure that at least one team member has a technical background in the areas relevant to each project judged by the team. During these activities, judges will also be informed of which, if any, students the team will be interviewing as a part of the judging activities.

<u>Survey of the entire fair</u>: (No students present at exhibits.) The purpose of this survey is to gain an understanding of the general trend of the exhibits and to make an estimate of the quality of the projects/exhibits in those areas other than those that you are judging. There are a large number of exhibits so judges should plan their time carefully so that they will be able to examine a reasonable number of the exhibits in the areas judged by others. It is vital that each judge have an understanding of the overall caliber of the projects so that the judging teams can make a consistent evaluation of the quality of each project in the context of the entire science fair.

<u>Survey of exhibits to be judged by your team</u>: (No students present at exhibits.) The purpose of this survey is to make a general estimate of the quality of the projects/exhibits that your team will be judging so that you

will have a frame of reference to decide what is good quality and what is lesser quality. Remember that you are judging on a relative basis rather than an absolute basis. You are comparing projects with each other and not with the work of high school or college students or professional scientists. It is also important to establish your final standards of quality during this survey to ensure that the projects that you evaluate first are judged on the same basis as those that you evaluate later.

<u>Examination of exhibits to be judged by your team</u>: (No students present at exhibits.) The purpose of this examination is to make a detailed evaluation of the overall quality of the project/exhibit against the judging standards. During this time you should: (1) study the exhibit; (2) discuss your conclusions about its quality with the other member(s) of your judging team; (3) make notes on the types of questions that you want to ask during the interview; and (4) assign a quality rating to the project against each of the judging criteria. If your team is assigned to conduct an interview as aprt of the judging process, then this quality rating is a preliminary rating and should be revised based upon the interview. If your team will not be conducting an interview then this is the final rating to be assigned to the project. (See te guide section entitled, *Recording of Rating Information*, for instructions on completing your judge's rating sheet.)

You will be assisted by the fact that the exhibits are substantially self-explanatory, and that there will also be an abstract that describes the project. However, during this stage of the judging you should be alert to the possibility that what appears to be a poor quality exhibit may be a poor presentation of a high quality project. It is certainly appropriate to down grade such exhibits in the area of presentation. Nevertheless, the judge should make an effort to look beyond the exhibit (making particular use of the interview, if one is to be conducted) to try ascertain the true quality of the project.

This period also provides an opportunity for a judging team that does not feel that they have, in aggregate, sufficient technical background to evaluate a specific project, to bring this concern to the attention of the Science Fair Director. Some projects may require interdisciplinary judging (e.g., a botany project that uses a lot of mathematics). If you feel that a team with experience in another technical discipline also needs to judge one of the projects assigned to your team, you should notify the Science Fair Director.

Depending upon the availability of judges and the number of science fair projects, it may not be possible to have the judging of each project include an interview or to have all judging teams conduct interviews. If your judging team will not be conducting interviews, skip ahead to the judging criteria.

Interviews: One purpose of the interview is to determine how well the student understands his or her project and to evaluate the quality of the project from a perspective independent of the quality of its presentation in the exhibit. During this time, you should determine the final quality rating that you believe should be assigned to the project in each of the judging criteria.

However, the interview also provides you with an opportunity to stimulate students' interest in science and engineering. In many cases you may be one of the few professional scientists or engineers that the student has ever met. He or she may reach conclusions about the desirability of working in a science or engineering

profession based upon this interview with you. Therefore, the interview is important not only to the judging process but also to the achievement of the overall science fair objectives.

Each interview should last for 10 to 15 minutes. Judges are encouraged to talk to each student as much as possible, but with one limitation -- it should not be at the expense of other students. A judge should ask the questions necessary for the purpose of judging, but should not take spend time just talking if it means that there will not be sufficient time to interview other students.

No student whom you have been assigned to interview should be passed over regardless of what you think of his or her exhibit. Judging is an educational process as well as a selection process and so a student should be given as much time as possible. Students will appreciate your suggestions on how to improve their research. In addition to suggesting improvements, it is important that you let the student know what he or she has done well in preparing the project. Remember that each exhibit, no matter what you think of its quality, represents a commendable effort on the student's part. You try to find at least one thing good to say to each student about his or her work.

Remember, do not fill out your judges' rating sheet, or discuss the assignment of ratings with your team, in front of the students. All rating sheets must be turned in to the Science Fair Director prior to leaving.

When interviewing, judges should remember that the Taylor Middle school Science Fair is not only a competition -- it is also an educational and a motivational experience. Most students say that they enjoy talking to

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the judges, and that in many cases, it is the high point of their experience in the Science Fair. As a general rule the judge represents professional authority to the student being evaluated. Therefore, it is imperative that judges conduct themselves in an appropriate, professional manner. In all instances judges should ask questions, offer suggestions, or proved constructive criticism in a way that encourages continued effort. Judges must never tear down, treat lightly, or display boredom toward projects that they personally consider to be unimportant. Always recognize that the student has made an effort to prepare and present the project and that the project has been judged to merit an interview.

Judging Criteria

What Are We Judging?

We are judging the following:

- The quality of the work done on a project in science, engineering, or mathematics by a middle school student, and how well that student understands the project and the area in which he or she has been working. The quality of the physical display (exhibit) is of secondary importance.

- A project that involves some thought and effort over and above library research or gadgeteering.

- A middle school student's work -- not that of a high school or college student or a professional. Sometimes judges overreact to middle school students, either giving them far more credit than they deserve or acting as though the work done by the student is worthless because it is not top quality original research.

- A project as compared with other projects at the Taylor Middle School Science Fair, and not with projects seen elsewhere under other circumstances.

Criteria

Projects are judged on the following basis:

Creative Ability	30 points
Scientific Thought/Engineering Goals	30 points
Thoroughness	15 points
Clarity and Dramatic Value	15 points
Technical Skill	10 points

Creative Ability (30 points)

1. Does the project show creative ability and originality in:
   - the question asked?
   - the approach to solving the problem?
   - the analysis of data?
   - the interpretation of data?
   - the use of equipment?
   - the construction or design of new equipment?

Obviously no project will be creative and original in all of these aspects and, in addition, it is necessary to keep in mind that these are middle school students' projects. Thus, it necessary to determine whether the project is creative for a middle school student as opposed to what would be expected from a professional scientist or engineer.

A student should not be penalized for asking for and getting help from others (all professionals receive help in some way). However, credit for creative ability and originality should be based upon the student's contribution rather than upon the help given by others. For example, did the student get an idea for the project from a textbook suggestion for research or did he or she develop the idea as a result of independent reading or other work? If the student developed the idea alone, it should be considered more creative. Making this type of determination can be difficult. There have been projects that contained elements that judges thought were original, but that actually came from textbooks or laboratory materials in school curricula, with which the judges were unfamiliar. Judges should keep this possibility in mind and use the interview portion of the judging to help determine the actual level of creativity demonstrated.

Another source of possible help that needs to be evaluated is the student's teachers, parents, or other adult mentors. The approach that a student uses to solve a problem amy appear to be very original. However, this original approach may have come from suggestions made by a teacher, parent, or other adult. Thus the idea is original but it is not totally the student's. Such an idea must be compared with a less sophisticated approach that came completely from the student's own work or

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thinking. Obviously, the latter should be considered more creative.

2. Collections cannot be considered to be creative unless they are used to support an investigation or help to answer a question in some original way. Likewise, construction of equipment from a commercially available kit cannot be considered to be creative unless some unusual approach or design is employed.

3. For engineering, a clear distinction should be made between gadgeteering and a genuine contribution. A "Rube Goldberg" device may be ingenious but if is not really: (1) the most efficient way to solve the problem; (2) acceptable to potential users; or (3) reliable in its functioning, then it cannot really be considered to be a valuable creative contribution.

As a general rule, the scoring in this area should be "normalized" so that a project of average quality for the science fair receives a score of 18 points. (See the section of this guide entitled, "Recording of Rating Information.)

<u>Scientific Thought/Engineering Goals (30 Points)</u>

<u>Scientific Thought</u>:

1. Is the problem stated clearly and unambiguously?

2. Was the scope of the problem limited to a sufficient extent that it could be solved within the

context of a science fair project? One of the characteristics of good scientists is the ability to identify important problems that can be solved. Merely working on a difficult problem without making progress in solving it does not make much of a contribution. On the other hand, neither does solving a very simple problem.

3. Was there a procedural plan to obtain a solution to the problem?

4. Have all of the variables been clearly recognized, defined, and controlled, if such controls were required to solve the problem?

5. If controls were necessary, was this need recognized and were the controls correctly used?

6. Were adequate data collected to support the conclusion?

7. Have the limitations of the data been recognized?

8. Overall, does the project demonstrate an understanding of the scientific method?

9. Does the student understand the relationship of this project to other associated research?

10. Does the student have an idea of what further research is indicated?

11. Did the student cite scientific literature, or cite only popular literature (e.g., local newspaper, Readers Digest, or magazines)?

Again, it is important to recognize that the participants in the science fair are middle school students and that both the scientific method and the techniques used by professional scientists and engineers are likely to be new to them. It is also important to note once more that the student may have received assistance and that it is an important part of the judging to estimate the extent of this assistance and to evaluate the contribution that it made to the project.

Engineering Goals:

1. Does the project have a clear objective?

2. Is this objective relevant to a practical problem? That is, does it meet, or help meet, the needs of a potential user?

3. Is the solution

   - workable? Unworkable solutions may be interesting but are of no value in practice.

   - acceptable to the potential user? Solutions that will be rejected or ignored are of no practical value?

   - economically feasible? A solution that is so expensive that it cannot be used is of no practical value?

4. Can the solution be successfully employed in the design or construction of some useful end product?

5. Does the solution represent a significant improvement over previous alternative solutions?

6. Has the solution been tested to see whether it will actually perform under intended use conditions? (This will be difficult for many students, but it should have been considered. If no testing has been done, does the student have any idea how such testing could be practically accomplished?)

As a general rule, the scoring in the area of scientific thought/ engineering goals should be "normalized" so that a project of average quality for the science fair receives a score of 18 points. (See the section of this guide entitled, "Recording of Rating Information.)

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Thoroughness (15 Points)

1. Is the project complete within the scope of the purpose originally established?

2. How completely has the project covered the stated problem?

3. Are the conclusions based upon a single experiment or on several replications of the experiment?

4. If notes are appropriate for this type of project, how complete are they?

5. Is the student aware of other approaches or theories related to solving the stated problem?

6. How much time was spent on the project?

7. Was the project well planned?

8. Has the student thoroughly reviewed and become familiar with the scientific or technical literature related to the project? Although citations are not considered to be as important in engineering as in science, the student should have made an effort to determine how problems similar to his or her problem are being, or have been, solved.

Again, it is important to recognize that the participants in the science fair are middle school students and will not have the familiarity with either the scientific and technical literature or the techniques used by professional scientists and engineers. It is also important to note once more that the student may have received assistance and that it is an important part of the judging to estimate the extent of this assistance and to evaluate the contribution that it made to the thoroughness of the project.

As a general rule, the scoring in this area should be "normalized" so that a project of average quality for the science fair receives a score of 9 points. (See the section of this guide entitled, "Recording of Rating Information.)

Clarity and Dramatic Value (15 Points)

1. How clearly is the student able to discuss the project? Can he or she explain its purpose, procedure, and conclusions in a clear and concise

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manner? Discount superficial glibness but try to make allowance for the nervousness that may be natural in talking to an authority. Watch out for instances in which students have memorized speeches that they don't really understand.

2. Does the written and graphical material clearly and dramatically present the project? Remember that the student may have had help in preparing this material. Try to estimate the extent of this assistance and to evaluate the contribution that it made to the clarity and dramatic value of the exhibit.

3. Are the important phases of the project presented in an orderly manner?

4. How clear is the presentation of the data and the procedure employed to obtain them?

5. How clear is the presentation of results?

6. How well does the exhibit present itself?

7. Is the exhibit visually attractive? Does it draw and hold your interest?

8. Is the presentation made in forthright manner, without cute tricks or gadgets?

9. Was all of the work done by the student or was assistance obtained from parents, teachers, or others?

As a general rule, the scoring in the area of clarity and dramatic value should be "normalized" so that a

project of average quality for the science fair receives a score of 9 points. (See the section of this guide entitled, "Recording of Rating Information.)

Technical Skill (10 Points)

1. How high a level of technical skill was required to accomplish the project (e.g., laboratory skill, computational skill, observational skill, design skill)?

2. Does the student appear, based upon the interview, to know or have learned all of the skills required to accomplish the project?

3. Where was the project done? Home? School Laboratory? University or other laboratory facility? What assistance was received from parents, teachers, scientists, or engineers?

4. Was the project carried out under the supervision of an adult or did the student work largely on his or her own?

5. How was any specialized equipment obtained? Was it built independently by the student? Was it obtained on loan? Was it part of a laboratory in which the student worked?

As a general rule, the scoring in the area of clarity and dramatic value should be "normalized" so that a project of average quality for the science fair receives a score of 6 points. (See the section of this guide entitled, "Recording of Rating Information.)

Recording of Rating Information

Each judging team is to record their evaluation of each project on the "Taylor Middle School Science Fair Judge's Rating Sheet," copies of which will be provided. The rating sheet is divided into two sections by a dashed line. The upper section, upon which the numerical scores are recorded, will not be provided to the students. The lower section, upon which the judges' comments and suggestions are recorded will be provided to the students to help them do better in future projects. The instructions for completing the rating sheet are as follow:

Record the number and title of the project being rated, as the number and title appear on the exhibit in the blanks labeled, "project number" and "project title" on the upper and lower sections of the rating sheet.

Record the numerical scores corresponding to the ratings in each of the judging categories in the portion of the upper section of the form labeled "numerical ratings." In order to record the numerical score for a particular category, rate the overall quality of the project in that category as: (1) unsatisfactory; (2) poor; (3) average; (4) good; or (5) excellent.

- If the project is unsatisfactory, record a 2 on the line in the "unsatisfactory" column in the row corresponding to the category that you are evaluating.
- If the project is poor, record a 4 on the line in the "poor" column in the row corresponding to the category that you are evaluating.

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- If the project is average, record a 6 on the line in the "average" column in the row corresponding to the category that you are evaluating.
- If the project is good, record an 8 on the line in the "good" column in the row corresponding to the category that you are evaluating.
- If the project is excellent, record a 10 on the line in the "excellent" column in the row corresponding to the category that you are evaluating.

If your team determines that the proper rating for a project is intermediate between two of the established ratings, record the average of the numbers corresponding to the two ratings on the line in the column corresponding to the higher rating. For example, if your team determines that a project is good to excellent in the area of creative ability, record a 9 in the line under the heading "excellent" on the row labeled "creative ability."

Compute the total score for a category by multiplying the number that you recorded in the column corresponding to the rating by the number in the weighting factor column and enter the result on the line in the total score column.

For example, if you rated a project as average in creative ability, then you would record a 6 in the "average" column in the "creative ability" row. The weighting factor for the "creative ability" row is 3. Therefore, you would multiply the 6 by 3 to get 18, which you would enter in the "total score" column in the "creative ability" row.

Compute the total score for the project by summing the entries in the "total score" column in all of the rows.

In addition to recording the numerical scores for each category, your team should also record, in the comments portion of the lower section of the form, a brief explanation of the bases for the numerical ratings. You may also include suggestions for further research or for other enhancement of the project in the comments section.

Finally, record your names in the blanks labeled "judging team" at the bottom of the upper and lower sections of the form.

INFORMATION REGARDING JUDGING

Courtesy of Washington Middle School

JUDGE'S INFORMATION FORM

NAME ______________________ PHONE NUMBER ____________

HOME
ADDRESS ______________________ ZIP CODE ____________

COMPANY NAME ______________________

POSITION ______________________

COMPANY ADDRESS ______________________

COMPANY TELEPHONE NUMBER ______________________

EDUCATION (circle one): B.A. B.S. M.A. M.S. Ph.D.

MAJOR: ______________________

Please check one or more of the following:

____ I would like to be a judge at the Science Fair at Washington Middle School.

____ I am interested in being a mentor and/or tutor at Washington Middle School.

____ I am unable to be a judge at this time, please keep my name and phone number available for other forms of participating with Washington Middle School.

____ On behalf of myself or my company, I would like to present the following award(s):

Name of Award ______________________
Criteria for selection:

Form of Award: Plaque ____ Certificate ____
Cash Award (specify amount) ____________
Other ______________________

PLEASE RETURN TO:
Rhonda Sandoval, Science Dept. (505) 764-2000
Washington Middle School
1101 Park Avenue, S.W.
Albuquerque, N.M. 87102-2967

ALBUQUERQUE PUBLIC SCHOOLS
WASHINGTON MIDDLE SCHOOL
1101 PARK AVENUE, S.W.
ALBUQUERQUE, NEW MEXICO 87102-2967

DR. JACK BOBROFF
SUPERINTENDENT

JOSEPH M. VIGIL
PRINCIPAL
(505) 764-2000

November 12, 1991

Mr. David Menicucci

Dear Mr. Menicucci:

Washington Middle School is having it's Science Fair.

We would like to ask you to participate as one of our judges. The Science Fair is scheduled for Wednesday, December 11, 1991, and judging will begin at 8:00 A.M. and end at 1:00 P.M. However, we would also like to invite to you join us for lunch.

Enclosed is a "Judge's Information Form", which we would ask that you complete and return. Perhaps you are unavailable at this time, but are interested in helping in other activities, such as tutoring or mentoring--we would welcome your help.

If you would like to be a judge on Wednesday, December 11, please contact Mrs. Lynn Hightower at 247-3009.

Sincerely,

Rhonda Sandoval
Department Head for Science

/tvn
Enclosure

JUDGES SCORE SHEET

JUDGES NAME____________________

PROJECT #__________

CATEGORY____________________

TITLE OF PROJECT____

____

RATING	Needs Improvement	Acceptable	Good	Very Good	Excellent		Total
POINTS	(2)	(4)	(6)	(8)	(10)		
Creative Ability	____	____	____	____	____	x 3 =	________
Scientific Thought	____	____	____	____	____	x 3 =	________
Thouroughness	____	____	____	____	____	x 1.5 =	________
Clarity and Dramatic Value	____	____	____	____	____	x 1.5 =	________
Technical Skill	____	____	____	____	____	x 1.0 =	________
						Total	________

Signature______________________________

Project #__________

Title:____

____

Comments:

1. What would have made this project better?

2. What was done well on this project?

3. Would you consider this project for Regionals? Yes No

WASHINGTON MIDDLE SCHOOL

SCIENCE FAIR

JUDGES BRIEFING

IMPORTANT! These contestants are 6th, 7th, and 8th graders. Don't expect graduate student work. On the other hand, don't be too soft-hearted. Take time to review enough exhibits to recalibrate yourself to mid-high level.

Interviews Ask Ms. Sandoval to get students for interviews: top 2-5 in category; all with potential to go to Regional Fair. Interview and rate by yourself. But, discuss with other judges.

Look at "Judges Score Sheet" in your packet.

Break judgement into five independent areas (not equally weighted):

1. **Creative Ability** (30%) Use interview to verify contestant's contributions versus helpers'.

2. **Scientific Thought** (30%) In Engineering, Mathematics, and Computer categories, consider engineering goals, or mathematical or computer methodology.

3. **Thoroughness** (15%) Better to thoroughly treat a bounded problem definition than to tackle too large a project.

4. **Clarity** (15%) This is the place -- and the <u>only</u> place -- where I give credit for the display.

5. **Skill** (10%) Again, in relation to what a mid-high student could be expected to do.

For each individual area, score as one of five ratings:

Rating	% Max
Excellent	100
Very Good	80
Good	60
Acceptable	40
Needs Improvement	20

Use the full range of ratings. The best you see here should get 100%, the worst should get 20%.

Do your arithmetic on the "Judges Score Sheet". Be sure to sign Score Sheet, then turn it in.

Two-way interaction with students. Emphasize positive suggestions for improvement. Verbal, or written on Score Sheet, or both.

To repeat the most important factor you must consider. These contestants are 6th, 7th, and 8th graders. Don't expect graduate student work. On the other hand, don't be too soft-hearted. Take time to review enough exhibits to recalibrate yourself to mid-high level.

Questions?

JUDGES' SCORING SUMMARY SHEET

Category(ies) Judged: ____

(PLACE A LARGE "X" AT POINT TOTAL FOR EACH LISTED PROJECT)

Number of Total Points								
100								
90								
80								
70								
60								
50								
40								
30								
20								
10								
Project Number								

JUDGING CRITERIA

Courtesy of Northwest New Mexico Regional
Science and Engineering Fair

HELPFUL HINTS

1) Examine the quality of work the student did, and how well the student understands the project and area of study. The physical display is merely secondary to the student's knowledge of the actual research.

2) Look for evidence of laboratory, field or theoretical work, not just library research or gadgeteering.

3) Keep in mind that projects are high-school level, not Ph.D. or professional levels. Sometimes judges tend to go to extremes, giving students either far more credit than they deserve or not enough because it is not in the Nobel Prize category.

4) Compare projects only with those in the same competition, and not with projects seen elsewhere under other circumstances.

5) Judges should keep in mind that the fair is not only a competition, but an educational and motivating experience for students. The high point of the Fair experience for most students is their interviews with the judges.

6) As a general rule, judges represent professional authority to students. For this reason, judges should use an encouraging tone when asking questions, offering suggestions or giving constructive criticism. A judge should never criticize, treat lightly, or display boredom toward projects they personally consider unimportant. Always give credit to the student for having expended the effort to present a project.

7) Please be discreet when discussing winners or making critical comments in elevators, restaurants, or elsewhere about judging, as students or adult escorts might overhear them. We would not want the results to get out before the winners are announced. In addition, please do not leave written notes or comments in the exhibit area or other common areas.

ISEF JUDGING CRITERIA

	Individual	Teams
Creative Ability	30 points	25 points
Scientific Thought/Engineering Goals	30 points	25 points
Thoroughness	15 points	12 points
Skill	15 points	12 points
Clarity	10 points	10 points
Teamwork	—	16 points

Creative Ability

1) Does the project show creative ability and originality in
- -the questions asked?
- -the approach to solving the problem?
- -the analysis of the data?
- -the interpretation of the data?
- -the use of equipment?
- -the construction or design of new equipment?

An original idea for a project would show greater creativity than a suggested project from a textbook. Obviously no project is creative and original in every aspect. Remember that a creative and original project for high school students is different from that of professionals.

Keep in mind some projects may contain elements that seem original. However, the material might have come from new curricula in textbooks or laboratory manuals unfamiliar to judges.

Another point to consider when judging is how much help a student received. A student's approach to solving a problem may seem original, but may have come from a scientist's or engineer's suggestions. If a student received help on a project, any credit for creative ability and originality should reflect the student's own contributions.

2) Creative research should support an investigation and help answer a question in an original way. The assembly of a kit would not be creative unless an unusual approach was taken. Collections should not be considered creative unless they are used to support an investigation, and to help answer a question in an original way.

3) A creative contribution promotes an efficient and reliable way to solve a problem. When judging, make sure to distinguish between gadgeteering and genuine creativity.

Scientific Thought/Engineering Goals

Scientific Thought

1) Is the problem stated clearly and unambiguously?

2) Was the problem sufficiently limited to allow plausible attack? One characteristic of good scientists is the ability to identify important problems capable of solutions. Neither working on a difficult problem without getting anywhere nor solving an extremely simple problem is a substantial contribution.

3) Was there a procedural plan for obtaining a solution?

4) Are the variables clearly recognized and defined?

5) If controls were necessary, did the student recognize their need and were they correctly used?

6) Are there adequate data to support the conclusions?

7) Does the student recognize the data's limitations?

8) Does the student understand the project's ties to related research?

9) Does the student have an idea of what further research is warranted?

10) Did the student cite scientific literature, or only popular literature (i.e., local newspapers, *Reader's Digest*).

Engineering Goals

1) Does the project have a clear objective?

2) Is the objective relevant to the potential user's needs?

3) Is the solution
 -workable? Unworkable solutions might seem interesting but are not practical.
 -acceptable to the potential user? Solutions that will be rejected or ignored are not valuable.
 -economically feasible? A solution so expensive it cannot be used is not valuable.

4) Could the solution be utilized successfully in design or construction of some end product?

5) Does the solution represent a significant improvement over previous alternatives?

6) Has the solution been tested for performance under the conditions of use? (Testing might prove difficult, but should be considered).

Thoroughness

1) Was the purpose carried out to completion within the scope of the original intent?

2) How completely was the problem covered?

3) Are the conclusions based on a single experiment or replication?

4) How complete are the project notes?

5) Is the student aware of other approaches or theories concerning the project?

6) How much time did the student spend on the project?

7) Is the student familiar with the scientific literature in the studied field?

Skill

1) Does the student have the required laboratory, computation, observational and design skills to obtain supporting data?

2) Where was the project done? (i.e., home, school laboratory, university laboratory) Did the student receive assistance from parents, teachers, scientists or engineers?

3) Was the project carried out under adult supervision, or did the student work largely alone?

4) Where did the equipment come from? Was it built independently by the student? Was it obtained on loan? Was it part of a laboratory where the student worked?

Clarity

1) How clearly can the student discuss the project and explain the project's purpose, procedure, and conclusions? Make allowances for nervousness. Watch out for memorized speeches that reflect little understanding of principles.

2) Does the written material reflect the student's understanding of the research? (Take outside help into account.)

3) Are the important phases of the project presented in an orderly manner?

4) How clearly are the data presented?

5) How clearly are the results presented?

6) How well does the project display explain itself?

7) Is the presentation done in a forthright manner, without cute tricks or gadgets?

8) Did the student do all the exhibit work, or did someone help?

Teamwork (Team Projects only)

1) Are the tasks and contributions of each team member clearly outlined?

2) Was each team member fully involved with the project, and is each member familiar with all aspects?

3) Does the final work reflect the coordinated efforts of all team members?

Appendix G: Resource Materials for the SFVSC Mentoring Program

Courtesy of Washington Middle School

WASHINGTON MIDDLE SCHOOL
SCIENCE MENTORING GUIDELINES
1991-1992

Welcome to the Washington Middle School Science Mentoring Program. We are glad to have you as a mentor, and we hope this will be a positive experience for you and the student(s) with whom you will be working.

The goal of the Mentoring Program is to increase the quality of the student science projects presented at the Regional Science Fair, and with an extended goal to promote more representatives selected for the State Science Fair. This can only be done by continued development of the students' self-esteem and confidence, and by teaching extended strategies in science problem-solving throughout the refinement of the project. "Si se puede" (it can be done) needs to be the standard for the students rather than the exception. You, as a mentor, can be instrumental in helping to continue the students success.

A mentor is a successful citizen interested in realizing the potential of the youth. Research shows that students, who have a parent or other adult challenging and supporting them, score higher in thinking/reasoning skills. You, as a mentor, will primarily act as a role model. Most Washington students have had limited exposure to science experimentation development, and you may be able to broaden the experience base of your protege. You will be able to provide support, encourage educational goals, share experiences and activities, and become an adult friend of a young person. You will not have to be an "authority figure" or a parent replacement. In short, you get to have the fun.

The information attached is designed to give you some direction in working with your protege. You are not limited to the activities suggested nor are you expected to participate in each one. Rather, you may use the suggestions as guidelines to find mutual interests.

We ask that you phone you protege at least once a week and meet in person at least once a week up to the date of the Regional Science Fair, March 13, 1992. Each student has been asked to call if an appointment must be cancelled or reschedules, and we ask the same of you. We hope you and your protege will have a mutually rewarding experience.

A MENTOR IS:

A PROFESSIONAL ROLE MODEL
A MOTIVATOR
A RESOURCE TO THE STUDENT
A HELPING HAND
A FRIEND

WHAT WILL MENTORS DO:

GET IN TOUCH WITH STUDENT AND HAVE A TALK
ASSESS HOW TO HELP A STUDENT-MAKE A LIST
- assist in setting up experiment
- develop timeline with regular check points
- check daily log on experiment process

CONTACT STUDENT AT LEAST ONCE A WEEK
- "How are you doing?"
- "What have you accomplished, RE: project?"
- "What's holding you back on this or that?"
- "Let's think together about how I can help."

WORK WITH STUDENT TO KEEP HIM/HER ON TRACK

PHONE TIPS

PREPARATION
FRIENDLY GREETING
SMALL TALK-ICE BREAKER
OPEN-ENDED QUESTIONS
- "Tell me more...", "Share with me...."

PROBING
- "Tell me more...", "That's interesting, please go on..."

SOLICIT MULTIPLE RESPONSES
- "What kinds of things....", "Which ones interests you?"

MENTORSHIP IS-

Helping parents and teachers guide student in completing revisions on their science project.
Giving students tips on success once he/she sets a focus on revisions.
Being a successful role model.
Supporting students in finding resources for project improvement.
Acting as, or leading a student to reliable sources of information as needed.

PROFILE OF A MENTOR:

Willing to contact student a minimum of once a week.
Willing and able to make a significant intervention toward success of the student.
Able to focus and persevere.

EXPECTATIONS

STUDENTS	MENTORS	PARENTS	TEACHERS	COORDINATORS
To express feeling, desires, expectations of working with mentors.	Contact student minimum of once a week.	Express an interest in the program and what the program provides for the student.	Remind students to complete projects on time and meet deadlines.	Serve as a liaison with school, mentor, student, parent.
Treat mentors with respect. Be courteous and polite.	To express feeling, desires, expectations of working with students.	Support the mentor by encouraging the student and participate in needed area of support.	Allow classtime for mentor to work with student if necessary.	Keep a line of communication between mentor, student and parent.
Be honest and open.	Treat students with understanding and respect.	Read, return, and respond to correspondence sent home.	Give students mentor/workshop reminder notes.	Provide materials, supplies, books, etc., necessary for tho success of the program.
Commit to having a successful personal/working relationship	Assist student in organizing materials for project, including scientific method, experimenting, graphing and data collection and charts.	Attend scheduled conferences or meetings.	Critique students' project at least 3 times prior to completion due date.	Evaluate program.
Complete assignments and activities on time.	Commit to having a successful personal/working relationship.	Keep open communication with mentor concerning activities and deadlines and scheduled meetings.	Be available to help in support areas such as xeroxing, typing, etc.	Provide students class schedules and home phone for mentor or place where student can be contacted.
Inform mentor if unable to keep a scheduled appointment.	Assist student in using resources outside the classroom in order to complete assignments (recommending outside resources).		Help students to have a professional looking project.	
Overall commitment to the success of the program and self.	Inform student if unable to keep a scheduled appointment.		Prepare students for judge interviews and schedule time for student project presentation (perhaps with other classes).	
Keep a progress log of experiment and project.	Serve a positive role model.			
Keep folder and calendar up to date and check items off when they are complete.	Keep calendar of planned student mediation time.			
Bring folder to all meetings with mentor and teachers. Responsible for all materials at all times.				

COMMITMENT REQUIRED

Both participants in this experience agree to try to fulfill their duties and make a personal commitment to succeed in the relationship.

Duties of a Mentor

1. Make a list of goals which you and your protege hope to accomplish.
2. Set a timeline for completion of project objectives and goals.
3. Meet once a week and/or a phone call to evaluate progress, address problems, determine solutions, and maintain timeline completion.

Duties of a Protege

1. Make a list of goals which you and your mentor hope to accomplish.
2. Set a timeline for completion of project objectives and goals.
3. Meet once a week and/or a phone call to evaluate progress, address problems, determine solutions, and maintain timeline completion.

BUILDING RELATIONSHIPS THROUGH GOAL-RELATED ACTIVITIES

One of the best ways to build the mentor/protege relationship is for the pair to participate in enjoyable activities.

Field trips around the community to observe resources relative to project.

Visit to mentor's work place

Dinner in the mentor's home

Talking about important experiences in your live

Talking with adults in protege's project area

Provide positive feedback on completion of timeline goals

GUIDES FOR EFFECTIVE MENTOR

1. Establish a warm, genuine, and open relationship.
2. Keep in frequent contact with student; take the initiative, don't always wait for students to come to you.

   Consider taking student to work to tour facility and discuss job opportunities.
3. Monitor student's progress toward project goals.
4. Be realistic with student.
5. Encourage students to consider/develop alternative directions when appropriate.
6. Encourage student to talk by asking open-ended questions.
7. Don't make decisions for students; help them make their own.
8. Focus on student's strengths and potentials, rather than limitations.
9. Provide accurate information.
10. Be a good listener.

GUIDELINES FOR MENTORS TO HELP STUDENTS ACHIEVE GOALS:

Monitor student's study time by having student keep a record of time spent on project.

Assist student in organizing materials for project development.

Assist student in using resources outside the classroom in order to complete project (recommending outside resources).

Serve as a positive role model.

Provide materials, supplies, books, etc., necessary for the success of project

MENTOR PITFALLS

Many mentors will undoubtedly encounter the temptation to go beyond the minimum expectations in their relationships with the students. Please be aware that good intentions can, at times, backfire. Here are a few warning signs:

Your sole responsibility is to your student, NOT his/her family, too.

Short, but regular contacts accomplish much more for the student than lengthy but irregular get together. Quantity is as important as quality.

Remember, we are not trained and not expected to be social workers.

Mentors are not expected to make a large financial as well as personal contribution.

Only break an appointment with the student because of an emergency. Trust will be crucial to the relationship, and nothing undermines trust quicker than broken appointments.

Be careful to initially establish guidelines for each contacting the other: both-too difficult and too easy-patterns of communication can breed misunderstandings.

Be conscious of goals and accountability in your relationships.

STUDENT HANDBOOK

WHAT IS A MENTOR?

The words "MENTOR" has a Greek root meaning "steadfast and enduring." a *Mentor* should be a caring person who establishes a relationship with you over a period of time in order to provide support and assistance in setting goals, making decisions, or resolving problems. Traits which we hope mentors will exhibit are listening, nurturing, and supporting. They are not a replacement for your parents.

Some activities in which your mentor might want to be involved are:

- evaluating your science project
- suggest refinement/extension of project for Regional Science Fair
- assist in setting up experiments
- suggest logging documentation procedures
- problem-solve experiment outcome/gliches
- assist in redesigning/writing of research paper/display board
- provide fieldtrip to community/work resources
- provide fieldtrip to personnal work site

WHAT IS YOUR ROLE?

You, better than anyone else, know hat help you need. Research shows that students, who have a parent or other adult challenging and supporting them, score higher in thinking/reasoning skills. Mentors have opportunities to relate to you in unique ways. They are not "authority figures.: They maybe be wonderful role models, however, who can share experiences, guide you in difficult decisions, and be an adult friend.

We hope you and your mentor will form a positive relationship. Remember that both parties must work toward this goal. We know that you will treat your mentor with respect. If you are unable to keep a scheduled appointment, you will call and cancel. Hopefully, your mentor will call/meet with you at least once a week. If this doesn't happen, call your mentor. Continuing communications is critical!

At your first meeting, you will want to exchange phone numbers and learn something about each other. What do you want your mentor to know about you? Make a list before you go. What do you want to know about your mentor? Include it on your list. Find the best times to get together. Be ready to discuss an area where you can use some help. Encourage your mentor to call school if more assistance is needed.

SOME ANSWERS TO COMMON PARENT QUESTIONS ABOUT MENTORING

What should I do if my child cannot make it for a meeting with the mentor?

You can encourage responsibility in your child, by having him/her call the mentor when a meeting must be rescheduled. If your child is very ill, you may want to call yourself. Be sure that you have the phone numbers necessary to reach the mentor both at home and work.

What if family plans conflict with the mentor and youth meeting?

The role of the mentor should be one of complementing or adding to opportunities for growth already available through the family. Time with the mentor is essential for completion of the science project. It would be helpful if you let the mentor and your child know when you have planned family events.

BAD AND GOOD LISTENING HABITS

BAD LISTENING HABITS	GOOD LISTENING HABITS
• Closing your mind by calling the message "uninteresting"	• Opening your mind to see if there's anything in the message you can benefit from
• "Putting down" the speaker -- the way he/she speaks, dresses, gestures, etc.	• Getting the speaker's message which is more important than his/her delivery or dress
• Planning what you will say when it is your "turn" to speak -- your rebuttal, judgment	• "Hearing the speaker out" and delaying judgment
• Listening for facts only	• Listening for facts, concepts, main ideas, and feelings
• Trying to outline everything the speaker says	• Listening a few minutes to determine the speaker's organization
• Faking attention to the speaker	• Spending energy listening, instead of pretending to listen
• Creating or tolerating distractions	• Creating a positive listening environment -- asking the speaker to talk louder, close a door, etc.
• Avoiding listening to difficult material	• Practicing listening by trying to understand difficult material
• Letting a reaction to words used by the speaker inhibit your listening	• Identifying words that might cause a negative reaction, and doing something about it

Source: Pam Wilson, coordinator for the Mentor Project

YOUR SCIENCE FAIR PRESENTATION TO THE JUDGES

Do not memorize your presentation. You may initiate the presentation or the judge may take the initiative by asking specific questions.

1. Introduce yourself. "Hello, my name is ______________________________."
2. Give the title of your project. "The title of my project is______________________."
3. Explain the purpose of your project. "The purpose of my project is __________ ____________________."
4. Tell the judges how you got interested in the topic.
5. Explain your procedure. "The procedure that I followed was ________________."
6. Show your results. Explain your charts, graphs, or notebooks.
7. List your conclusions. Explain what you have proven. If you think you had some problems or errors in your experiments, don't be afraid to admit these.
8. Tell the judges what you might do in the future to continue your experimentation. What would you have done differently if you were to do the project again?
9. If you do not know the answer to a judge's question, then say, "I'm sorry, but I don't know the answer."
10. Thank the judges. Always remain composed.

OTHER TIPS FOR PRESENTING

1. Practice your presentation to your parents, teacher, brothers and sisters, neighbors, friends, or your dog. Be comfortable and confident. You know alot about your project.
2. Wear your best clothes. Look your very best.
3. Look straight into the eyes of your judges. Pay attention to the judges.
4. Stand to the side of your exhibit.
5. Do not chew gum or candy.
6. Speak loudly enough to be heard by all the judges.
7. Smile.
8. Be polite.

ALBUQUERQUE PUBLIC SCHOOLS
WASHINGTON MIDDLE SCHOOL
1101 PARK AVENUE, S.W.
ALBUQUERQUE, NEW MEXICO 87102-2967

DR. JACK BOBROFF
SUPERINTENDENT

Mary Mercado
PRINCIPAL
(505) 764-2000

May 26, 1992

Mr. Dave Menicucci
1521 San Carlos SW
Albuquerque, NM 87104

Dear Mr. Menicucci:

We would like to say once again, "THANK YOU," for a terrific experience with our students at Washington Middle School. We learned a lot, and see positive results in the quality of our students projects. We look forward to next years science fair.

Although few of our students were recognized for their time and quality of project, we feel they learned a lot and had a rewarding experience through community interaction and development of cross-generational communication skills. They made a commitment, and learned to interact with adults in specific job related fields of study. This enhanced their knowledge of vocations and education needs. They shared their learning experiences with us, and their excitement was obvious.

We hope you will be available for next year. We are enclosing a questionaire for evaluation of this years experience, and to develop focus for change next year. We hope to continue to develop the mentoring project, and see continued growth in our students abilities.

We apologize for this late recognition as the year has passed ever so quickly. We do appreciate your time and talents volunteered for our students. We look forward to seeing many of you again next year. Have a relaxing summer.

Cordially yours,

Mrs. Sue Gorman
Ms Cherry L Zielaskowski

An Equal Opportunity Employer

SURVEY

WASHINGTON MIDDLE SCHOOL - MENTORING PROGRAM
NW REGIONAL SCIENCE FAIR PARTICIPANTS

Please give both positive and negative responses.

1. What were the key points of strength and weakness in the mentoring guidelines?

2. What needs to be developed for the mentoring workshops?

3. Would you be interested in working with a Science Fair Club after school next year?

4. What types of pre-workshops for the students would you suggest for student preparation next fall?

5. Would you be available for mentoring again next year? or know others who would also?

Name ______________________________ Phone ____________
Address ______________________________ ZIP ____________
Specialty expertise ______________________________

Please return to:

Ms Cherry Zielaskowski
Mentoring Program
Washington Mid School
1101 Park Ave., SW
Albuquerque, NM 87102-2967

Appendix H: Handout Materials for the Science Fair Orientation Workshop for Parents and Students

HANDOUT MATERIALS FOR PARENT/STUDENT WORKSHOP

Courtesy of St. Charles Borromeo School

HANDOUTS FOR WORKSHOP STATION:

SELECTING A TOPIC AND GETTING ORGANIZED

SELECTING A TOPIC FOR THE SCIENCE AND ENGINEERING FAIR

Students complete science fair projects for a variety of reasons. For many, it is a requirement of the regular science curriculum for the school. Others choose to do a project because they are interested in science or engineering and want to investigate these areas. Finally, other students find the competition exciting. Regardless of the reasons, a science or engineering project is an excellent opportunity to get real "on the job training" in carrying out a long-term independent study and to share experiences with other students. As a result, the most important aspect of choosing a topic is to select one that the student finds interesting and fun. Listed below are some things to consider in making a choice.

Interests

- What kinds of things does the student enjoy doing?
- What area of science or engineering does the student find interesting?
- What kinds of books does the student like to read?
- Does the student have any special skills or talents?

Is this a project that the student can do?

- How hard will the topic be for the student to understand?
- Is the student familiar with the topic or is it new?
- Will the student need to gather a lot of outside information and how long will it take?
- Can books be checked out from the library or will they need to be used there?
- Will professional advice be needed and is it available?
- How much involvement will be required from parents?
- Will the student be able to work in this area for 10 - 12 weeks and still be interested?
- Can a special schedule be set up to complete all the things that will need to be done?
- Is it possible to complete the project in the time allowed or will it need to be broken into phases?
- Does student have enough free time to work on the project?
- What special tools or apparatus will be needed and are they available at a low cost?
- Is there anything about the experiment the student's family will object to?

Safety

- Will the student be able to follow all safety rules as outlined in the rule book referenced below?
- Are there any dangers from equipment or materials associated with the project?
- Will there be any danger to the student or the subjects of the experiment at any time during the investigation of this project?

Clearly, selecting an appropriate topic depends on several factors that must be discussed and agreed on before the project is begun. Participants in local science fairs are encouraged to follow the guidelines for participating in the International Science and Engineering Fair. These are available in a booklet entitled "Rules of the International Science and Engineering Fair and all ISEF Affiliated and Local Feeder Fairs". Copies may be obtained by writing to Science Service, 1719 N Street N.W., Washington, DC 20036 or calling 202/785-2255.

SELECTING THE CORRECT CATEGORY

Because each project competes against all of the other projects in the same category, it is important to place the project into the correct category. Errors usually arise because the student confuses the basic idea behind the project with some of the methods or equipment used to carry out the work. For example, many projects involve the use of the computer, but only a few qualify for placement in the Computer Science category. Today's science and engineering projects are becoming increasingly interdisciplinary, so it is important to identify the primary emphasis of the project. By determining this emphasis, the student can more easily select the correct category.

Descriptions of the science fair categories are given below. In addition, some examples of project areas and how they might fit into different categories are also given. If the student is not sure about the appropriate category, he or she should contact science fair officials for assistance before completing the registration forms.

DESCRIPTIONS OF SCIENCE FAIR CATEGORIES

BEHAVIORAL AND SOCIAL SCIENCES Psychology, sociology, anthropology, archaeology, ethnology, ethology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, reading problems, public opinion surveys, educational testing.

BIOCHEMISTRY Molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, etc. (This is often a senior division category only, and is occasionally eliminated at some fairs because of the small number of entries.)

BOTANY Agriculture, agronomy, horticulture, forestry, plant taxonomy, plant physiology, plant pathology, plant genetics, hydroponics, algae, etc.

CHEMISTRY Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry, etc.

COMPUTER SCIENCE New developments in software or hardware, information systems, computer systems organization, computer methodologies, and data (including structures, encryption, coding and information theory), etc.

EARTH AND SPACE SCIENCES Geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum, geography, speology, mineralogy, topography, optical astronomy, radio astronomy, astrophysics, etc.

ENGINEERING Civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, etc. Power transmission and generation, electronics, communications, architecture, bioengineering, lasers, computers, instrumentation.

ENVIRONMENTAL SCIENCES Pollution sources and their control, waste disposal, impact studies, environmental alteration, (heat, light, irrigation, erosion, etc.), ecology.

MATHEMATICS Calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics.

MEDICINE AND HEALTH Medicine, dentistry, pharmacology, veterinary medicine, pathology, opthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, etc.

MICROBIOLOGY Bacteriology, virology, protozoology, fungi, bacterial genetics, yeast, etc.

PHYSICS Solid state, optics, acoustics, particle, nuclear, atomic, plasma, super-conductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

ZOOLOGY Animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, anatomy paleontology, cellular physiology, circadian rhythms, animal husbandry, cytology, histology, animal physiology, invertebrate neurophysiology, studies of invertebrates, etc.

SOME PROJECT AREAS AND HOW THEY MIGHT FIT INTO DIFFERENT CATEGORIES

Instruments - The design and construction of a telescope, bubble chamber, laser, or other instrument would be Engineering if the design and construction were the primary purpose of the project. If a telescope were constructed, data gathered using the telescope, and an analysis presented, the project would be placed in Earth and Space Sciences.

Marine Biology - Behavioral and Social Sciences (eg. schooling of fish), Botany (eg. marine algae), or Zoology (eg. sea urchins)

Fossils - Botany (eg. remnants of ferns), Chemistry (eg. chemical composition of fossil shells), Earth and Space Sciences (eg. geological ages), and Zoology (eg. prehistoric animals).

Rockets - Chemistry (eg. rocket fuels), Earth and Space Sciences (eg. use of a rocket as a vehicle for meteorological instruments), Engineering (eg. design of a rocket), or Physics (eg. computing rocket trajectories). A project on the effects of rocket acceleration on mice would go in Medicine and Health.

Genetics - Biochemistry (eg. studies of DNA), Botany (eg. hybrid corn), Microbiology (eg. genetic studies of bacteria), or Zoology (eg. fruit flies).

Vitamins - Biochemistry (eg. how the body deals with vitamin C), Chemistry (eg, analysis), and Medicine and Health (eg. effects of vitamin deficiencies).

Ecology - Environment - Pollution - For example, in a study of the eutrophication of Lake Erie: Behavioral and Social Sciences (the human beings who cause the problem), Chemistry (the process of eutrophication), Botany (growth of algae), Engineering (water purification micro-organisms), and Zoology (fish population). If the primary emphasis is environment, there is an Environmental Science category.

Pesticides - Biochemistry (eg. the mechanism of toxic effects), Botany (eg. plant intake and concentration), Chemistry (eg. composition of pesticides), Earth and Space Sciences (eg. mechanism of runoff), Medicine and Health (eg. effects on human beings and animals).

Crystallography - Chemistry (eg, crystal composition), Mathematics (eg. symmetry), Physics (eg. lattice structure), and Earth and Space Sciences (eg. crystal morphology and habit).

Speech and Hearing - Behavioral and Social Sciences (eg. reading problems), Engineering (eg. hearing aids), Medicine and Health (eg. speech defects), Physics (eg. sound), Zoology (eg. structure of the ear).

Radioactivity - Biochemistry, Botany, Medicine and Health, and Zoology could involve the use of tracers. Earth and Space Sciences or Physics could involve the measurement of radioactivity. Engineering could involve design and construction of detection instruments.

Space-related Projects - Note that many projects involving "space" do not go into Earth and Space Sciences: Botany (eg. effect of zero G on plants), Medicine and Health (eg. effects of G on human beings), Engineering (eg. development of closed environmental system for space capsule).

POSSIBLE TOPICS FOR SCIENCE FAIR PROJECTS

1. How can plants be grown without soil?
2. What are the best methods of removing stains from textiles and home furnishings?
3. What insecticides are the most effective?
4. What are the effects of trace elements on plant growth?
5. What are the comparative effects of different fertilizers on plant growth?
6. How effective is the action of toothpastes on bacteria?
7. What tropisms do plants exhibit?
8. What are the differences between human and other mammalian hair?
9. What are differences in pollen grains as shown by a microscopic study?
10. Can insects distinguish among colors? To what colors are they most attracted?
11. How are fingerprints made and how do they differ?
12. What biological fallacies can be found in modern day advertising?
13. What are the techniques of plant dwarfing?
14. What are some common types of molds and how do they differ?
15. Is it possible to hatch colored chicks?
16. What is the influence of varying environmental factors on the germination ratio of some common seeds?
17. How does size of tubes affect capillary action? Does capillary action vary for different liquids?
18. What are the effects of selected noises on the learning of white mice?
19. What is the relationship between height, weight, and cephalic index of a selected group of students during a stated growth period?
20. What are heat losses and specific heats of selected metals?
21. What are the specific gravities of selected materials as determined by a homemade hydrometer?
22. What is the effect of lens size on the light gathering qualities of a homemade telescope?
23. How do the reflection values of paints differ?
24. What effects do filters have on different types of photographic films?
25. What is the effect of different gases and gas and oil mixtures on the operation of an engine?
26. How effective are fire resistant and fire-proofed materials?
27. Can chromatic effects be induced in floral envelopes of the narcissus?
28. What are the effects of water soluble chlorophyll on white fats?
29. How do amino acids and sucrose sprays affect dwarf marigolds?
30. What are the effects of antiseptics and disinfectants on molds?
31. What are the blood types of tenth grade students in your high school in comparison with the U.S. average?
32. What are the effects of mating normal and vestigial winged fruit flies?
33. How can you determine experimentally whether there is any inheritance of an acquired trait?
34. How does the weight of a rolling object affect its speed? (or rolling distance, or collision with another object)
35. A study in human population genetics--tongue rolling.
36. Where did that trait first occur in my family? (A study of an interesting family trait in your own or some other family.)
37. How common is acne among teen-agers and what treatments are proving most effective? (A study conducted among classmates)
38. How do different combinations of sand, gravel, and cement affect concrete?
39. What is the probability of two people having the same birthdate?
40. Exploring fractals.
41. What physicai disorders cause absences from schools? What percentage of absences are due to such causes?
42. Build an electrically indicating propeller-type anemometer and calibrate a galvanometer or voltmeter to MPH of wind velocity.
43. Construct a device to time and determine the rate of acceleration of a freely falling object.
44. Make and calibrate a gauge to measure the expansion or contraction of various materials due to temperature change.
45. How may Boyle's Law be explained through the operation of a homemade hydraulic press?

46. How may the Law of Conservation be proved by using an apparatus similar to that used by Joule?
47. How may the speed of sound and echoes be determined experimentally?
48. How may the relationship between length and width of resonance tubes and sound be determined by the use of homemade resonance tubes?
49. How may Archimedes' Principle be proved experimentally by the use of homemade equipment?
50. How may voltage drop be determined and predicted?
51. Do all metals sink in all liquids?
52. Does the rate of cooling a hot metal affect its hardness?
53. Are all parts of the human tongue's surface equally sensitive to taste?
54. What is the smallest concentration of a "taste" chemical which can be detected?
55 Is there a relationship between certain types of weather and the incidence of hay fever?
56. What is the effect of ____________________ on water plants and invertebrates? (Substitute any commercially available chemical such as detergents, oils, pesticides in the blank.)
57. Are there any biochemical differences between animals of the same species from two different isolated populations? (Enzymes and hemoglobins are the easiest to test for.)
58. What chemical are present in polluted water before and after chlorination?
59. Is there any relationship between eating a good breakfast and making good grades in classes before lunch?
60. What effect does _________________ have on the web pattern produced by the ________________ spider? (This type of project normally uses drugs or various types. Would radical changes in the value of normal environmental variables such as temperature or humidity also have an effect?)
61. Is there any relationship between the barometric pressure and the number of times teachers have to discipline school children during the day? How about cloud cover?
62. Is there any relationship between the phases of the moon and either the rate of seed germination or the percentage of seeds that germinate successfully?
63. Some plants grow well together and some plants do not (This is the idea of companion planting) If two plants don't grow well together, can a substance be extracted from one kind of plant that has an adverse effect on the growth of the other?
64. Can nitrogen fixing bacteria be found associated with the roots of common non-leguminous plants?
65. How much more light bounces off a dust-filled atmosphere than a clean one?
66. Is there a relationship between the mass/height ratio of persons and their heartbeat rate?
67. Is there any relationship between the diversity of life forms in different bodies of water and the level of pollutants in that water?
68. What are the actual constituents of "Folk Medicines"? (Many old folk medicines have been found to use plants that contain natural products resembling modern medicines used to treat the same diseases the folk medicine is used to treat.)
69. What is the effect of watching certain kinds of T.V. programs on pulse rate?
70. Is there any relationship between the scent of flowers and their color?
71. Do the colors of food packages affect which ones are bought?
72. Are "ecologically safe" washing powders as good as ordinary washing powders?
73. How does the velocity of sound vary in different substances?
74. Can eggs withstand a greater force from one direction than from another?
75. How do the viscosities of lubricating, multi-grade, transmission or other oils vary with temperature?
76. How do the lubricating properties of various oils compare?
77. Does music have any effect on plants? What kind of music? What kind of plant?
78. Is there a relationship between a person's diet and the tendency for their fingernails to break?
79. Is there a relationship between measurable qualities of teachers or types of courses that students say are their "favorites" and how much work they have to do for those teachers or courses?
80. What liquids do rats or mice prefer to drink if given free choice? (Alcohol, sugar water, regular water, coffee, tea, etc.)
81. How can ____________________ be made to work better? (This is an engineering question where the student picks a piece of apparatus or equipment, studies its function and tries several new designs to make it work better.)
82. What thrust is exerted by an average sprinter as he or she starts to run?
83. What is the percentage of body fat found on male and female swimmers compared to a similar group of males and females who do not regularly engage in an active sport?
84. Is there a relationship between lung capacity and height? or weight?

85. Does one taste prevent another one from being tasted? What are the relationships between the concentrations of the two if this is true?
86. Does electricity have any effect on plant growth? How about on repairing slightly damaged stems?
87. What is the effect of introducing moderate amounts of fertilizer to a wild plant community? (Do all the plants grow better? Do some grow better than others? Does the diversity of the community increase, decrease, or stay the same?)
88. What is the relationship between liquid input and urine output in humans? Other selected species?
89. What is the relationship between conditions (temperature, wind speed, pressure, cloud cover, etc.) one hour and the weather the next hour? Day? Week?
90. Can bacteria that secrete substances which promote the growth of a plant be isolated from the roots of that plant? That inhibit the growth of a competing species?
91. What are the effects of different kinds of shampoo on different types of hair?
92. What is the effect of varying the amount of light and/or temperature on the growth of different kinds of micro-organisms
93. Which colored constituents of leaves or flowers change colors when the pH is varied?
94. Can the scent be extracted from flowers? If so, and the scent from one kind of flower be separated into different components, each with a characteristic scent?
95. Which of several brands of a certain type of product is most effective?
96. Do different kinds of (tobacco) cigarettes produce different kinds of smoke?
97. What is the effect of cigarette smoke on crickets?
98. Do plants that are prayed over grow faster/better than plants that are not?
99. Does plant growth affect the pH of the soil in which it is grows?
100. What are the levels of various pollutants in different bodies of water in a certain area? If there are differences why?

SCIENCE FAIR EXPERIMENT TITLES

Earth and Space Science

Precession of the Earth
The Red Planet--Can We Live On It?
How Do the Planets Move through the Sky?
How Does Florite Fluoresce?
Setsmoscope -- What They Do
How Much Power Is the Sun Putting on My Lawn Per Square CM?
Crystals and Geodes
Simple Passive Solar Heating
What Effects Do Grain Size and Shape Have on Porosity and Permeability?
Does Slope Affect Stream Velocity?
The Wind Chill Factor
How a Homemade Spectroscope Works
Waves. Why They Break
Wave Formation in Sand

Engineering

Does the Shape of a Nosecone Affect the Altitude a Model Rocket Will Attain?
Which Truss Design Makes the Strongest Bridge?
Solar Heat When the Sun Is Not Out
How Does the Aerodynamical Design of a Car React to Wind Resistance?
Will Salt Hydrates Improve the Performance of Passive Solar Heating Systems?

Environmental Science

How Differences in Water Temperature Affect Microscopic Life in Pond Water
How Do Various Detergents Affect the Surface Tension of Water
Nitrogen Content Level in Fuel Exhaust
Why Do Some Soils Absorb Water Faster than Others?
What Materials Absorb the Most Oil in an Oil Spill?
Does Acid Rain Hurt Some Buildings and Statues?
The Effect of Acid Rain on Plant Growth and Germination
Testing Various Water Sources for Nitrates

Mathematics

What Are the Properties of Matrices?
Complex Numbers
Binomial Distribution Experiment
Area Measurement Using the Monte Carlo Method
Cycloid Curves
Fibonacci Numbers
Can a Mathematical Model Be Devised to Predict the Outcome of Sporting Events?

Zoology

Chemoreception In Musca Domestica
Color Genetics of Netherland Dwarfs
All About Butterflies

Medicine and Health

Chemical Effects on Oral Bacteria
Hot or Not: A Test of the Accuracy of Thermometers
The Effects of MSG on Mice
How Soluble Is Your Calcium Supplement?
Testing for Diabetes

GETTING ORGANIZED

One of the biggest pitfalls in a long-term assignment is the tendency to leave things until the last minute. This tendency to procrastinate is not limited to students--many people battle with this problem into their adult years. A schedule with short-term due dates will help to prevent the work from piling up at the end and can provide the student with a continuing sense of accomplishment as the work on the project progresses. An outline for a twelve-week schedule is given below. If the student has less than twelve weeks before the science fair project is to be completed, this schedule can be adjusted to fit the time available.

12-Week Timetable

Date of the science fair_______________________

Date to begin working on the project__________

Scheduled Completion Date	Actual Completion Date	
__________	__________	12 Weeks before the fair

- Choose a topic or problem to investigate
- Make a list or resources (libraries, places to write, people to interview)
- Select your reading material

__________	__________	11 Weeks before the fair

- Begin preliminary investigations
- Write for additional information from business firms, government agencies, etc.
- Start a notebook for keeping records. Write down what you have done so far
- Decide what materials you will use in the display. Make a list to be checked later.

__________	__________	10 Weeks before the fair

- Complete initial research
- Interview experts for more information
- Decide how to set up your investigation or experiment/begin a preliminary design for the construction of your engineering project
- Set up the experiment or collect materials for construction of the project
- Learn how to use any apparatus you need
- Write in notebook more of what you have done

__________	__________	9 Weeks before the fair

- Organize and read materials sent in response to your letters
- Decide whether you need additional material from outside sources
- Begin experiment or construction of engineering project
- Add information to project notebook as you work

Scheduled Completion Date	Actual Completion Date	
________	________	8 Weeks before the fair

- Continue the experiment or working on construction
- Continue recording notes and observations
- Take photographs of the project in progress
- Continue research for background information about the topic

________ ________ 7 Weeks before the fair

- Continue experiment or construction as needed
- Begin work on first draft of written report (statement of problem, hypothesis/engineering goal, preliminary information, bibliographic information)
- Continue recording notes and observations
- Continue taking photographs of project

________ ________ 6 Weeks before the fair

- Continue experiment or construction as needed
- Check with experts contacted earlier as needed
- Review books, articles, etc. for additional ideas
- Continue recording notes and observations
- Take photographs of final stages of project
- Review work done to date on report

________ ________ 5 Weeks before the fair

- Begin preparing signs, titles, labels for display
- Begin analysis of data collected
- Begin designing charts, graphs, or other visual aids for display and written report
- Have photographs developed and enlarged as needed
- Continue writing first draft of report including sections on experimental procedure or engineering approach and recording/analysis of data

________ ________ 4 Weeks before the fair

- Review analysis of data and results obtained
- Write second draft of your report to also include analysis of information, evaluation of possible solutions, and conclusions and presentation of results of your project
- Continue writing about progress in your notebook
- Continue designing display

________ ________ 3 Weeks before the fair

- Finish constructing display
- Write text for background of display and plan its layout
- Complete charts, graphs, and visual aids
- Work on draft of written report

Scheduled Completion Date	Actual Completion Date	
________	________	2 Weeks before the fair

- Write another draft of written report
- Do lettering of explanations and mount themon your display
- Check and double-check display for spelling, punctuation and grammar
- Mount graphs, charts, drawings, photographs
- Assemble apparatus or other display materials; check against your list
- Write and type final report

________	________	1 Week before the fair

- Proofread your written report
- Set up display at home and check for any flaws (leave standing for 2 days)
- Check and double-check everything, especially spelling, punctuation, and grammar on display
- Transport materials to science fair site
- Congratulate yourself!

HANDOUTS FOR WORKSHOP STATION:

THE SCIENTIFIC AND ENGINEERING METHODS

DESCRIPTION OF THE SCIENTIFIC METHOD

Scientists direct their efforts toward improving mankind's understanding of nature by searching for explanations, classifications, and models to predict natural phenomena. The end product of the scientist's efforts is knowledge, sometimes without regard to its immediate application in the world. When a student selects an investigative topic like this, the most important factor in the project is the proper use of the scientific method--an organized plan for conducting an experiment to gather information to help answer a question. It is important to select a problem that is not too general or broad in scope, a problem for which the student will have sufficient resources, materials and time to investigate it properly, and to design the experiment to eliminate biases as much as possible.

There are five basic steps in the scientific method. These include 1) identify a question to be answered, 2) hypothesis, 3) methodology, 4) data collection and analysis, and 5) draw conclusions. Each of these steps is outlined below:

1. **Identify a question to be answered** -- this involves formulating a very specific question about the topic which indicates what subjects will be studied and what variables will be observed. Preliminary research about the topic should be done including reading books and magazines, and talking with experts in the field. From the information gathered, the student can describe a curious physical behavior that he or she would like to explain through the use of an experiment.

2. **Formulate an hypothesis** -- Based on the preliminary research, the student usually has an "educated" guess about the answer to the question being investigated. This "hunch" is stated as the hypothesis to be tested. A well constructed hypothesis identifies the subjects of the experiment (plants, mice, etc.), states what is being measured (rate of growth, weight, behavior, etc.), states the conditions of the experiment (different colored light sources, junk food versus regular food, etc.), and the results expected (light colors produce faster growth rates than dark colors; junk food diets cause the mice to be more active, etc.)

3. **Methodology** -- The student can now develop a plan to test the accuracy of the hypothesis by examining the effects on the subjects of changes in certain experimental conditions or factors. The best design is a controlled experiment in which there are two groups of subjects--one which is observed while the experimental conditions change, and one which is observed while there are no changes made in the conditions. Since many things can go wrong with only one subject in each group, it is best to use several subjects (a reasonable number might be ten) in each group.

   It is best to test only one change in condition at a time in order to observed the effects on the subject of just that one change. If several variables are changed at one time, the student will not be able to determine which variable affected the subject, and the results will be biased. In order to keep biases from creeping in, the student can do a variety of things. For projects involving seeds and plants, he or she might want to select seeds of uniform size or plants that are all the same height initially. Subjects can be assigned to the experimental and control groups randomly by flipping a coin. Using multiple subjects in each groups or repeating the experiment several times and recording all of the results helps to eliminate biases due to uncontrolled variables. It may be difficult to try to think of all the ways biases might influence the experiment, but careful planning and thinking ahead can help reduce the problem.

4. **Data collection and analysis** -- Students should collect data according to the plan for the experiment. That plan should indicate how precisely, how frequently, and in what way the effects of the variable should be measured. The condition that is being varied is called the independent variable and the effect on the subject that is being observed is called the dependent variable. All experimental observations should be recorded, and measurements should be made in metric units, when appropriate. Observations should also be quantified, if possible, thereby keeping them as objective as possible.

   Once the data is collected, the student should analyze the results looking for interesting patterns in the data that might say something about the hypothesis. Data should be summarized and neatly displayed in tables, graphs and other visual aids that are clearly labeled to allow for easy reading. Some examples of tables and graphs are provided on another handout. The student should perform the appropriate statistical techniques to make the data more easily understood and to determine the significance of any differences that were observed in the experimental group. It is better to use simple descriptive statistics that the student fully understands (such as finding the mean and standard deviation for the data) than to attempt to apply high powered statistical techniques that the student does not understand. Pictures taken during different stages of the experiment can also be part of the data collected. The available results help the student begin to formulate some conclusions.

Sometimes the data gathered may not confirm the original hypothesis. That's OK. The original hypothesis was simply an educated guess based on preliminary information. If the data do not support to hypothesis or even if they refute it, the student should begin to think about why this might be the case. Were there uncontrolled variables? Were the effects actually there, but they were too small to measure? This is all a normal part of the scientific process. If the experiment has been well designed to control extraneous variables, if the results are clearly substantiated by the data and if someone repeating the same experiment receives the same results, the experiment has been a success and the student has learned something he or she did not previously know about the topic.

5. **Draw conclusions** -- Based on the data and analysis, draw a conclusion about the accuracy of the hypothesis. One does not prove or disprove an hypothesis, but the student can make a statement that the evidence supports or does not support the hypothesis. It is also possible that the evidence will be inconclusive and the question will remain unanswered. The conclusion should state what the student accomplished, or what was really learned from the testing in the experiment. What relevance does it have to the world in which we live? Are there some additional questions that were raised as a result of doing the experiment?

DESCRIPTION OF THE ENGINEERING METHOD **

Work done by engineers centers around solving a problem. The end product is a physical device, a design for a device, or a process or procedure. The process used in creating these end products is called design, and the techniques employed are called the engineering method. Some of the engineer's concerns in applying this method include economic feasibility, safety, manufacturability, public reactions to the design, and effectiveness of the device or process in solving the problem.

There are five basic steps in the engineering method. These include 1) problem definition and engineering goal, 2) approach, 3) analysis, 4) evaluation, and 5) presentation of results. Each of these steps is outlined below:

1. **Problem definition and engineering goal** -- This involves identifying and describing the engineering problem clearly. Details should be provided to show that the problem is real and that a solution is needed. The limitations of the problem and some suggested, acceptable solutions are proposed. The final outcome of this step is a problem statement. The engineering goal follows directly from the problem definition and is stated clearly in this section.

2. **Approach** -- In this step the engineer documents the plan for reaching the engineering goal. This begins with a literature review about the problem and a brief discussion of what other people who have written about the same or similar problem have to say. It should include a discussion of previous work others have done to solve the problem and an explanation of why these efforts failed. If there are any new technological developments or scientific innovations which could be applied to the problem, they should be mentioned here. This section should then include a discussion of the additional information that is needed to solve the problem, how this information will be obtained. The level of accuracy of the experimental data is also described here.

After this discussion, the engineer outlines the steps that will be used to solve the problem. Each step is described in enough detail to allow the plan to be easily understood by the reader. In general, the first steps in the process can be seen more clearly than those that will come later, so the amount of detail for the early steps will be greater. The latter steps often will depend on the results of the first ones, so the plan should describe how decisions will be made about these latter steps when they come up. The plan usually concludes with a timetable that shows the expected level of effort on each of the steps, and if a budget is involved, it will indicate the expected cost for each of the steps. This will insure that the goal can be achieved in the required time-frame and within an acceptable budget.

3. **Analysis** -- The basic objective of this step is to begin executing the plan outlined in the approach. Analysis consists of three components: data and information gathering, design, and checking results.

Data and information gathering is the process of collecting all the necessary information needed to solve the engineering problem. In addition to the information gathered from literature in the previous step, the engineer will often include results of testing and measurements of components or systems in order to understand their operational limitations and constraints. Other information may include the advice of experts and copies of mathematical or physical models. At this stage the engineer begins testing and measuring the effectiveness of all of the different types of approaches that he or she could use to achieve the goal. This testing can be done with physical, mathematical, or computer models. Testing and measuring continue until enough data exists to begin drawing conclusions about the details of the engineering solution.

Design involves considering all of the data gathered to this point and using them to construct specific engineering solutions. These solutions may be in the form of a physical device, a design for a product, or a description of a process, all of which are often referred to as the design product. The engineer may be able to think of several design products, and none of them is rejected at this time. The selection of the final design will be done in the evaluation step.

The purpose of checking results is to insure that no fundamental mistakes were made in the process of gathering information or formulating the design product. The engineer makes sure that all of the information used in developing the possible solutions is accurate and that the logic used in the design is sound.

4. **Evaluation** -- In this step the engineer considers the merits of each of the proposed design products with respect to the engineering goal. The design that most effectively meets the goal at a reasonable cost is selected. The engineer must consider the one-time costs of construction, the recurring costs of maintenance, and the effectiveness of the design to solve the engineering problem. Often the least expensive design is rejected because it is also less effective in solving the engineering problem than a more expensive design. In some cases a prototype device is built to demonstrate the effectiveness of the design. As a final step in the process, the selected design should be compared with the original design goal to insure that it meets the main objectives.

5. **Presentation of results** -- The presentation should clearly document the entire engineering process and should contain all of the details about the final design. A final report is prepared, and often an oral presentation is made to interested parties. Any recommendations for further work are documented at this time. These recommendations usually center on refinements that could be applied to the final design.

** Adapted from "Outline of the Engineering Method" by David Menicucci, Sandia National Laboratories.

HANDOUTS FOR WORKSHOP STATION:

PRESENTING YOUR PROJECT AT THE SCIENCE FAIR

PRESENTING YOUR PROJECT AT THE SCIENCE FAIR

The science fair project display is the culmination of weeks of study and preparation. As in the scientific and engineering workplaces, a person's investigation or experiment is not really complete until he or she has been able to document the results and present it to other people in the field. That is why the display for the science fair is as important as the investigative work. It is here that students can demonstrate their creativity in sharing what they have learned.

Each project entered in the fair must consist of three elements: the display unit, the exhibit materials, and the written report. In most science fairs, the displays are evaluated as part of the competition when the student is not present. As a result, they must present a complete picture of the student's efforts to the judges. Each science fair will have space requirements for the displays, so each student must design his or her display to conform to those requirements. Most displays will be placed on tables, but floor displays may also be acceptable. Below is a discussion of the important factors to be considered when designing the backboard for the display and the materials to present in front of the backboard. Information about the written report is given in an additional handout.

BACKBOARDS

The display unit, or backboard, is a kind of advertisement for the project. It is what people will see first and establishes the "professionalism" of the student's efforts. It should be constructed of sturdy and durable materials that will allow it to stand freely for several days. As a result, backboards usually consist of three equal-sized panels hinged together. Students should check the space requirements of the science fair before designing the display. Local science fairs are encouraged to follow the guidelines listed in booklet entitled "RULES OF THE INTERNATIONAL SCIENCE AND ENGINEERING FAIR and All ISEF Affiliated and Local Feeder Fairs" available from Science Service, 1719 N Street N.W., Washington, DC 20036 Phone # 202/785-2255.

Suggested materials:

pegboard and corkboard - available from a lumber store; predrilled holes are handy, but will need a frame or support to prevent buckling.

foam board - available from an art supply store; is light weight and can be cut easily; may need a frame if the display is particularly tall.

plywood and particle board - available from a lumber store; useful for larger floor displays; is very durable, but also can be quite heavy for setup.

To set up the display and make it look attractive, the student might want to consider painting the backboard or covering it with construction paper or fabric. It is best not to choose colors that are too bright or that otherwise draw the viewer's attention away from the information presented. The student will want to present enough information to fully describe the project and the results without the panels appearing too cluttered. The following information for either science projects or engineering projects should be included on the backboard. Note that it is essentially the same information that is contained in the student's written report, only in a condensed form.

SCIENCE PROJECT

Title of the project - neatly lettered, easy to read and fairly short.

Purpose or problem - this statement lists the student's reasons for pursuing the project. What did the student hope to learn by investigating this area? In an engineering project, this is the focus of the project-- what problem the student is trying to solve.

Hypothesis - In an experimental project, this is an educated guess or prediction about what the student thinks may happen.

Procedure - What did the student do to carry out his or her plan of action? What methods or materials were used to test the hypothesis or solve the engineering problem?
Results - What facts were discovered that were not known before the project was completed? The results should be presented using visual aids such as graphs, charts, diagrams, photographs, etc.
Conclusion - This statement summarizes the student's investigation and should offer an answer to the student's original question or problem. Sometimes students may discover something they did not expect--that should be included also because that is how scientists and engineers learn from their work.

ENGINEERING PROJECT

Title of the project - neatly lettered, easy to read and fairly short.
Problem definition and engineering goal - Describe what the problem is and what solution is needed.
Approach - An outline of the plan to solve the problem
Analysis - A description of the process to begin execution of the plan, to collect information, to design possible solutions, and to check results.
Evaluation - Evaluate all possible solutions and choose the best one.
Present Results - This is a complete description of the final solution.

All lettering should be neat and easily read from about four feet in front of the display. Different sizes of letters used for the title, section headings, and text, and space between sections on the backboard help the reader to see how the material is organized. Good hand lettering is sometimes sufficient, but stencils or press-on letters (available at art supply or large variety stores) often give a neater appearance. The student should check and double-check all spelling and punctuation. Also, students often misuse the words "affect" and "effect", as well as other words, so all text should be checked carefully.

EXHIBIT MATERIALS

The materials, devices, and samples shown in front of the backboards should reflect the items used throughout the student's investigation. The display items should tell a story or illustrate the scope of the project sufficiently so that the student scientist does not need to be present to explain the entire project to an observer. The materials should be arranged in an attractive way that illustrates important concepts of the project but avoids clutter. Students should always follow the safety requirements of the science fair concerning electricity, hazardous materials, and the use of live animals. These rules are included in the rule book for the International Science and Engineering Fair listed above which also contains all the protocol forms required when doing research on vertebrate subjects, humans, recombinant DNA, and tissue or pathogenic agents/controlled substances. These rules describe what types of items are not acceptable for research or for the display. In addition, students should use good sense when displaying small items that could be swallowed by children viewing the project or when displaying valuable and expensive equipment.

HANDOUTS FOR WORKSHOP STATION:

THE WRITTEN REPORT OR SCIENTIFIC PAPER

THE WRITTEN REPORT OR SCIENTIFIC PAPER

A complete science fair display includes a written scientific paper which is a summary of everything the student did to investigate the selected topic. In addition, the student may decide to submit a copy of this paper to the Junior Academy of Sciences--Scientific Paper Competition. (Students who do not do science fair projects are also eligible to compete in this activity.) The steps below comprise a guide for preparing a scientific paper.

1. **Select a Topic for Research**
The topic of the paper is the same as the topic of the student's science fair project, or, for students who do not do projects, the paper will cover a topic of interest to the student. In either case, the topic should be limited in scope to one that is not too broad, has reference material available for preliminary study, allows for the possibility of first-hand observations and/or experimentation, and can be accomplished within the time frame available. (In the case of a project, it sometimes means the student completes one phase of the project during the course of one year.)

2. **Information Gathering**
Students should use a variety of sources of information which may include books, encyclopedias, almanacs, abstracts and journals from specialized fields, and personal interviews with experts in the field. Newspapers and popular magazines are generally not good sources of factual information because they do not always report scientific information accurately or in enough detail to present the complete picture of the research. Students may want to use note cards or separate sheets of paper for each source of information. Students should be careful in copying dates and figures, proper names, unfamiliar terms, chemical formulas, etc. Double-check! The top of the card or sheet should contain all of the information about the source that will be required in the bibliography entry at the end of the report. A description of proper entries is given later in this document.

Information from actual experimentation or construction done by the student is extremely valuable. The student should be careful to follow good scientific/engineering methods and keep careful records of all procedures used in a large notebook. He or she should keep careful records of all results in the same notebook, and should write additional notes of any unusual conditions or results in another section in the same notebook. (Since it is easy to misplace notebooks, a special place should be designated for all science fair materials that is safe and out of the reach of interested younger siblings and pets.)

3. **Organize the Information**
Once the literature research and the experimentation or construction has been completed, the student can select from his or her notes those that will be used in the introduction or as supporting evidence in the body of the report. The note cards should be arranged in a probable sequence. Experimental notes should be reviewed to determine what facts should be illustrated by diagrams, charts, graphs, or photographs. Any direct quotes should be flagged for inclusion in the text and bibliography.

4. **Writing the research paper**

a. Abstract: When the report is complete, the student should prepare an "abstract" following the guidelines given on a separate page provided later in the document. A copy of the abstract is included as the first page in the written report.

b. Protocol forms: Completed protocol forms are required for all projects done using vertebrate animals, humans, recombinant DNA, tissue or pathogenic agents/controlled substances. Copies of the protocol forms are to be completed and filed according to the rules for the International Science and Engineering Fair. Copies should also be included in the front of the written report. Protocol forms are not required for all projects--just those involving the subjects and substances listed above.

c Title Page: The first page of the report should include the title of the project or will specifically identify the content of the scientific paper for competition. The title should clearly describe the nature of the study and be fairly short. The student may wish to include the date and some reference to the competition for which the report was prepared. Students should check the rules for including their name and grade as some competitions do not allow this information on the report.

d. Table of Contents: This page provides the reader with a list of the different parts of the report and the page number on which each section can be found.

e Statement of Purpose or Problem: This two-or three-sentence statement explains why the student selected this topic, what he or she expected to discover by investigating it, or what problem was to be solved. For a scientific paper competition this section may be replaced by an "Introduction" describing the significance of the topic and why it was chosen by the student.

f. Hypothesis or Problem Definition and Engineering Goal:
Students who select an experiment to perform should include the hypothesis which is an educated guess about what the student thinks will occur as a result of conducting the selected experiment. Students who select engineering projects should describe what the problem is, what solution is needed and outline the plan to solve the problem.

g. Research: This is the part of the report that contains all the background information the student collected about the chosen topic. Any books or articles read, authorities consulted, or outside materials collected should be summarized and presented in this section. It should be written in the student's own words and not copied from an encyclopedia or other reference.

h. Materials: This is a list of all the materials and supplies used in the project. Amounts of all materials should be indicated, especially if the student conducted an experiment.

i. Procedure: This section describes the steps the student undertook to complete the project. The steps are usually presented in a numbered format and show the stages of the project in such a way that others could reproduce the procedure. This goes back to one of the purposes of the report which is to share the student's information with other scientists in the field.

j. Observations and Results: In this section, the student tells what he or she has observed from the project. How do these results compare to results of others who have investigated the same or similar topic? The results should be discussed in detail and carefully analyzed to be sure that they are supported by the data gathered. Graphs, charts, or other visual data are effective ways to supplement the explanations written in the text. Visual aids should be labeled clearly and explained in the text of the report. Some examples of ways to display data are given as an additional handout. A common error is to include too much data in a single illustration. It is better to use a series of tables or other illustrations to present the results. The student should double-check that they are accurate, neat, and understandable. The reader should not have to spend a lot of time figuring out what the student is trying to say or interpreting graphs and charts. For an engineering project, the student should evaluate all possible solutions, describe how each attempts to solve the problem, and choose the best one.

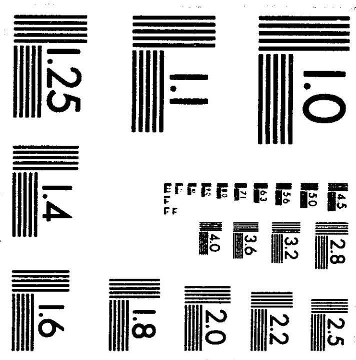
k. Conclusion: This is a brief statement explaining why the project turned out the way it did and why the events occurred as they were observed. If an experiment was chosen, the conclusion should tell whether the data supports the hypothesis or does not support it. For an engineering project or for a general scientific paper for competition, this section will include a summary statement of the problem and the results obtained or a complete description of the final solution selected.

l Bibliography: This section should list all the printed materials consulted and the personal interviews conducted by the student in carrying out the project. Items should be listed in alphabetical order in a standard format. A page of examples is found later in this document. The term "bibliography" is properly used when all the literature pertinent to the subject has been reviewed. Since this is seldom done, the student may choose to title this section "Literature Cited" or "References" and list only the citations, quotations, and references given to interviews provided in the body of the report.

m. Acknowledgments: For students who have completed a science fair project, this is where he or she thanks all the individuals who assisted in the research or development of the project (including Mom and Dad). Note that experts who were interviewed will be listed in "References" rather than in the "Acknowledgments" section.

5. **Technical Details**
The student should use standard 8 1/2" x 11" paper and type or use the computer to print on one side of the paper only. Double space the text and use underlines, bold face or all capital letters to set aside section headings. Pages should be numbered at the bottom of the page, in the center. A list of charts and graphs may be prepared similar to the Table of Contents. The final copy should be neatly bound in an attractive folder or binder (available at any variety or stationery store).

Write and rewrite! The rough draft is just that, a first attempt at writing the research paper. There are no hard and fast rules as to how many drafts a paper should go through, but each draft should be an improvement on the one before it. A genuine, typical, professional paper may be revised fifty times before publication. Writing or typing the first draft with triple spacing allows the student to make revisions between the lines. The author may also want to have family members, teachers, or other experts review the report before the final copy is done. Using a computer word processing program can be very helpful at this point, but it is not essential. Before personal computers, everyone retyped scientific reports many times to get a final copy.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4.0
4.5
5.0
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3 of 4

CORRECT STYLE FOR CERTAIN TYPES OF REFERENCES AND BIBLIOGRAPHIC ENTRIES

The key elements: Author, Date of publication, Title of article, book or paper, Where published (book chapter, journal, conference), and Publisher's name and location

1. Journal article, one author

   Jones, Thomas A. (1976). "The development of the chick." Animal Development Journal, 15, 27-34.

2. Journal article, two authors

   Becker, L. J., & Seligman, C. (1982). "Welcome to the energy crisis." Journal of Environmental Science, 37, 1-7

3. An entire book, one author, revised edition

   Cohen, J. (1977). Statistical power analysis for the behavioral sciences (rev. ed.). New York: Academic Press.

4. An entire book, more than one author

   Anderson, Garron P., Bennett, S. John, & DeVries, K. L. (1971). Analysis and testing of adhesive bonds. Long Beach, CA: Foster Publishing Co.

5. Edited book

   Letheridge, S., & Cannon C. R. (Eds.). (1980). Bilingual education: Teaching English as a second language. New York: Praeger.

6. Encyclopedias

   "Microcomputers." The World Book Encyclopedia, Vol. 11. (1990) Chicago, IL: World Book, Inc.

7. Conference paper

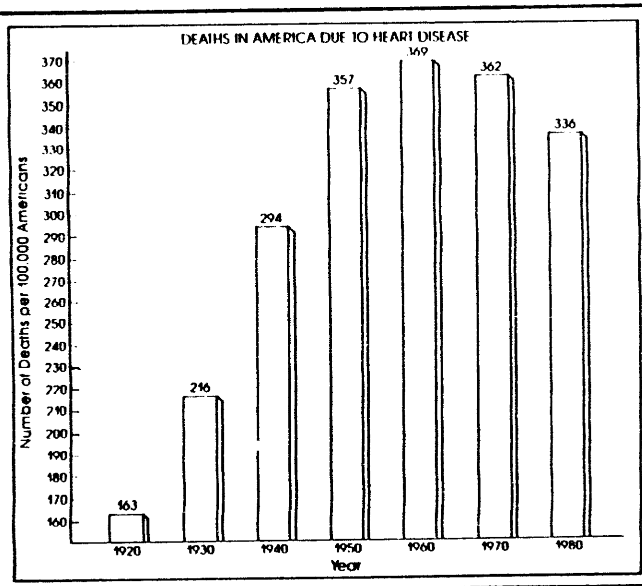
   Brener, J. (1979, October). "Energy, information, and the control of heart rate." Paper presented at the meeting of the Society for Psychophysiological Research, Cincinnati, OH.

WRITING AN ABSTRACT

Each student who completes a science fair project should write an abstract to be displayed with the project. Some fairs require a copy of the abstract be attached to the registration form for the fair. It should have the exact title of the exhibit as the heading, but most fairs require that the student's name not appear on it.

The abstract gives the essence of the project in a brief but complete form. It should not exceed 250 words and should be typed with double spacing. Judges and the public should have a fairly accurate idea of the project from reading the abstract. Details and discussions should be included in the longer written report. A general format for the abstract includes a paragraph on each of the following topics:

1. An introductory statement of the reason for investigating the topic of the project.
2. The purpose of the investigation--what the student attempted to prove or disprove. The project should try to set up and test a very definite question--such as "Does increasing the temperature made flowers blossom earlier?"
3. The abstract should also describe the key points and the general plan of how the investigation was done.
4. The results of the investigation or a brief analysis of how the problem was solved should be stated.
5. The conclusions from the investigation or a statement of the selected solution to the problem should be described briefly.
6. The student can summarize the project briefly by reflecting on the process or stating some applications or extensions of the topic in the final paragraph.



USING THINKING SKILLS

Heart disease is one of the biggest killers of Americans today. One method of treating people with severe heart disease is to perform a heart transplant. Another method is to give the person an artificial heart. Think about this as you answer the following questions.

1. One problem with depending on heart transplants is a shortage of heart donors. A long search is usually needed before the right heart is found for a person who needs one. How do you think doctors should decide who gets a specific heart? Explain your answer.
2. There are many problems with using an artificial heart. For one thing, people with artificial hearts have not lived for long periods of time. People who have artificial hearts have to be connected to many pieces of equipment. Should doctors continue to use artificial hearts? Explain your answer.

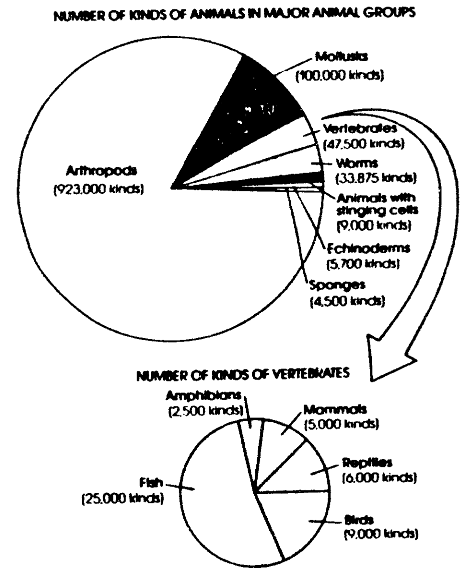
SKILL

Reading a Circle Graph

Look at these circle graphs. A circle graph is a good way to show how something is divided. The large circle graph shows how animals are divided, or classified, into major animal groups. It gives the number of different kinds of animals in each group. The smaller circle graph shows the major groups of vertebrates and gives the number of kinds in each.

Use the circle graphs to answer these questions.

1. Which is the largest major group of animals? Which is the smallest major group?
2. How many kinds of echinoderms are there? How many kinds of arthropods are there?
3. Which is the smallest group of vertebrates? The largest?
4. How many more kinds of worms are there than kinds of reptiles?

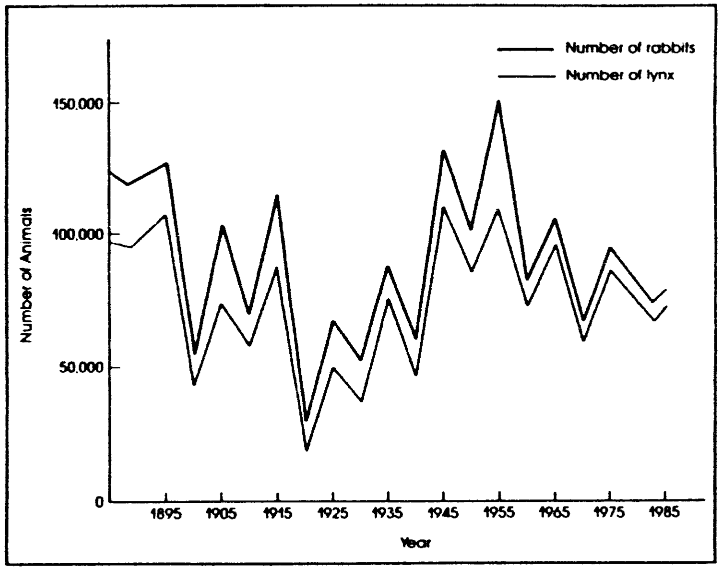


SKILL

Reading a Line Graph

Some line graphs contain only one line. Other line graphs, like the one shown here, contain two lines. This line graph compares the population of a group of lynx with the population of a group of rabbits. As you can see, the graph compares these populations over 90 years. Use the graph to answer the following questions.

1. During which year was the rabbit population the greatest?
2. During which year was the lynx population the greatest?
3. During which year was the rabbit population the lowest?
4. During which year was the lynx population the lowest?
5. What happened to the lynx population every time the rabbit population increased?
6. What happened to the lynx population every time the rabbit population decreased?



SKILL

Reading a Table

Tables can be used to show and compare information. This table gives you the names of different animal groups and the names of different animals and their young. Use the table to answer the following questions.

1. What is a female hog called?
2. What is a group of lions called?
3. What is a young kangaroo called?
4. Which animals in the table travel in groups called herds?
5. Which of the male animals are called bulls?
6. What is a young seal called? What is a young turkey called?

NAMES FOR ANIMAL GROUPS, ANIMALS, AND THEIR YOUNG

Animal	Group	Adult Male	Adult Female	Young
antelope	herd	buck	doe	kid
bear	sloth	boar	sow	cub
cat	clowder	tom	puss	kitten
cattle	herd or drove	bull	cow	calf
deer	herd	buck	doe	fawn
elephant	herd	bull	cow	calf
goose	flock or gaggle	gander	goose	gosling
hog	herd or drove	boar	sow	shoat or piglet
kangaroo	troop or mob	buck	doe	joey
lion	pride	lion	lioness	cub
rabbit	warren	buck	doe	kit or kitten
seal	herd or trip	bull	cow	pup or whelp
turkey	flock	tom	hen	poult
whale	herd	bull	cow	calf

H-37

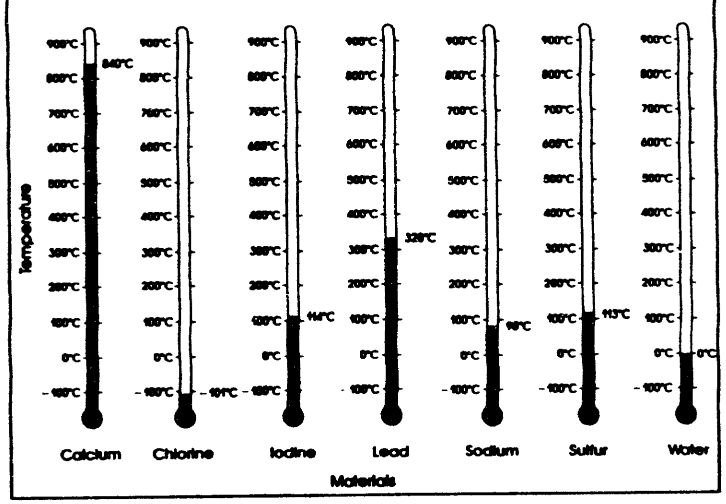
SKILL

Reading a Pictograph

A pictograph uses pictures or symbols to show information. This pictograph uses thermometers to show the freezing points of different types of matter. Use it to answer the following questions.

1. Which of the types of matter shown has the highest freezing point?
2. Which has the lowest freezing point?
3. Which has the higher freezing point–sodium or sulfur?
4. How much higher is the freezing point of lead than iodine?
5. Which of the materials shown would be a solid at room temperature (22°C)?

FREEZING POINTS OF DIFFERENT MATERIALS



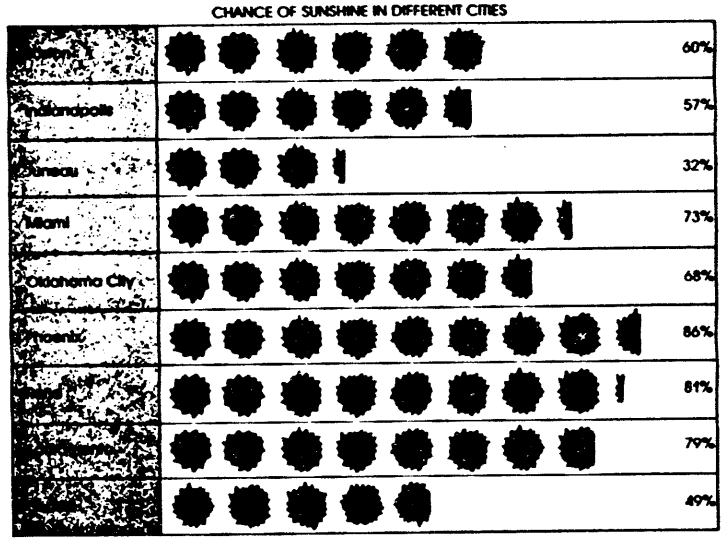
SKILL

Reading a Pictograph

Obviously, the amount of sunshine a place gets determines whether solar energy can be used there. This information can be shown with a pictograph such as the one you see here. It shows what chance there is of having a sunny day in different cities. Use the pictograph to answer the following questions.

1. In which city is there the greatest chance of having a sunny day?
2. In which city is there the least chance of having a sunny day?
3. In which of these cities is there a greater than 50 percent chance of having a sunny day? Less than a 50 percent chance?
4. Suppose you wanted to build a solar energy plant. Your research indicates that you must build the plant in a city in which there is at least a 70 percent chance of sunshine. In which of these cities could you build your plant–Boston, Seattle, Miami, or Sacramento?

CHANCE OF SUNSHINE IN DIFFERENT CITIES



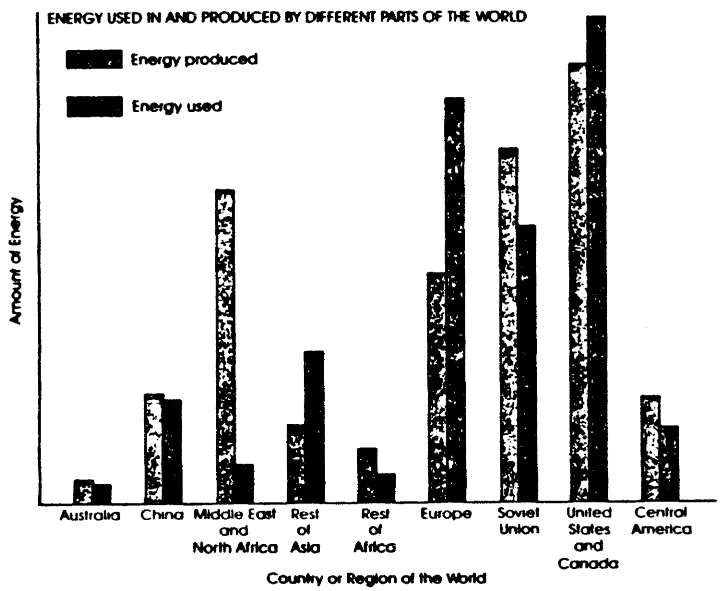
H-38

SKILL

Reading a Bar Graph

Some bar graphs can be used to compare two things at the same time. This bar graph compares the amount of energy different countries or regions produce with the amount they use. Use the graph to answer the following questions.

1. Which country or region uses the most energy? Which uses the least?
2. Which country or region produces the most energy? Which produces the least?
3. Which countries or regions produce more energy than they use?
4. Which countries or regions use more energy than they produce?
5. Which countries or regions use more energy than the United States and Canada do?

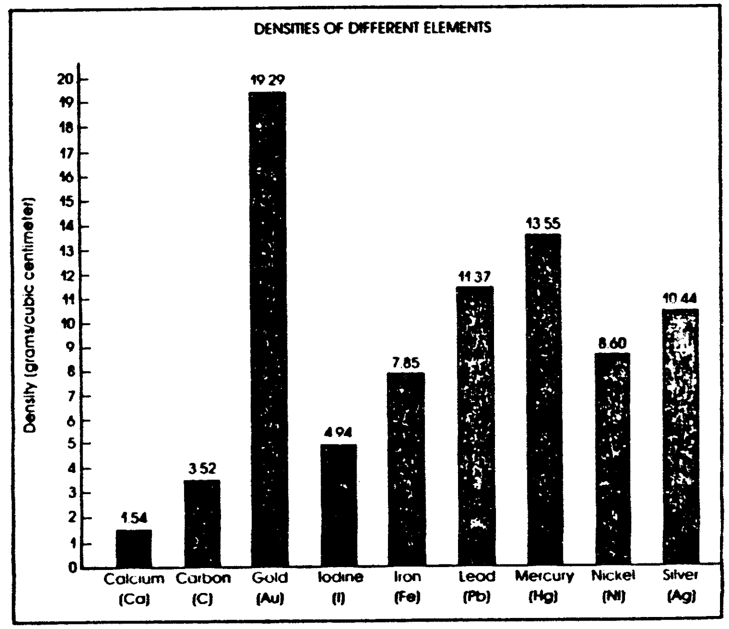


SKILL

Reading a Bar Graph

This bar graph shows the density of different elements. Use the graph to answer the following questions.

1. What is the most dense element shown?
2. What is the lea-t dense element shown?
3. Which elements shown are more dense than silver?
4. How much more dense is mercury than carbon?
5. Topaz is a mineral with a density of about 3.6. Which of the elements in the table are more dense than topaz? Which are less dense?



HANDOUTS FOR WORKSHOP STATION:

JUDGING AT THE SCIENCE FAIR

WHAT TO EXPECT DURING THE JUDGING ON THE DAY OF THE FAIR

Understandably, the students will be a bit nervous on the day of the fair. Students should remember all those bits of advice their parents and grandparents have given them about getting a good night's sleep, dressing neatly, standing up straight, speaking loudly and clearly, and making contact with the judges through the use of smiles and speaking directly to them. The judges are not specifically evaluating the student, but rather the soundness and presentation of the project done. However, it is much easier for judges to understand the student's work if they have pleasant and professional interactions with the student.

At most fairs, the judges have a chance to review each project for a few minutes before the students arrive. As a result it is important that the display have enough information on it to present a complete picture of the project by itself. It will also help the student when he or she arrives, because the student will be able to use the format of the display as a structure for his or her oral presentation to the judges. Students should be brief but address all of the components of the project.

The judges will probably have some questions. Students can prepare for these by having a relative or friend rehearse them with the student before the fair. Some common ones are:

- How or why did you get interested in this topic?
- Are there any aspects of the experiment or engineering project that you might have changed or corrected, if you had the time?
- Do you intend to continue work in this area? If so, how? If not, why not?
- What practical application or future use does your work have in the "real world"?
- Have you seen the article last month in the Such-and-Such Magazine by Dr. So-and-So dealing with the further implications of etcetera and so forth?

A student should not be afraid to admit that he or she does not know an answer or has not read the article or book in question. It is far better to be honest than to try to "snow" the judge. Science fair judges agree that the factors that come across most positively are knowledge and enthusiasm. Even if a student does not know an answer to a question, he or she can demonstrate genuine interest and enthusiasm in learning more about the question by listening to and interacting with the judge about the subject.

JUDGING CRITERIA

CREATIVE ABILITY (30%)
1. Is the project creative in
   - question asked
   - approach to solving the problem
   - analysis of the data
   - interpreting the data
   - use of equipment
   - construction or design of equipment
2. Collections are not creative
3. For engineering, avoid useless gadgets

SCIENTIFIC THOUGHT/ENGINEERING GOALS (30%) SCIENCE:
1. Is problem stated clearly?
2. Was the problem limited enough to solve but not so simple it is of limited value?
3. Was the procedure reasonable?
4. Are the variables defined?
5. Did the student recognize the need for controls and use them appropriately?
6. Was enough data taken to support the conclusion?
7. Is other appropriate scientific research cited?

ENGINEERING:
1. Is the objective clear and useful?
2. Is the solution workable, acceptable, and economic?
3. Is the solution an improvement over existing methods?
4. Has the solution been tested or possible methods of testing it been suggested?

THOROUGHNESS (15%)
1. Did the project meet its purpose within the scope of its original aims?
2. Has the problem been covered adequately?
3. Are the conclusions based on replication?
4. Was a notebook used to record all observations?
5. Were other approaches to investigating the topic considered?
6. Was enough time spend on the project?

SKILL (15%)
1. Does the student have the skills required to do all the work necessary to obtain the data which support the project?
2. What assistance was received?
3. How much of the work was the student's? What was the type and extent of help received from others?
4. Where did the equipment come from?

CLARITY (10%)
1. How clearly can the student discuss the project?
2. How clearly is the project presented and does it reflect a real understanding by the student?
3. Are important phases of the project presented in an orderly manner?
4. Are the data and results clearly presented?
5. Is the display clear and free of cute tricks/gadgets?

ADDITIONAL HANDOUT MATERIALS FOR PARENT/STUDENT WORKSHOP

Courtesy of Sandia National Laboratories

DIFFERENCES BETWEEN SCIENCE AND ENGINEERING

1. The process of science focuses on research while engineering focuses on design

2. Science produces knowledge about the world while engineering produces a physical product

THE FIVE-STEP ENGINEERING METHOD

1. PROBLEM DEFINITION AND ENGINEERING GOAL
   - Describe what the problem is and what solution is needed

2. APPROACH
   - Outline the plan to solve the problem

3. ANALYSIS
   - Begin plan execution; collect information, design possible solutions, check results

4. EVALUATION
   - Evaluate possible solutions and choose the best one

5. PRESENT RESULTS
   - Write a complete description of the final solution

THE FIVE-STEP SCIENTIFIC METHOD

1. IDENTIFY A QUESTION TO BE ANSWERED
   - Describe a curious physical behavior to be explained

2. HYPOTHESIS
   - Form a guess to explain the behavior

3. METHODOLOGY
   - Develop a plan to test the accuracy of the hypothesis

4. DATA COLLECTION AND ANALYSIS
   - Collect data according to the plan; analyze results

5. DRAW CONCLUSIONS
   - Based on the data and analysis, draw a conclusion about the accuracy of the hypothesis

EXAMPLES OF SCIENCE PROJECTS

1. Do flies have a color preference?

2. Do lighting levels affect the performance of 8th grade math students?

3. What are the effects of nitrates on bacterial reproduction rates? (Why doesn't bacon spoil very fast)

4. Can you use random numbers to simulate weather patters in Northern New Mexico?

5. Is there a relationship between age of men and the severity of allergy symptoms?

EXAMPLES OF ENGINEERING PROJECTS

1. The development of a plastic coating to retard rust on metal bridges in marine environments

2. A technique to make paper from weeds

3. A method to use nitrates to remove organic pollution from well water

4. Design and construction of a mechanical arm

5. Testing of clay materials for use as wall insulation

SAMPLE ENGINEERING PROJECT

1. **PROBLEM DEFINITION AND ENGINEERING GOAL**
   - Black roofing tar used to seal around pipes on roofs cracks in the hot NM sun. This reduces the life of the roof. A solution is to develop a way to reduce the cracking.

2. **APPROACH**
   - Outline the plan to solve the problem

3. **ANALYSIS**
   - Begin plan execution; collect information, design possible solutions, check results

4. **EVALUATION**
   - Evaluate possible solutions and choose the best one

5. **PRESENT RESULTS**
   - Write a complete description of the final solution

JUDGING CRITERIA

1. CREATIVE ABILITY (30%)

2. SCIENTIFIC THOUGHT/ENGINEER GOALS (30%)

3. THOROUGHNESS (15%)

4. SKILL (15%)

5. CLARITY (10%)

SCIENTIFIC THOUGHT/ENGINEERING GOALS (30%)

SCIENCE:
1. Is problem state clearly
2. Was the problem limited enough to solve
3. Was the procedure reasonable
4. Are the variables defined
5. Were controls used
6. Was enough data taken
7. Is other research cited

ENGINEERING:
1. Is the objective clear and useful
2. Is the solution workable, acceptable, and economic
3. Is the solution an improvement over existing methods
4. Has the solution been tested

CREATIVE ABILITY (30%)

1. Is the project creative in
   -question asked
   -approach to solving the problem
   -analysis of the data
   -interpreting the data
   -use of equipment
   -construction or design of equipment

2. Collections are not creative

3. For engineering, avoid useless gadgets

THOROUGHNESS (15%)

1. Did the project meet its purpose
2. Has the problem been addressed
3. Are the conclusion based on replication
4. Was a notebook used for observations
5. Were other approaches considered
6. Was enough time spent on the project

SKILL (15%)

1. Does the project meet the student skill
2. What assistance was received
3. How much of the work was the student's
4. Where did the equipment come from

CLARITY (10%)

1. How clearly can the student discuss the project
2. How clearly is the project presented
3. Is the project logically presented
4. Are the data clearly presented
5. Are the results clearly presented
6. Is the display clear and free of cute tricks or gadgets

STEPS IN DOING A SCIENCE FAIR PROJECT

1. IDENTIFY THE PROBLEM AND PURPOSE OF PROJECT; STATE A HYPOTHESIS (GUESS) AS TO THE SOLUTION

2. FORM PROCEDURES; ESTABLISH WHAT EXPERIMENTS TO DO; LIST ALL MATERIALS AND HOW USE THEM

3. EXPERIMENT AND COLLECT DATA; OBSERVE AND RECORD IN A NOTEBOOK; USE TABLES AND GRAPHS; USE METRIC SYSTEM

4. STATE THE RESULTS; DISCUSS WHAT HAPPENED DURING EXPERIMENTS AND HOW RESULTS MATCH THE HYPOTHESIS

5. STATE A CONCLUSION

A RESEARCH PAPER CONTAINS:

1. An abstract
2. A title page
3. The purpose of the project
4. Acknowledgement to those who helped
5. Any protocol forms for working with animals, etc.
6. Materials and methods of procedure
7. Results
8. Conclusions
9. Bibliography or list of literature cited.

Appendix I: Handout Materials for the Science Fair Teacher's In-Service Training

Courtesy of Washington Middle School

CHECKLIST FOR A SUCCESSFUL SCIENCE FAIR

1. Introduce science fair idea. Invite guest speakers (Visiting Scientists Program) to spark interest.

2. Identify school committee consisting of science and math teacher representative, librarian, principal, etc. Include parents and students if possible.

   Specific duties should be assigned and should include:

   — reserving date, time, place for local fair and open house.
   — arranging for judges (see sample letter and forms this section); hosting judges.
   — identifying awards and possible sponsors (certificates may be printed by Monroe Graphics, APS).
   — informing parents. It should be their responsibility to transport students if necessary.
   — arrangements should be made for school science fair coordinator and students to be excused from classes during day of fairs.
   — awards presentation

3. Develop Timeline. Find out dates for State and Regional Science Fairs and work backwards. First protocol review for live animal experimentation is early in November. Students should select topic by early October.

4. Involve principal and librarian early in planning stages.

5. Inform students of Judging Criteria.

"Tomorrow's Scientists are in Today's Schools"

— National Science Foundation

PRESCRIPTION FOR SUCCESSFUL SCIENCE FAIR PARTICIPATION

1. Positive commitment by teachers involved.

   - Decision should be made if projects will be mandatory.

   - Projects must be by individual students; group projects are not admissable beyond the local school.

   - Teachers must provide guidance and certify the project for further competition. Thus, when the teacher signs the sponsor's form they are giving approval of the quality and appropriateness of the project. Students should be encouraged to exhibit only their very best effort.

2. Clear communication (in writing) to students about

   - What a science project is.

   - What is expected of them.

   - What the timelines are.

   - Where they may go for help.

   - How much help they can get.

3. Continuous encouragement and follow-up

   - Schedule 10-15 minutes at least twice a week for discussions of students' progress, ideas, etc.

4. Use available resources: Teacher, librarian, a science fair contact person, parents, and professionals in the community.

5. Science department or school staff should identify a science fair committee:

   - to provide information to students and teachers

   - to plan logistics for setting up the fair exhibits

   - to arrange for judges and awards

   - to plan logistics for judging projects

6. Involve parents by making them aware of students' pursuit of project. Provide for public display of projects (i.e. open house, PTA, school newspapers, parents' newsletter, etc.)

MAIN FOCUS is not to be a top winner, but to get the students involved, to participate.

Appendix J: General Resource Materials for Organizing and Conducting the Science Fair

INFORMATION ON SCIENCE FAIR TECHNICAL PAPER COMPETITIONS

Courtesy of Northwest New Mexico Regional
Science and Engineering Fair

New Mexico Junior Academy of Science
Regional and State Paper Competition Rules

1. Before papers will be accepted for presentation, the presenting student must be a member of the N.M.J.A.S. If not paid yet during this current school year, the membership fee of $3.00 must accompany the completed **REGIONAL** entry form.

2. Although the project need not be entered in a science fair, the paper MUST reflect **actual science experimentation by the student, or theoretical work of the student in an area of pure mathematics or physics, or the development of a scientific computer model.** Papers that are simply literary 'search' papers are not acceptable for competition.

3. The maximum length of the paper is 1500 words, not including appendixes.

4. The paper MUST be typed, double-spaced, and on one side of the paper only.

5. The following information must appear on the title page: title, name of writer, age, school grade, school, school address, school telephone number, home address, home telephone number, and name and signature of teacher or sponsor who endorses the paper. Repeat the last name of writer and title of the paper at the top of each page.

6. An entry form MUST be completed and submitted with the paper.

7. Three copies of the paper (including abstracts), one for each judge, along with the completed entry form must be mailed to the Regional Director by the deadline on the entry form.

8. Each paper should be clipped together, but not bound. Judges will judge the paper on its merits before the presentation, as well as the presentation itself.

9. The author should, without fail keep a copy of the paper as protection against loss. However, all copies of the paper will be returned to the student at the close of competition.

10. Presentation time limits will be strictly enforced. Each presenter has 10 minutes maximum for the presentation and 5 minutes after the presentation for judges' questions.

11. It is strongly recommended that audio-visual aids be employed in the presentation. Audio-visual aids are limited to 35 mm slides and/or overhead transparencies. **NO OTHER AUDIO-VISUAL AIDS, such as charts, hand-held demonstrations, chemicals,** etc., are allowed. A carousel slide projector and an overhead projector will be provided at regional and state competitions.

12. Copies of the current judging forms will be sent to sponsors who request information, so there will be no confusion between judges' expectations and presenters' preparations.

13. Each regional director is responsible for ensuring that NO MORE than two entries for each division, junior and senior, are sent to state competition.

14. It may be necessary because of time constraints, if there are more that eight entries in one division, for the judges to eliminate some entries on the basis of the written paper. Those eliminated will be informed as soon as possible.

15. Senior division includes students in grades 9, 10, 11, and 12. Junior division includes students in grades 6, 7, and 8.

16. Order of presentation is determined by random drawing. Once the order of presentation is determined, **NO CHANGES WILL BE MADE**, except for absences. Failure to appear for competition on time and ready to present will result in disqualification.

17. A student may secure help in structuring, proofreading, and typing the paper. However, <u>any and all assistance MUST be noted in the acknowledgments.</u>

18. Multiple authorship of papers is not allowed, nor may a presenter have assistance during the presentation, other than technical assistance with projectors.

19. In order to promote professional courtesy, and to minimize distractions, all presenters are required to stay for the entire paper session. You should arrive at least 15 minutes before it begins, and stay until the last paper has been presented. Coming or going during the session may cause you to be disqualified.

SPONSORS: *IT IS YOUR RESPONSIBILITY TO SEE THAT THE RULES ARE FOLLOWED. USE THIS SHEET AS A CHECKLIST, SO THAT THERE ARE NO OMISSIONS OR MISUNDERSTANDINGS. SIGN THE TITLE PAGE, AFTER YOU HAVE CHECKED THIS LIST CAREFULLY.* If you have questions, feel free to contact your regional director or the state director. But please . . . do so well before the date of competition.

Rules revised: September 1989

New Mexico Junior Academy of Science
Regional and State Paper Competition

RECOMMENDED COMPONENTS FOR TECHNICAL PAPERS FOR JUNIOR ACADEMY OF SCIENCE PAPER SESSION

Technical papers are somewhat different from other literary papers in their composition. Characteristics which distinguish science research papers from other types of papers are: the abstract; the table of contents; the captioned text; and often, author-date reference citations.

There are basically two types of science research papers: reviews of the literature, and reports of empirical studies. For purposes of the Junior Academy of Science Paper competition, your paper will be a report of your empirical study, with a short literature review included in it.

You must do a science investigation, or a project in theoretical mathematics or physics, or a scientific computer model. Keep careful records of everything you do, and all your results, then write your paper. It should contain the following components:

1. Title page – containing your title, your name, your age, your school grade, your school, school address and school phone number; your home address and home phone number; and the name and signature of your teacher-sponsor.
2. Abstract – a brief statement of the contents of your paper with regard to the work that you did. In one or two paragraphs, define your problem, describe your methodology, summarize your results, and state your principal conclusions.
3. Table of contents – Use captions from your text as entries in the table of contents, and list the beginning page of each.
4. Acknowledgments – Thank people who have helped you in any way.
5. Text – consisting of the following:
   - Introduction
   - Review of the literature (cite references)
   - Materials and Methods of Experiment or Mathematical Assumptions and/or Proofs
   - Results
   - Conclusions or Discussion
6. Summary – of the whole paper
7. Glossary – if needed
8. Appendix(es) – if needed
9. References

REGIONAL SCIENCE PROJECT TIMELINE

JANUARY

Monday	Jan 6	-	Announcement of potential students
Tuesday	Jan 7	-	Regional Candidates Meeting, 8:30a Commitment letters due
Wed	Jan 8		Commitment Parent Ltrs due
Thurs	Jan 9		Mentor Workshop, 6:30p
Friday	Jan 10	-	Protocols Due
Saturday	Jan 11	-	Mentor's Workshop
Thursday	Jan 16	-	Student-Mentor-Parent Get-together, 6:30p
Saturday	Jan 18	-	Free Weekend-Monday Holiday
Saturday	Jan 25	-	Student-Mentor Workshop, 9a - 12p

FEBRUARY

Saturday	Feb 1	-	Student-Mentor Workshop, 9a - 12p
Saturday	Feb 8	-	Student-Mentor Workshop, 9a - 12p
Saturday	Feb 17	-	Free Weekend-Monday Holiday
Friday	Feb 21	-	All written reports due/Abstracts Due
Saturday	Feb 22	-	Student-Mentor Workshop, 9a - 12p
Mon-Thur	Feb 24-27	-	Teacher Edit Reports
Friday	Feb 28	-	All written data/graphs due
Saturday	Feb 29	-	Student-Mentor Workshop, 9a - 12p

MARCH

Mon-Fri	Mar 2-6	-	Board Set-up after School, 3-4:30p
Thursday	Mar 5	-	Interview Schedule/Student List to Tchrs
Friday	Mar 6	-	All typing completed - reports/abstracts Final copy of graphs/charts/word strips
Saturday	Mar 7	-	Laminate materials Final Backboard Set-Up with Mentors, 9a-3p
Mon-Tues	Mar 9-10	-	last-minute touch-ups, 3-4:30p Permission slips home
Tues	Mar 10	-	Permission slips due
Tues-Wed	Mar 10-11	-	Staff-Mentor Evaluation/Questioning, 3-4p
Thurs	Mar 12	-	Parent/Student/Mentor Set-Up/Check-In Johnson Gym - Leave School 3:30p Briefing-dress/lunch/behavior/car-pool 3p Absence list to attendance secretary
Friday	Mar 13	-	Regional Science Fair Judging, 7a - 4:30p Student Participants Report to Johnson Gym 7:00a- get items out of security, display item final set-up
Saturday	Mar 14	-	Regional Science Fair Awards Assembly Popejoy Hall, Univ of New Mexico 8:30a-12p
Monday	Mar 16	-	Project Display, Washington Middle School
Tuesday	Mar 17	-	Evaluation/board clean-up, 3p rm 205
Wed	Mar 18	-	Final board clean-up, 3p rm 205
Thursday	Mar 19	-	Student-Mentor-Parent Potluck Dinner 6p, Washington MS Cafeteria

FINIS

JOB WELL DONE

CHOOSING PROJECT CATEGORIES

Courtesy of Northwest New Mexico Regional
Science and Engineering Fair

CHOOSE THE CORRECT CATEGORY

Every year a few exhibits are placed in the wrong category. The error usually arises because the student confuses the basic idea behind the project with some of the methods or equipment used to carry out the work. For example, many projects will involve the use of a computer, but only a few will qualify for the Computer Science category. The Earth and Space category involves geology and astronomy. Solar collecting systems belong in the Environmental Science or Engineering category. Please give your students a chance to compete fairly. Double check their categories.

BEHAVIORAL AND SOCIAL SCIENCES. Psychology, sociology, anthropology, archaeology, ethology, ethnology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, reading problems, public opinion surveys, educational testing,

BIOCHEMISTRY. Molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, etc. *SEE FOOTNOTE BELOW

BOTANY. Agriculture, agronomy, horticulture, forestry, plant taxonomy, plant physiology, plant pathology, plant genetics, hydroponics, algae, etc.

CHEMISTRY. Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry, etc.

COMPUTER SCIENCE. New developments in software or hardware, information systems, computer systems organization, computer methodologies, and data (including structures, encryption, coding and information theory), etc.

EARTH AND SPACE SCIENCES. Geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum, geography, speology, mineralogy, topography, optical astronomy, radio astronomy, astrophysics, etc.

ENGINEERING. Civil, mechanical, aeronautical, chemical electrical, photographic, sound, automotive, marine, hearing and refrigerating, transportation, environmental engineering, etc. Power transmission and generation, electronics, communications, architecture, bioengineering, lasers, computers, instrumentation, etc.

ENVIRONMENTAL SCIENCES. Pollution sources and their control, waste disposal, impact studies, environmental alteration (heat, light, irrigation, erosion, etc.), ecology.

MATHEMATICS. Calculus, geometry, abstracts algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics.

MEDICINE AND HEALTH. Medicine, dentistry, pharmacology, veterinary medicine, pathology, opthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, etc.

MICROBIOLOGY. Bacteriology, virology, protozoology, fungi bacterial genetics, yeast, etc.

PHYSICS. Solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

ZOOLOGY. Animal genetics, ornithology, ichthyology, herpetology, enthomology, animal ecology, anatomy, paleontology, cellular physiology, circadian rhythms, animal husbandry, cytology, histology, animal physiology, invertebrate neurophysiology, studies of invertebrates, etc.

*BIOCHEMISTRY is a Senior Division category at the regional fairs and ISEF. Because of the small number of entries in this area in recent years, it is not a category at the State Fair.

CATEGORY INTERPRETATIONS

It is impossible to develop category descriptions which can be applied to any and all projects without some questions. In particular, the increasingly interdisciplinary nature of science and engineering means that many projects will draw upon more than one field. To determine a project category, it may therefore be necessary to identify the primary emphasis.

For example, limnology is defined as the scientific study ot the physical, chemical, meteorological, and biological conditions in fresh water. A project in limnology would thus have to be considered from the point of view of its primary emphasis (physics, chemistry, etc.) to be placed in the appropriate category.

Here is a list of project areas about which questions may arise. This is not a complete list, and is simply given to provide some basis for interpretation of the category descriptions.

Instruments.

The design and construction of a telescope, bubble chamber, laser, or other instrument would be Engineering if the design and construction were the primary purpose of the project. If a telescope were constructed, data gathered using the telescope, and an analysis presented, the project would be placed in Earth and Space Sciences.

Marine Biology. Behavioral and Social Sciences (schooling of fish), Botany (marine algae), or Zoology (sea urchins).

Fossils. Botany (remnants of ferns), Chemistry (chemical composition of fossil shells), Earth and Space Sciences (geological ages), and Zoology (prehistoric animals).

Rockets. Chemistry (rocket fuels), Earth and Space Sciences (use of a rocket as a vehicle for meteorological instruments), Engineering (design of a rocket), or Physics (computing rocket trajectories). A project on the effects of rocket acceleration on mice would go in Medicine and Health.

Genetics. Biochemistry (studies of DNA), Botany (hybrid corn), Microbiology (genetic studies of bacteria), or Zoology (fruit flies).

Vitamins. Biochemistry (how the body deals with vitamin C), Chemistry (analysis), and Medicine and Health (effects of vitamin deficiencies).

Ecology - Environment - Pollution. In a study of the eutrophication of Lake Erie: Behavioral and Social Sciences (the human beings who cause the problem), Chemistry (the process of eutrophication), Botany (growth of algae), Engineering (water purification micro-organisms), and Zoology (fish population). If the primary emphasis is environment there is an ENVIRONMENTAL SCIENCE category (1982).

Pesticides. Biochemistry (the mechanism of toxic effects), Botany (plant intake and concentration), Chemistrty (composition of pesticides), Earth and Space Sciences (mechanism of runoff), Medicine and Health (effects on human beings and animals).

Crystallography. Chemistry (crystal composition), Mathematics (symmetry), physics (lattice structure), and Earth and Space Sciences (crystal morphology and habit).

Project Categories (continued)

Speech and Hearing. Behaviorial and Social Sciences (reading problems), Engineering (hearing aids), Medicine and Health (speech defects), Physics (sound), Zoology (structure of the ear).

Radioactivity. Biochemistry, Botany, Medicine and Health, and Zoology could involve the use of tracers. Earth and Space Sciences or Physics could involve the measurement of radioactivity. Engineering could involve design and construction of detection instruments.

Space-related Projects. Note that many projects involving "space" do not go into Earth and Space Sciences: Botany (effect of zero G on plants), Medicine and Health (effects of G on human beings), Engineering (development of closed environmental system for space capsule).

LIST OF SCIENCE FAIR PROJECT TITLES

Courtesy of Northwest New Mexico Regional
Science and Engineering Fair

These lists are included because titles of previous entries can often provide ideas for new projects

SCIENCE AND ENGINEERING FAIR PROJECT TITLES

BEHAVIORAL AND SOCIAL SCIENCE :

INTELLECTUAL THINKING IN CHILDREN
WHAT ARE THE STRESS LEVELS OF H.H.S. STUDENTS
DOES WHERE STUDENTS ATTEND SCHOOL AFFECT THEIR ATTITUDES TOWARDS COLLEGE SUCCESS
WHY ARE SOME SOUNDS FOUND TO BE DISTURBING?
ASYMMETRY: LATERAL PROPENSITY VS ACTIVITY PREFERENCE
DO DAILY HABITS AFFECT THE WAY YOU DREAM
IS FIGHTING INSTINCTIVE?
FACTORS AFFECTING ANGULAR POSITION ESTIMATION CAPABILITIES
GEOMETRICAL OPTICAL ILLUSION
A COMPARISON OF MALE AND FEMALE TODDLERS VOCABULARY
IS PERSONALITY HEREDITARY?
WHAT COLOR BEST MATCHES A MOUSE?
WHO ARE BETTER AT FIGURING OUR MAZES IN THE SHORTEST PERIOD OF TIME/CHILD OR ADU
ATTITUDES ABOUT AIDS A SURVEY OF MID-SCHOOL STUDENTS
HOW DO DIFFERENT AGE GROUPS RESPOND TO OPTICAL ILLUSIONS?
CURBING THE COUCH POTATO
ACTIVITY RHYTHMS IN MICE
TEENAGE PROBLEMS
LEARNING MODALITIES
WHICH GUM'S FLAVOR LASTS THE LONGEST?
IS YOUR PERSONALITY DETERMINED BY YOUR ASTROLOGICAL SIGN?
OPTICAL ILLUSIONS: MYSTERIES OF THE BRAIN AND EYES
DO ESP ABILITIES DIFFER BETWEEN MALES AND FEMALES OF THE SAME AGE?
DOES COLOR VISION AFFECT READING ABILITY?
SIGHT AND BALANCE
MEMORY
CAN COLORS CONFUSE?
LEARNING AND MEMORY: A MAZE CHALLENGE
HOW SCIENCE LITERATE ARE PEOPLE?
GARBAGE BAGS IS SKIMPY REALLY WHIMPY
DO YOU KNOW HOW MUCH STARCH YOU EAT?
MIND GAMES
WHEN CAN YOU REMEMBER THE MOST?
DID YOU GET THE LICENSE PLATE
WILL RIGHT BRAIN LEARNERS WHO SCORE HIGH ON COMPUTER GAMES SCORE C'S OR LOWER?
FLAVORAMA
HOW CERTAIN FACTORS AFFECT LEARNING
DOES AGE AFFECT THE WAY WE ASSOCIATE COLOR WITH MOOD?
JOHNNY APPLE SEED
DOES SPACE TRAVEL AFFECT LEARING?
DO MORE THINGS HAPPEN DURING FULL MOON?
CATS-WHAT WILL THEY DO FOR FOOD?
DOES A PERSON'S READING ABILITY AFFECT HOW FASTTHEY CAN LEARN TO PLAY NINTENDO
WHAT ARE THE LEARNING PATTERNS OF MALE AND FEMALE MICE
WHICH CHOCOLATE CHIP COOKIES TASTE BEST?
WHICH OF 6 POPULAR SOFT DRINKS CONTAIN THE MOST GAS?
IS THE SENSE OF TASTE AFFECTED BY WHAT WE SEE AND SMELL/
DOES THE ORDER IN WHICH WE SELECT A SAMPLE HAVE ANY EFFECT ON OUR PREFERENCE?
A NERVOUS TESTER
DO YOU KNOW WHAT YOUR NOSE KNOWS?
HOW DO MIRRORS COMPLICATE EVERYDAY ACTIVITIES
DO O.L.A MID-SCHOOLERS KNOW THEIR GEOGRAPY?
COLOR-HOW DOES IT AFFECT US?
OPTICAL ILLUSIONS
SMELL VS. TASTE
SHORT-TERM MEMORY IN HUMANS
DOES E.S.P. REALLY EXIST?
COMPARATIVE STUDY OF VISUAL INTERPRETATION
IS YOUR FAVORITE COLOR RELATED TO YOUR PERSONALITY?
LEARNING MODALITIES PHASE II - TRACING LEARNING MODALITIES THROUGH GENERATIONS
BEAUTY, BRAINS, AND BEST FRIENDS: THE EFFECT ON THE STEREOTYPICAL RELATIONSHIP
CLASSROOM INTERACTION AND STUDENT SATISFACTION
CAN GERBILS DISTINGUISH BETWEEN BLACK AND WHITE
LUCKY LEFTIES?
BODY IMAGE: A CROSS CULTURAL STUDY OF RURAL NEW MEXICO HIGH SCHOOL STUDENT
DOES YOUR TYPE OF FINGERPRINT AFFECT YOUR SENSE OF TOUCH?
A CROSS CULTURAL STUDY OF BULIMIA
CAN QUESTIONS BE ANSWERED THROUGH DREAMS
AURAL ASSOCIATION
BABBLING FINGERS
CAN YOU TELL THE DOG'S BREED BY THE BARK PATTERN
ARCHES, LOOPS, OR WHORLS- WHICH ARE YOU?
HOW DO DREAMS RELATE TO OUR DAILY LIVES?
HOW DO DAY AND TIME AFFECT CHILD BEHAVIOR IN THE CLASSROOM?
MUSICAL CHANGES
DOES COLOR AFFECT THE READING COMPREHENSION OF DYSLEXICS

TIME OF DAY: EFFECTS ON LEARNING
PUNISHMENT OR REWARD?
BATTLE OF THE SUDS
DOES SIGHT AFFECT YOUR OTHER SENSES?
FEMALE AND MALE ATTITUDES AND PREFERENCES
PUZZLING REFLECTIONS
WHAT COLORS ARE INFANTS AND TODDLERS MOST ATTRACTED TO?
CAN CAPTIONING HELP STUDENTS LEARN?
WHAT LIGHT CONDITIONS ENABLE A PERSON TO READ MORE EASILY?
WHICH HAND HAS THE QUICKER REACTION TIME?
PRODUCT COMPARISONS
IS CHEAP THE WAY TO GO? A COMPARISON OF GUITAR STRINGS CHEAPER BRAND VS EXPENSI
IS HEAVY METAL MUSIC STRESSFUL?
IS THE CONTENT OF ADULT VS. TEEN DREAMS SIMILAR?
HOW FAST MICE LEARN
EFFECT OF EXPECTATION DIFFICULTY ON TEST RESULTS
COLOR'S EFFECT ON TASK PERCEPTION
FOOLING THE EYE WITH LINES, CIRCLES, AND COLORS
STUDYING- DOES MUSIC REALLY MAKE A DIFFERENCE?
HOW MUCH OF OUR WORLD DO WE REALLY NOTICE?
DOES YOUR SEEING IN OPTICAL ILLUSIONS IMPROVE AS YOU GET OLDER?
ILLUSIONS
ANGER
HI-TOPS VS. LOW-TOPS IN A MILE RUN
THE DIFFERENCES BETWEEN MALE AND FEMALE ATTITUDES TOWARD SCHOOL
"ARE O.L.A MID-SCHOOL STUDENTS LEARNING THEIR GEOGRAPHY?"
MICE 'N' MUSIC
ARE THERE PATTERNS IN ABSENCE FIGURES?
"PRACTICE MAKES PERFECT: A STUDY IN VISUAL-MOTOR LEARNING
MALE OR FEMALE: WHO HAS A KEENER SENSE OF SMELL?
DOES THIS MAKE GOOD SCENTS?
THE VALUE OF POPCORN
THE MOST ECONOMICAL PAPER TOWEL
EMOTIONAL RESPONSE TO COLORS
A SCHOOL FOR FISH
HOW WELL CAN YOU ESTIMATE TIME?
CHILDREN AND THEIR SEX ROLE WITH TOYS
THE EFFECTS OF HEAVY METAL
IS LEFT-HAND DOMINANCE A PREDICTOR OF ENHANCED CREATIVITY?
DOES THE BAROMETRIC PRESSURE AFFECT CHILDREN'S BEHAVIOR IN THE CLASSROOM
ALTERATIONS OF NOCTURNAL INSTINCTS
DO EIGHTH GRADERS REALLY KNOW BASIC SCIENCE?
WHERE DOES A PHYSIGNATHUS COCINCINUS HANG IT'S HAT?
WHAT SCHOOL PERIOD DO 8TH GRADE STUDENTS GET THE BEST GRADES IN?
DO STUDENTS WHO ARE INVOLVED IN EXTRACURRICULAR ACTIVITIES HAVE HIGHER G.P.A.'S?
WHICH HAND HAS A QUICKER REACTION TIME?
HOW DOES HEREDITY OF TWINS DIFFER FROM OTHER CHILDREN IN A FAMILY?
DOES TV EFFECT THE GRADES OF CHILDREN BETWEEN THE AGES OF 11 - 13?
DO MNEMONIC CLUES IMPROVE MEMORY?
CAN MICE ASSOCIATE MAZE PATTERNS WITH CORRESPONDING COLORS?
COLOR CONFUSION
THE EFFECT OF ASSOCIATION AND PRESENTATION ON PERCEIVED ATTRACTIVENESS OF FEMALE
REFLEX TIME-LAPSES
LEARNING IN A QUIET AND NOISY ENVIRONMENT
HOW ARE MOODS AFFECTED BY HOLIDAYS
COLOR AND MEMORY
AT WHAT AGE DOES A CHILD BECOME A CONSERVER?
LEARNING MODALITIES PHASE III: ATTENTION DEFICIT DISORDER-KINESTHETIC CONNECTION
CORRELATING TEMPERAMENT WITH MORAL DEVELOPMENT
DOES RIGHT-BRAIN STIMULATION AFFECT READING COMP. OF STUDENTS W/ L-DYSLEXIA?
IS THERE REALLY A DIFFERENCE?
GORILLA DOMINANCE OVER OTHERS
TRANSFER OF MEMORY BY INJECTION OF RNA
FREUD'S OEDIPAL/ELEKTRA COMPLEXES AND SEDUCTION THEORY
SUBLIMINAL MESSAGES
REPEAT AFTER ME
SOUND
CAN COLOR AFFECT A PERSON'S BLOOD PRESSURE?
HEMISPHERE DOMINANCE AND BEHAVIOR IN HUMANS
HOW DOES LIGHT AFFECT DROSOPHILA?
HOW DOES THE AGGRESSIVENESS OF CRICKETS FORM HIERARCHIES?
TASTE TEST: POPCORN
CAN YOU TASTE FOOD WITHOUT YOUR SENSE OF SIGHT OR SMELL?
DOES SLEEP LEARNING WORK
HOW CAN YOU HELP A RIGHT BRAINED STUDENT?
HOW WELL HAMSTERS CAN REMEMBER?
METHODS OF ARCHAEOLOGICAL DATING
TOTAL RECALL
"CAN ONE COMMUNICATE WITH PEOPLE IN OTHER COUNTRIES USING A TTY?"
GENDER DIFFERENCES IN SPACIAL PERCEPTION
CAN CAPTIONING HELP STUDENTS LEARN? TO CAPTION OR NOT TO CAPTION - PHASE 2
DOCUMENTING DANGEROUS DRIVERS
GENERATIONS' ATTITUDES TOWARDS ETHICAL ISSUES

AIRCRAFT PROCEDURE TRAINING
OPTICAL ILLUSIONS
IS HANDEDNESS A RESULT OF GENETICS?
HOW MANY PICTURES DO YOU REMEMBER IN A MUSIC VIDEO?
DOES COOPERATIVE LEARNING IN HAMPSTERS HAVE A + EFFECT ON THE SPEED OF PROB.
WHERE IN THE WORLD?
DOES MUSIC AFFECT TESTING?
PREFERENCES AND GRADES
A ROSE BY ANY OTHER NAME
WHICH IS MORE RELIABLE? SELF-CHARTED OR COMPUTER-CHARTED BIORHYTHMS.
SENSORIMOTOR SKILLS
HOW FAST CAN A HAMSTER RUN A MAZE
WHAT IS THE BEST COLOR FOR A STOP LIGHT?
WHICH LEARNS FASTER, A MOUSE OR A GERBIL? WHICH HAS BETTER MONEY?
IS THERE SEXISM IN THE CLASSROOM
COLA WARS!
LEFT-HANDED AND RIGHT-HANDED OPTICAL ILLUSIONS
MIRROR MAZES
PSYCHOKINESIS
COLORS: HOW DO THEY MAKE YOU FEEL?
ESP: SCIENCE OF THE MIND
TO SLEEP OR NOT TO SLEEP
ARE YOU COLOR-BLIND?
MARRIAGE, DIVORCE, ASTROLOGY - ANY RELATIONSHIP?
PEOPLE, PERSONALITY AND PETS
DO DIFFERENT SONGS AFFECT THE PULSE RATE OF THE LISTENER
DOES COLOR INFLUENCE TASTE?
DOES MUSIC AFFECT BLOOD PRESSURE?
VIOLENCE AND T.V.
TYPING SKILLS
HOROSCOPES-HOW ACCURATE?
CIRCADIAN RHYTHMS
THE EFFECT OF BACKGROUND MUSIC ON LEARNING CHEMICAL SYMBOLS
WHICH TYPE OF PEOPLE SEE THE BEST IN THE DARK?
DO LEFTIES AND RIGHTIES PERCEIVE OPTICAL ILLUSIONS THE SAME WAY?
RIGHT, LEFT OR BOTH?
HOW DOES MUSIC AFFECT VIDEO GAME PLAYERS
OPTICAL ILLUSIONS
AUDIO VERSUS VISUAL MEMORY
CHANNEL ONE SURVEY
TIME FLIES WHEN YOU ARE HAVING FUN!
THE RACE OF THE SEXES
THE NATURAL EFFECT OF COLOR ON MICE
WHAT ARE OPTICAL ILLUSIONS AND WHY DO WE SEE THEM?
IN WHICH KIND OF GUM DOES THE FLAVOR LAST LONGER?
SOUNDTRACKS: HOW THEY AFFECT THE TRAIN OF THOUGHT
INTUITIVE VS. MEASURED ANALYSIS OF VIOLIN SOUNDS
DO RIGHT OR LEFT-BRAINED PEOPLE RETAIN MORE INFORMATION?
CAN A STRONG EYE GLASS PRESCRIPTION HAVE AN EFFECT ON YOUR EYESIGHT?
DRUG AND ALCOHOL ABUSE
WHICH AGE GROUP CARES MORE ABOUT THEIR HEALTH?
DOES FAT AFFECT THE TASTE AND TEXTURE OF FOOD?
ARE COMPUTERS BETTER?
HOW RODENTS LEARN MAZES
HISTORY ON A HILLSIDE
PUCKER UP- CAN RATS SIMULATE HUMAN SOCIAL BEHAVIOR
THE DIFFERENCES IN MAZE RUNNING BEHAVIOR BETWEEN A RAT, A MOUSE AND A HAMSTER
LEARN. MODALITIES PHASE4:EFF.OF PRES.STIMULANT THERAPY ON LEARNING STYLES KIDS
MAXIMIZING WRESTLING PERFORMANCE THROUGH DIET
ARE FOURTH GRADERS MORE CREATIVE THAN SENIORS?
HAND WARMING
SLEEP...WHY DON'T WE GET ENOUGH?
WILL HEMISPHERE SPECIFIC STIM.IMPROVE READING ABILITY OF STUDENTS W/ L-DYSLEXIA
HIRLIAN PHOTOGRAPHY DEVICE: DESIGN AND EXPLORATORY EXPERIMENTATIONS
THE AFFECTS ON BABIES WHEN THEIR PARENTS USE DRUGS
DO COLORS AFFECT PEOPLE'S TEST TAKING SKILLS?
AMAZING GERBILS
DO HAMSTERS HAVE A MEMORY?
WHAT WERE 6TH GRADERS FAVORITE MOVIE OVER THE SUMMER OF 1991
COLOR AND ITS EFFECTS ON THE STRENGTH AND ENDURANCE OF PEOPLE.
DOES FULL SPECTRUM LIGHTING AFFECT PEOPLE'S BUYING
OPERANT CONDITIONING IN RATS
DO COLORS AFFECT A PERSON'S MOOD DIFFERENTLY AFTER ONE YEAR?
DREAMS
DOES COLOR INFLUENCE WHAT PRODUCTS YOU CHOOSE?
WHAT IS YOUR REACTION TO COLOR?
LOOK ALIKE COUPLES
IS THERE CORRELATION BETWEEN NOISE DEPENDENCY AND CERTAIN AGE GROUPS?
DOES TV AFFECT YOUR LEARNING?

BIOCHEMISTRY :

NITRITES
CAN METHYL SALICYLATE'S OPTICAL & THERMODYNAMIC PROP SHOW SIM IN CHEM STRUC/COMP
THE EFFECT OF EXPERIMENTAL DIABETES ON PROTEIN DEGRADATION
THE ANTIGENIC DETERMINANT PREDICTION OF AN INFLUENZA B VIRUS PROTEIN
CELLS: BACK TO THE BASICS
HOW ENZYMES AFFECT DIGESTION
CATALITIC ACTIVITY OF ENZYMES IN ORGANIC SUBSTANCES
"WHO KILLED MRS. X" A STUDY OF FORENSIC BLOOD ANALYSIS
ENZYME ACTIVITY: HOW IS IT AFFECTED?
SEPARATION AND EXAMINATION OF CHLOROPLAST PIGMENTS
GLUTEN CONTENT OF THREE FLOURS
EFFECT OF A CANCER TREATING AGENT ON THE FRAGILITY AND DEFORMITY OF HUMAN RBC'S

BOTANY :

CAN PLANTS BE CLONED?
INORGANIC AND ORGANIC SOLVENT INFUSION
CAN IT HELP THE CARROT?
COMPARISON BETWEEN THE EFFECTIVENESS OF PLANT GROWTH IN DIFFERENT TYPES OF SOIL
GEOTROPISM IN BEAN PLANTS
EFFECTS OF VITAMINS C AND E ON TOMATOES
THE EFFECT CHLORINE HAS ON PLANTS
HOW DOES FERTILIZER AFFECT PLANT GROWTH?
SO FUTURE GENERATIONS CAN HAVE A BEAUTIFUL GREEN PLANET, MAN MUST CLEAN UP ENVIR
GROWING PLANTS WITHOUT SOIL
HYDROPHOBICS:WORLD OF FUTURE FARMING
WHICH APPLES SPOLI FASTER?
CAN PLANTS BE GROWN WITHOUT SOIL?
HOW DOES X-RAY RADIATION AFFECT THE GROWTH OF POLE BEANS?
DOES MICRO-RADIATION AFFECT THE GERMINATION OF SEEDS?
HOW DO THE DIFFERENT CHEMICALS IN FERTILIZERS EFFECT PLANT GROWTH?
SMOKE CAN KILL ME
THE GROWTH OF PLANTS IN DIFFERENT FERTILIZERS
THE CREOSOTE BUSH-A TRUE FIGHTER OF THE PLANT WORLD
WHAT IS THE EFFECT OF ALFALFA ON THE GERMINATION OF PLANTS?
HOW DOES COLOR AFFECT PLANT GROWTH?
TO FERTILIZE OR NOT TO FERTILIZE
HOW DO ATMOSPHERIC GASES AFFECT THE SWEET MARJORAM PLANT?
BOTANY TWINS?
WHICH GRASS OR GRASSES WILL GROW BETTER IN THE ALBUQUERQUE AREA?
BALANCE OF NATURE
HOW DIFFERENT LIGHTS AFFECT PLANT GROWTH
PHOTOTROPISM
PHOTOTROPISM
THE PLANT EXPERIMENT
DOES IT HAVE TO BE WATER?
HOW THE AMOUNT OF LIGHT AFFECTS PLANT GROWTH
HOW A PLANT'S WATER AFFECTS IT'S GROWTH
WHY DO TUMBLEWEEDS GROW BEST IN DISTURBED SOIL?
HOW ACID SOLUTIONS AFFECT PINTO BEANS
HOW DIFFERENT SOILS AND FERTILIZERS AFFECT PLANT GROWTH
HOW DOES THE ANGLE OF SUNLIGHT AFFECT PLANT GROWTH?
EFFECT OF ENVIRONMENTAL TEMPERATURE ON CROP SEED GERMINATION
THE FIBONACCI SEQUENCE IN PLANTS: GENETIC OR AQUIRED?
ALFALFA THE ORGANIC HERBICIDE
PLANTS ARE PEOPLE TOO! DOES FREQUENT ATTENTION AFFECT THE GROWTH RATE OF PLANTS?
HOW LIGHT AFFECTS GROWTH
DOES A CHANGE IN GRAVITY EFFECT THE GERMINATION OF RADISH SEEDS?
INTRAVENOUS FEEDING: IT IS NOT JUST FOR PEOPLE ANYMORE.
THE ATOMIC GARDEN- THE EFFECTS OF RADIATION ON BEANS
HYDROPONICS OR DIRT: WHICH IS BETTER FOR PLANT GROWTH?
"WAR BETWEEN PLANTS" THE EFFECTS OF CROWDING ON PLANT GROWTH
PLANTS
DO DIFFERENT TYPES OF LIGHT AFFECT PLANTS?
PLANTS AND ELECTRICITY
FERTILIZERS
HOW DO DIFFERNT COLORED LIGHTS AFFECT PLANT GROWTH?
THE EFFECTS OF SUGAR AND SALT WATER ON THE GROWTH OF A SPIDER PLANT
GROWING POPPIES
WHAT IS THE EFFECT OF DIFFERENT KINDS OF LIGHT ON THE GERMINATION OF PEA SEEDS?
THE EFFECTS OF RADIATION ON PLANT GROWTH
WHICH PLANT CAN GROW THE BEST?
DOES THE COLOR OF LIGHT AFFECT HOW BEANS AND ZINNIZA GROW?
WHICH WAY IS DOWN?
WHAT LIGHT PRODUCES BETTER GROWTH?
FRUITS FROM FRUITS
WILL PLANTS GROW WHEN IRRIGATED WITH WATER FROM THE COAL SEAM GAS WELL

IS TRITICALE A BETTER ALTERNATIVE TO WHEAT?
CHLOROPHYLL AND FOOD
HOW WILL DIFFERENT FERTILIZERS AFFECT A SPIDER PLANT?
SHOCKING EXPERIENCE
WHAT BEANS GROW BEST IN
THE EFFECT OF COLORED LIGHTS ON THE GROWTH OF BEAN PLANTS
"EFFECTS OF MICROWAVE RADIATION ON MUNG SEEDS"
DO PLANTS KNOW WHAT THEY'RE DRINKING
DOES VITAMIN C AFFECT THE GROWTH OF THE DAYLILY
DO PLANTS GROW BETTER WITH OR WITHOUT SOIL?
PLANTS AND THEIR ATMOSPHERE
"THE EFFECT DIFFERENT COLORED LIGHTS HAVE ON PHOTOTROPHISM"
HOW PLANTS RESPOND TO DIFFERENT FOODS
DOES LIGHT AFFECT THE GERMINATION OF BEAN SEEDS?
GROWTH RINGS OF TREES
CAN PLANTS GROW WITHOUT SOIL?
THE EFFECT OF FERTILIZER ON A PLANT'S GROWTH
THE EFFECTS OF DIFFERENT MEDIA ON THE GERMINATION OF RADISH SEEDS IN LIGHT &DARK
DOES THE TIMING OF LIGHT AFFECT PLANT GROWTH?
CAN OXYGEN GAS BE PRODUCED BY A GREEN PLANT IN LIGHT
CAN PLANTS LIVE WITH SMOKERS
PHOTOSYNTHESIS
WHICH HAS MORE EVAPORATION AND WHY-PHILODENDRON, AIRPLANE PLANT, SWEDISH IVY OR
IN WHICH ENVIRONMENT WILL A BEAN PLANT GROW BEST?
DO DIFFERENT COLORS OF LIGHT AFFECT SEED GERMINATION OR PLANT GROWTH?
TERRARIUMS
CAN A TREE'S AGE BE PREDICTED BY IT'S HEIGHT?
DOES ELECTRICITY AFFECT PLANT GROWTH?
"THE EFFECTS OF LIQUIDS ON PLANTS"
DOES MUSIC AFFECT PLANTS?
WHAT EFFECT OF DARKNESS ON RIPENING PROCESS OF TOMATOES,(ON AND OFF THE VINE
THE EFFECT OF GRAVITY ON ROOTS.
WHICH KIND OF PLANT FOOD IS BETTER FOR PLANT GROWTH?
WILL CERTAIN GASES AFFECT A PLANT'S GROWTH?
PHOTOSYNTHETIC RESERVES
MINERAL MUNCHIES
PLANT ELECTRO-ECCELERATED GROWTH
WHY IS YEAST THE MAJOR PART IN COOKING TODAY?
THE EFFECT OF SALT WATER ON HOUSE PLANTS
DOES ELECROMAGNETISM HAVE AN EFFECT ON THE GROWTH OF BEAN PLANTS
WHICH NUTRIENT STIMULATES THE GROWTH OF BLUE-GREEN ALGAE?
ARE PLANTS AFFECTED BY DIFFERENT ENVIRONMENTS?
HOW DOES YEAST FERMENTATION AFFECT THE SIZE, TEXTURE, AND TASTE?
TEST OF HOUSEPLANT FOODS ON ENGLISH IVY
HOW DOES TEMPERATURE EFFECT SEED GERMINATION?
THE EFFECTS OF VITAMINS ON PLANT GROWTH
EFFECT OF SULFUR ADD.'S ON DESERT SOILS & ON GERMINATION OF PINTO BEAN AND GRASS
THE EFFECT OF SOIL SALINITY ON PLANT GROWTH
DOES THE ENVIRONMENT AFFECT THE GROWTH OF PLANTS
PLANTS AND HORIZONTAL LIGHT
DO PLANTS GROW BETTER IN DIFFERENT COLOR LIGHTS.
WHAT CONDITIONS ARE NECESSARY TO PRODUCE MOLD ON CITRUS FRUITS?
HOW DOES GEOTROPISM AFFECT PLANTS?
HOW DO DIFFERENT COLORED LIGHTS AFFECT PLANT GROWTH?
WHAT EFFECT DO COFFEE AND TEA HAVE ON PLANT GROWTH?
WHAT TYPE OF MUSIC HAS THE BEST EFFECT ON PLANTS?
HOW DIFFERENT COLORED LIGHT AFFECTS PLANT GROWTH
WHAT TYPE OF WOOD HEATS BEST?
HOW DO ELEMENTS IN THE SOIL AFFECT THE PLANT'S GROWTH?
PROJECT PLANT
AIR POLLUTION & HOW IT EFFECTS PLANTS
DOES THE COLORATION OF H20 AFFECT THE GROWTH OF RADISH PLANTS
COMPARISON IN GROWTH BETWEEN BEANS FROM EL SALVADOR AND THE U.S.
WILL FOODS MOLD UNDER THE SAME CONDITIONS?
SOIL VERSUS HYDROPONICS
"UPSIDE-DOWN AND RIGHT-SIDE UP PLANTS"
WHY LEAVES CHANGE COLORS
THE EFFECTS OF TWO FERTILIZERS ON IVY
SOLIDIFIDE CARBON DIOXIDE
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OUTLINE OF ENGINEERING METHOD

Courtesy of Sandia National Laboratories

OUTLINE OF THE ENGINEERING METHOD

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Background information about science and engineering

Before the engineering methodology can be fully appreciated, it is important to understand the differences between scientists and engineers. There are two characteristic differences: a) the process of science focuses on research while engineering focuses on design, 2) the end product of science is knowledge about the world, while engineering produces a physical product.

Scientists direct their efforts toward improving mankind's understanding of nature by searching for explanations, classifications, and models to predict natural phenomena. This process of searching is called research, and the techniques employed are referred to as the scientific method. Thus, the end product of the scientist's efforts is knowledge, sometimes without regard to its immediate application in the world.

In contrast, the end product for an engineer is a physical device, design for a device, or process or procedure. The process used in creating these end products is called design, and the techniques employed are called the engineering method. Some of the engineer's concerns in applying this method include economic feasibility, safety, manufacturability, public reactions to the design, and effectiveness of the device or process in solving a problem.

The Engineering Method:

There are five basic steps in the engineering method. These include 1) problem definition and engineering goal 2) approach, 3) analysis, 4) evaluation, and 5) presentation of results.

Each of these steps is outlined below:

Problem definition and engineering goal: The basic objective of this step is to clearly identify and describe the engineering problem. Details are provided to show that the problem is real and that a solution is needed. The limitations of the problem and the solution are outlined, and some suggestions may be put forth as to what may be acceptable solutions. The final outcome of this step is a problem statement. The engineering goal follows directly from the problem definition and is stated clearly in this section.

Approach: In this step the engineer documents the plan for achieving the engineering goal. This begins with a literature review about the problem and a discussion of the findings. This will include a presentation of previous work to solve the problem including an explanation of why these efforts failed and how much of the information can be applied to the problem. Related information will also be discussed including new technological developments or scientific innovations that may now be applied to solving the problem. This is followed by a discussion of the additional information needed to solve the problem and how this information will be obtained. The level of accuracy of experimental data is also described. Any simplifying assumptions should also be listed, especially those made to substitute for missing information.

The steps that will be used to solve the problem are then outlined in as much detail as possible. Usually the effort is separated into smaller sub-efforts, each of which has a specific objective and interrelates with the other sub-efforts to accomplish the goal. Each is described in sufficient detail to allow the plan to be easily understood by a reviewer. In general, the initial steps in the process can be seen more clearly than those that occur later, and this is reflected in the level of detail in the descriptions. In some cases, the course of the effort will rest on the decisions that will be made at a later time. In these cases, the plan centers on how the decisions will be made. The plan usually concludes with a timetable that shows the expected level of effort on each of the sub-efforts and includes expected expenditures. The purpose of this is to insure that the goal can be achieved in the required time-frame and within an acceptable budget.

Analysis: The basic objective of this step is to begin executing the plan outlined in the approach. Analysis comprises three components, including data and information gathering, design, and checking results.

Data and information gathering is the process of accumulating all of the necessary information needed to solve the engineering problem. This often includes testing and measurements of components, or systems in order to understand their operational limitations and constraints. Other information may include the advice of experts, copies of mathematical or physical models, and related literature or other documents. At this stage the engineer begins testing and measuring the effectiveness of the basic concepts of the object or process that is the goal of the effort. This testing can be done with physical, mathematical, or computer models. Testing and measuring continue until enough data exists to begin drawing conclusions about the details of the engineering solution.

At this point the engineering design begins. Design involves considering all of the data gathered to this point and using them to construct specific engineering solutions. These solutions may be a physical device, a design for a product, or a description of a process, all of which are often referred to as the design product. Even though a number of design products may be conceptualized at this time, none is rejected. The selection of the final design will occur in the evaluation step.

The purpose of checking results is to insure that no fundamental errors were made in the process of gathering information or formulating the design product. The objective is to assure that all of the information used in the developing the candidate engineering solutions is accurate and that the logic used in the design is sound.

Evaluation: In the evaluation step the engineer considers the merits of each of the proposed design products with respect to the engineering goal. The design that most effectively meets the goal is selected. In most cases, cost effectiveness is a primary concern. However, performance and/or schedule may be alternative considerations. Where cost effectiveness is the primary concern, the engineer considers the one-time costs of construction, the recurring costs of maintenance, and the effectiveness of the design to solve the engineering problem. Often the least expensive design is rejected because it is less effective in solving the engineering problem than a more expensive design. Frequently, the engineer develops various measures of merit to apply in weighing the alternatives. This helps eliminate human emotion from biasing the decision. In some cases a prototype device is built to demonstrate the viability of the design. As a final step in the process, the selected design should be compared with the original design goal to insure that it meets the main objectives.

Presentation of results: This is the final step in the process; here the engineer presents the final design product. This presentation should clearly document the entire engineering process and should contain all of the details about the final design. It is common that this be done in a final report. However, often the presentation is made verbally to the interested parties. Any recommendations for further work are also documented at this time. These recommendations frequently center on refinements that could be applied to the final design.

EXAMPLE OF HOW TO APPLY THE ENGINEERING METHOD

Problem definition and engineering goal: Suppose the problem is "Steel bridges located in marine environments have high corrosion rates that adversely affect maintenance costs and safety." An associated engineering goal might be "to identify an inexpensive metal coating for use in retarding corrosion of bridge materials in marine environments."

Approach: The basic approach to this problem is be to identify various types of metal coatings, test them on steel in humid environments, and select the best coating to be applied to bridges.

Analysis: This step begins with a library literature search about metal coating materials and any other type of coating materials that can be applied to steel. Based on the results of the search, some sample material will be acquired for testing. The testing may involve the application of the sample coatings to steel and subjecting the steel to a humid, salty environment (this may be simulated with salt water). The results will be noted. After all of the materials have been tested, all of the test results will be carefully checked to insure accuracy. Often this will involve another person to review the analysis.

Evaluation: In this step, the test results are reviewed and the best performing materials are selected for further evaluation regarding the cost of the materials, their market availability, durability, ease of application, and maintenance. In this case, the goal is for the most cost-effective solution. So the coating that gives the best protection for the lowest installation and maintenance costs is selected. To insure that this coating is an appropriate choice, further analysis may be needed. The engineer returns to the analysis step and applies the selected coating to a real (or model) bridge. The results are then evaluated and a final conclusion is drawn.

Presentation of results: The final results are presented in a report that documents, in detail, each of the steps the engineer used in the process of selecting a coating. A poster or oral presentation will contain highlights of the process along with the final conclusion, but will contain much less detail than the report.

REFERENCES

Beakley, G., and Leach, H., Engineering, The MacMillan Co., NY, NY, 1970.

Buhl, H., Creative Engineering Design, Iowa State University Press, Ames, Iowa, 1960.

Fish, J., The Engineering Method, Stanford University Press, Stanford, CA, 1950.

Krick, E., An Introduction to Engineering and Engineering Design, John Wiley & Sons, Inc., NY, NY, 1969.

PROJECT RULES, SAFETY RULES, AND DEFINITIONS (PROTOCOL)

Courtesy of Northwest New Mexico Regional
Science and Engineering Fair

(Reprinted courtesy of SCIENCE SERVICE,
1719 N Street, N.W., Washington, DC 20036, 202/785-2255)

GETTING STARTED

Before you begin, please note that research refers to library research and information gathering. Experimentation refers to work done in the field or laboratory after forming a hypothesis.

A) Pick Your Topic. Get an idea of what you want to study. Ideas might come from hobbies or problems you see that need solutions. Limit your topic, as you have little time and resources. You may want to study only one or two specific events. (See page 9 for resources.)

B) Research Your Topic. Go to the library and read everything you can on your topic. Observe related events. Gather existing information on your topic. Look for unexplained or unexpected results. At the same time, talk to professionals in the field, write to companies for information, and obtain or construct needed equipment.

C) Organize and Theorize. Organize everything you have learned about your topic. At this point you should narrow down your hypothesis by focusing on a particular idea. Your library research should help you.

D) Make a Timetable. As you narrow your ideas, remember to choose a topic that not only interests you, but can be done in the amount of time you have. Get out a calendar to mark important dates. Make sure to leave a week to fill out the necessary forms and to review your Research Plan with your Sponsor. Some projects need approval from a Scientific Review Committee (SRC) before they are started, so be sure to allow time for that process. Give yourself plenty of time to experiment and collect data -- even simple experiments do not always go as you might expect the first time, or even the second time. After you have finished your experiments, you will probably need a few weeks to write a paper and put together an exhibit.

E) Plan Out Your Research. Once you have a feasible project idea, you should write out a research plan. This plan should explain how you will do your experiment and exactly what it will involve. ***Any student participating in the ISEF is required to complete the Research Plan And Approval Form.***

F) Consult Your Adult Sponsor. You are ***required*** to discuss your Research Plan with your Adult Sponsor and get his/her signature of approval. Your Sponsor should review your Research Plan and use the Checklist on page 13 to determine if you need any additional forms and/or SRC approval.

G) Conduct Your Experiments. Give careful thought to designing your experiments. As you conduct your research and experiment, keep detailed notes of each and every experiment, measurement, and observation. ***Do not rely on your memory.*** Remember to change only one variable at a time when experimenting, and make sure to include control experiments in which none of the variables are changed. Make sure you include sufficient numbers of test subjects in both control and experimental groups.

H) Examine Your Results. When you complete your experiments, examine and organize your findings. Did your experiments give you the expected results? Why or why not? Was your experiment performed with the exact same steps each time? Are there other causes that you had not considered or observed? Were there errors in your observations? Remember that understanding errors and reporting that a suspected variable did not change the results can be valuable information.

I) Draw Conclusions. Which variables are important? Did you collect enough data? Do you need to do more experimenting? Keep an open mind -- never alter results to fit a theory. Remember, if your results do not support your original hypothesis, you still have accomplished successful scientific research. An experiment is done to prove or disprove a hypothesis.

Eligibility

Each ISEF affiliated fair may send up to two Finalists and one team project to the ISEF. Any student in grades 9-12 or equivalent is eligible, none of whom has reached age 21 on or before May 1 preceding the ISEF.

Requirements

1) Every student must complete Research Plan (1A) and Approval Form (1B).

2) Certain projects require additional forms. Experiments that involve human subjects, nonhuman vertebrate animals, pathogenic agents, controlled substances, recombinant DNA, or human/animal tissue require approval from an Institutional Review Board (IRB) or Scientific Review Committee (SRC) **before** experimentation begins. (see Checklist p. 11)

3) Each student must submit a (maximum) 250-word abstract. (See p. 8.)

4) Each student must display a project notebook, and a research paper is strongly recommended. (See p. 8)

5) All signed forms, certifications, and permits must be available for review at each fair a student enters. We recommend these be kept in a notebook or folder.

Limitations

1) Each student may enter only **one** project.

2) Students may only use research completed since the last ISEF, although limited reference can be made to previous years' work. However, <u>students will be judged on the current year's work only</u>. Any continuing research must document substantial expansion of experimentation. Documentation must include any previous abstracts and research reports, as well as permits and forms that were approved by an SRC. Attach signed copies to the current year's research plan and forms.

3) Team Projects may have a maximum of three persons (see page 6).

4) ISEF exhibits must adhere to ISEF safety and size requirements (see p. 5).

5) Students may compete in only **one** ISEF affiliated fair, except when proceeding on to a state fair affiliated with the ISEF.

Science Research & the Scientific Method

Science research tries to solve a problem or answer a question about people and the world in which we live. *When choosing your topic, give careful thought to how your research might enhance the world and its inhabitants.*

Good scientists, both young and old, use the scientific method to study what they see in the world for cause and effect. By following the six stages listed below, you can produce a superior scientific experiment:

1) Be curious, identify, or originate/define a problem.

2) Review published materials related to your problem.

3) Evaluate possible solutions and make your educated guess (hypothesis).

4) Challenge and test your hypothesis through experimentation and analysis.

5) Evaluate the results of your experiment and reach conclusions based on your data.

6) Prepare your report and exhibit.

****

Additional Sources for Doing Science Projects

1001 Ideas for Science Projects
By Marion A. Brisk, Ph.D.
Prentice Hall 1992

The Complete Handbook of Science Fair Projects
By Julianne Blair Bochinski
Wiley Science Editions, 1991

Students and Research: Practical Strategies for Science Classrooms and Competitions
By Julia Cochran, Ron Giese, and Dick Rezba

****

Display and Safety Regulations

Unacceptable for Display

1) living organisms (e.g., plants, animals, microbes)
2) dried plant materials
3) taxidermy specimens or parts
4) preserved vertebrate or invertebrate animals (includes embryos)
5) soil or waste samples
6) chemicals including water
7) human/animal parts (**Exceptions**: teeth, hair, nails, dried animal bones, histological sections, and wet mount tissue slides)
8) human or animal food
9) sharp items (i.e., syringes, needles, pipettes)
10) poisons, drugs, controlled substances
11) dry ice or other sublimating solids
12) flames or highly flammable display materials
13) tanks that have contained combustible liquids or gases, **UNLESS** purged with carbon dioxide
14) batteries with open top cells
15) awards, medals, business cards, flags, etc.
16) photographs or other visual presentations depicting vertebrate animals in other-than-normal conditions (i.e., surgical techniques, dissection, necropsies or other lab techniques)

Acceptable for Display Only (cannot be operated)

1) Projects with unshielded belts, pulleys, chains, and moving parts with tension or pinch points
2) Class III and IV lasers

Acceptable for Display & Operation With Restrictions

1) Class II lasers:
   a) must be student-operated
   b) posted sign must read "Laser radiation: Do Not Stare Into Beam"
   c) must have protective housing that prevents access to beam
   d) must be disconnected when not operating
2) Large vacuum tubes or dangerous ray-generating devices must be shielded properly.
3) Pressurized tanks that contained noncombustibles may be allowable if secured.
4) Any apparatus producing temperatures that will cause physical burns must be adequately insulated.
5) High-voltage equipment must be shielded with a grounded metal box or cage to prevent accidental contact.
6) High-voltage wiring, switches, and metal parts must have adequate insulation and overload safety factors, and must be inaccessible to others.
7) Electric circuits for 110-volt AC must have a nine-foot (min.) cord. The cord must have sufficient load-carrying capacity and be approved by Underwriters Laboratories.
8) Electrical connections in 110-volt circuits must be soldered or made with approved connectors. Connecting wires must be insulated.
9) Bare wire and exposed knife switches may be used only in circuits of 12 volts or less; otherwise, standard enclosed switches are required.

Size

Project space limitations:
76 cm (30 in) deep
122 cm (48 in) wide
274 cm (108 in) high

Tables are 76 cm high.

ISEF Category Descriptions

1) **Behavioral and Social Sciences**
   Human and Animal Behavior, Social and Community Relationships

2) **Biochemistry**
   Chemistry of life processes

3) **Botany**
   Study of plant life

4) **Chemistry**
   Study of the nature and composition of matter and laws governing it

5) **Computer Science**
   Study and development of computer software and hardware and associated logical devices

6) **Earth and Space Sciences**
   Geology, Mineralogy, Physiography, Oceanography, Meteorology, Climatology, Astronomy

7) **Engineering**
   Technology; projects that directly apply scientific principles to manufacturing and practical uses

8) **Environmental Sciences**
   Study of pollution (air, water, and land) sources and their control; Ecology

9) **Mathematics**
   Development of formal logical systems or various numerical and algebraic computations, and the application of these principles

10) **Medicine and Health**
    Study of diseases and health of humans and animals

11) **Microbiology**
    Biology of microorganisms

12) **Physics**
    Theories, principles, and laws governing energy and the effect of energy on matter

13) **Zoology**
    Study of animals

14) **Team Projects**
    All disciplines

Team Projects

Team Projects compete against each other in a multidisciplinary 14th Category. An ISEF affiliated fair has the option of sending a team project in addition to two individual projects. Team Projects are not required but are encouraged.

Teams may have up to three members. Teams planning to participate in the ISEF must adhere to ISEF requirements of no more than three members. NOTE: Teams may not have more than three members at a local fair and then eliminate members to qualify for the ISEF.

Each team should appoint a team leader to coordinate the work and act as spokesperson. However, each member of the team should be able to serve as spokesperson, be fully involved with the project, and be familiar with all aspects of the project.

The final work should reflect the coordinated efforts of all team members and will be evaluated using the same rules and similar judging criteria as the other 13 categories (see below). The team jointly submits one abstract and one research plan that outlines each person's tasks.

****

Judging

In particular, judges evaluate 1) how well a student followed the scientific method; 2) detail and accuracy of research notebook; and 3) if tools/equipment were used in the best possible way.

Overall, judges look for well thought-out research. They look at how significant your project is in its field, as well as how thorough you were. Did you leave something out? Did you start with four experiments and finish only three?

Judges applaud those students who can speak freely and confidently about their research. They are not interested in memorized speeches -- they simply want to TALK with you about your research to see if you have a good grasp of your project from start to finish. Besides asking the obvious questions, judges often ask questions outside the normal scope to test your insight into your research such as "What didn't you do?" and "What would be your next step?"

	Individual	Team
Creative Ability	30	25
Scientific Thought & Engineering Goals	30	25
Thoroughness	15	12
Skill	15	12
Clarity	10	10
Teamwork	—	16

Getting Started

A) Pick Your Topic. Get an idea of what you want to study. Ideas might come from hobbies or problems you see that need solutions. Due to limited time and resources, you may want to study only one or two specific events.

B) Research Your Topic. Go to the library and read everything you can on your topic. Observe related events. Gather existing information on your topic. Look for unexplained or unexpected results. Also, talk to professionals in the field, write to companies for **specific** information, and obtain or construct needed equipment.

C) Organize and Theorize. Organize everything you have learned about your topic. At this point you should narrow down your hypothesis by focusing on a particular idea. Your library research should help you.

D) Make a Timetable. Choose a topic that not only interests you, but can be done in the amount of time you have. Use a calendar to identify important dates. Leave time to fill out the forms and to review the Research Plan with your Sponsor. Certain projects require more time because they need prior Scientific Review Committee (SRC) approval. Allow plenty of time to experiment and collect data—even simple experiments do not always go as you might expect the first time, or even the second time. Also leave time to write a paper and put together an exhibit.

E) Plan Your Experiment. Once you have a feasible project idea, write a research plan. This plan should explain how you will do your experiment and exactly what it will involve. **All students participating in the ISEF and affiliated fairs are required to complete Research Plan (1A).**

F) Consult Your Adult Sponsor. You are *required* to discuss your research plan with an Adult Sponsor and obtain a signature of approval. In reviewing Research Plan (1A), your Sponsor should determine if additional forms and/or IRB/SRC approval is needed.

G) Conduct Your Experiments. Give careful thought to experimental design. During experimentation, keep detailed notes of each and every experiment, measurement, and observation. ***Do not rely on your memory.*** Remember to change only one variable at a time when experimenting, and make sure to include control experiments in which none of the variables are changed. Make sure you include sufficient numbers of test subjects in both control and experimental groups. **A group must have five or more subjects to be statistically valid.**

H) Examine Your Results. When you complete your experiments, examine and organize your findings. Did your experiments give you the expected results? Why or why not? Was your experiment performed with the exact same steps each time? Are there other causes that you had not considered or observed? Were there errors in your observations? Remember that understanding errors and reporting that a suspected variable did not change the results can be valuable information. If possible, statistically analyze your data.

I) Draw Conclusions. Which variables are important? Did you collect enough data? Do you need to conduct more experimentation? Keep an open mind -- never alter results to fit a theory. If your results do not support your original hypothesis, you still have accomplished successful scientific research. An experiment is done to prove or disprove a hypothesis.

Helpful Hints

A Good Title

Your title is an extremely important attention-grabber. A good title should simply and accurately present your research. The title should make the casual observer want to know more.

Take Photographs

Many projects involve elements that may not be safely exhibited at the fair, but are an important part of the project. You might want to take photographs of important parts/phases of your experiment to use in your display. Photographs or other visual images of human test subjects must have informed consent.

Be Organized

Make sure your display is logically presented and easy to read. A quick glance should permit anyone (particularly the judges) to locate quickly the title, experiment, results, and conclusions. When you arrange your display, imagine you are seeing it for the first time.

Eye-Catching

Make your display stand out. Use neat, colorful headings, charts, and graphs to present your project. Home-built equipment, construction paper, and colored markers are excellent for project displays. Pay special attention to the labeling of graphs, charts, diagrams, and tables. Each item must have a descriptive title. Anyone should be able to understand the visuals without further explanation.

Correctly Presented & Well Constructed

Be sure to adhere to the size limitations and safety rules when displaying your project. Display all required forms for your project. Make sure your display is sturdy, as it will need to hold up for quite a while. Do not hesitate to ask for advice from adults if you need it. (Remind your Sponsor to check the display rules.)

A top-notch science project includes four elements:

1) PROJECT NOTEBOOK
A project notebook is your most treasured piece of work. Accurate and detailed notes make a logical and winning project. Good notes show consistency and thoroughness to the judges, and help when writing a paper.

2) ABSTRACT
After finishing research and experimentation, you are required to write a (maximum) 250-word abstract. An abstract should include the purpose of the experiment and the procedures used, as well as the data and conclusions. It also may include any possible research applications.

3) RESEARCH PAPER
A research paper should be displayed along with a project notebook, and any necessary forms or relevant written materials. A research paper helps organize data as well as thoughts. A good report includes eight sections. Most sections should be short, except for the discussion.

a) Title Page. Center the project title, and put your name, address, school, and grade at the bottom right.

b) Table of Contents. Number each section when finished.

c) Introduction. The introduction sets the scene for your report. The introduction includes your hypothesis, and explain what prompted your research and what you hoped to achieve.

d) The Experiment. Describe in detail the methodology used to derive your data and observations. Your report should be detailed enough so that someone would be able to repeat the experiment just by reading the paper. Include detailed photographs or drawings of self-designed equipment.

e) Discussion. The discussion is the meat of your paper. The results and conclusions should flow smoothly and logically from your data. **Be thorough**. Take readers through your train of thought, letting them know exactly what you did. Compare your results with theoretical values, published data, commonly held beliefs, and/or expected results. Also include a discussion of possible errors. How did the data vary between repeated observations of similar events? How were your results affected by uncontrolled events? What would you do differently if you repeated this project? What other experiments should be conducted?

f) Conclusion. Briefly summarize your results. Be specific, do not generalize. Never introduce anything in the conclusion that has not already been discussed.

g) Acknowledgments. You should always credit in your paper those who assisted you, including people, businesses, and institutions, as well as financial support and donated materials.

h) References. Your reference list should include any material that is not your own (i.e., books, journal articles). See an appropriate reference in your discipline.

4) VISUAL DISPLAY
You want to attract and inform. Make it easy for interested spectators and judges to assess your study and the results you have obtained. Make the most of your space using clear and concise displays. Make headings stand out, and draw graphs and diagrams clearly and label them correctly. You would be surprised how often visuals are mislabeled, so pay careful attention.

Scientific Review Committee (SRC)

A Scientific Review Committee (SRC) examines projects for the following:
1) Evidence of library search
2) Type and amount of supervision
3) Use of accepted research techniques
4) Completed forms and signatures
5) Humane treatment of animals
6) Compliance with rules and laws governing human and animal research
7) Appropriate use of recombinant DNA, pathogenic organisms, and controlled substances

The SRC follows a three-step process:

1) Before experimentation, the SRC reviews and approves experimental procedures for projects involving human subjects, nonhuman vertebrates, pathogenic agents, controlled substances, recombinant DNA, and human/animal tissue to make sure they comply with the Rules and any pertinent laws.

2) After experimentation and before the regional fair, the SRC reviews and approves those same projects to make sure the student followed the approved research plan and the Rules.

3) After experimentation and before the regional fair, the SRC also reviews all remaining projects to make sure the student followed the Rules.

Institutional Review Board (IRB)

An Institutional Review Board (IRB) reviews all projects involving human subjects. They review the research plan and any surveys or questionnaires used, and determine the risk to the human subjects, paying special attention to risk assesment (physical and physiological). All human studies must comply with federal regulations. Any subjects under 18 must have consent from a parent/guardian to participate in the study. Parents have the right to deny participation, including studies using surveys.

Students may not administer medications to human subjects. In addition, students may only observe and collect data for new procedures and medications when human patients are involved.

Research Plan (1A)

This form is required for ALL projects.

Student's Name ______________________ ______________________

School ______________________

Affiliated Fair Name ______________________ Fair ID # ______________________

Title of Project ______________________

Is this a continuation from a previous year? ☐ Yes ☐ No Proposed starting date of experimentation: ___/___/___

Where will you complete your lab work? ☐ Home ☐ School ☐ Research Institution ☐ Field

Name and Address of work site: ______________________

____

These areas of study require approval from a Scientific Review Committee (SRC) before you begin experimentation. Check off any items that apply:

☐ Vertebrate Animals (See page 25 and complete the appropriate forms.)
☐ Pathogenic Agents (See page 31 and complete the appropriate forms.)
☐ Controlled Substances (See page 33 and complete the appropriate forms.)
☐ Recombinant DNA (See page 35 and complete the appropriate forms.)
☐ Human/Animal Tissue (See page 37 and complete the appropriate forms.)

Studies involving Human Subjects require approval from an Institutional Review Board (IRB) before experimentation begins.

☐ Human Subjects (See page 21 and complete the appropriate forms.)

Please type here or attach a separate computer printout.

1) What is the problem or question you intend to investigate?

2) Describe in detail the method or procedures you intend to use.

3) Bibliography. List at least three major sources (i.e., science journal articles, books) from your library research. If you plan to use animals, give an additional animal care reference.

Approval Form (1B)

1) **Required for all projects.**

Adult Sponsor Approval

I have read the Research Plan on the reverse side and reviewed the sponsor checklist on page 11 with the student. I agree to sponsor the student named below and assume responsibility for compliance with all ISEF and affiliated fair rules as they pertain to the Research Plan.

____________________________ ____________
Adult Sponsor's Signature Date

2A) **Required only for those projects that need prior approval (i.e., see checklist box on reverse side).**

SRC Approval Before Experimentation

The Committee has carefully studied this research plan and all the required forms are included. My signature indicates approval of this research plan before the student begins experimentation.

____________________________ ____________
☐ Local or ☐ Affiliated Fair Date
SRC Chairperson's Signature

2B) **Required for research conducted at summer institutes when an SRC is not available.**

SRC Approval After Experimentation

The Committee did not review and approve this research plan before experimentation. However, this project complies with ISEF Rules and was conducted at a registered research institution (e.g., university lab, medical center, NIH, student science training program).

____________________________ ____________
☐ Local or ☐ Affiliated Fair Date
SRC Chairperson's Signature

3) **Required for all projects.**

Student Approval

I understand the risks and possible dangers to me of the proposed research plan. I will adhere to all ISEF Rules when conducting this research.

____________________________ ____________
Student's Signature Date

4) **Required for all projects.**

Parent/Guardian Approval

I have read and understand the risks and possible dangers involved in the Sponsor-approved research plan. I consent to my child participating in this research.

____________________________ ____________
Parent/Guardian Signature Date

5) **Required for all projects.**

SRC Approval Before Competition at Regional Fair

I certify this project adheres to the approved research plan and complies with ISEF Rules.

____________________________ ____________
Regional SRC Chairperson's Signature Date Signed

____________________________ ____________
State SRC Chairperson's Signature *Date Approved

*If the regional/state fair does not return a signed copy of this form to the student, the SRC Chair should re-sign the form and provide the date the research plan was originally approved. This eliminates backdating.

Checklist for Adult Sponsor

1) ☐ I have reviewed and signed the **Research Plan (1A)/Approval Form (1B)**

2) ☐ The student and a parent/guardian have signed the **Approval Form (1B)**.

3) ☐ This project involves the following area(s) and requires prior approval:

- ☐ **Human Subjects**
- ☐ **Nonhuman Vertebrate Animals**
- ☐ **Pathogenic Agents**
- ☐ **Controlled Substances**
- ☐ **Recombinant DNA**
- ☐ **Human or Animal Tissue**

Section 1: **Human Subjects**
If a project involves human subjects, the student must have approval from an **Institutional Review Board (IRB)** before experimentation is started. (See pp. 21-23.)

Section 2: **Nonhuman Vertebrate Animals, Pathogenic Agents, Controlled Substances, Recombinant DNA, Human/Animal Tissue**
If a project involves nonhuman vertebrate animals, pathogenic agents, controlled substances, recombinant DNA, or human/animal tissue, the student must have approval from a **Scientific Review Committee (SRC)** before experimentation is started. (See p. 25-37.)

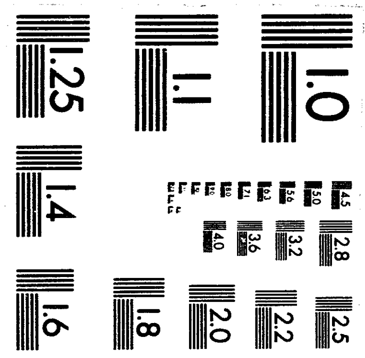
Section 3: **Areas that require review but do not require prior approval**

☐ **Chemicals** (i.e., explosive or highly toxic; carcinogens; mutagens). I have reviewed with the student the Material Safety Data Sheet (MSDS) Listing for each chemical that will be used. I have also reviewed the proper safety standards for each chemical including toxicity data, proper handling techniques, and disposal methods. For *Safety in the High School*, write to the American Chemical Society, Career Publications, 1155 16th St., NW, Washington, DC 20036 (202/872-6168).

☐ **Equipment** (i.e., welders; lasers; voltage greater than 220 volts). I have reviewed with the student the proper operational procedures and safety precautions for the student's equipment. For information about laser standards and research, write to the Food and Drug Administration, Office of Compliance and Surveillance, 1390 Piccard Drive, Rockville, MD 20850 (301/427-1172).

☐ **Radioactive Substances**. I have reviewed the proper safety standards for each radioactive substance the student will use.

☐ **Radiation** (i.e., x-ray or nuclear; unshielded ionizing radiation of 100-400 nm wavelength). I have reviewed with the student the proper safety methods concerning the type of radiation the student will use.


1.25
1.1
1.0
1.4
4.5
5.0
5.6
4.0
3.6
3.2
2.8
1.6
1.8
2.0
2.2
2.5

4 of 4

QUALIFIED SCIENTIST FORM (2A)

Required for research involving Humans, Animals, Controlled Substances, or Pathogens.

Must be signed prior to the start of student experimentation

Student's Name ______________________________

School ______________________________

Title of Project ______________________________

TO BE COMPLETED BY THE QUALIFIED SCIENTIST

Scientist's Name ______________________________

Earned Advanced Degree ______________________________

Position ______________________________

Institution ______________________________

Address ______________________________

Phone ______________________________

Vertebrate Animals used?	☐ yes	☐ no
Human subjects used?	☐ yes	☐ no
Controlled substance used?	☐ yes	☐ no
Controlled substances were used according to existing local state and federal law?	☐ yes	☐ no
Substance Name(s): ______________	**Scientist's DEA #** ______________	
Recombinant DNA used?	☐ yes	☐ no
Pathogenic agents used?	☐ yes	☐ no
If so, according to accepted procedures?	☐ yes	☐ no

I certify that I have reviewed and approved the Research Plan prior to the start of the research, that if the student or Designated Supervisor is not trained in the necessary procedures I will ensure his/her training, that I will provide advice and supervision during the research, and that I am a Qualified Scientist with a working knowledge of the techniques to be used by the student in this Research Plan. I understand that a Designated Supervisor is required when the student is not conducting his/her research in my laboratory.

______________________________   ____/____/____
Qualified Scientist's Signature   Date

______________________________   ____/____/____
Designated Supervisor Signature (if applicable)   Date

Please turn over for more questions

(2B) To be completed by the Qualified Scientist after research is completed if research was conducted in an institutional setting (*e.g.*, university lab, medical center, NIH, SSTP, etc.).

This form should be displayed with the project at the ISEF.

Student's Name ______________________________

High School ______________________________

Title of Project ______________________________

TO BE COMPLETED BY THE QUALIFIED SCIENTIST

1. How did the student get the idea for his/her project?
   Was the project assigned, was it picked from a list of possible research topics, did it come out of discussion with a scientist, did it arise from some work in which the student was engaged, or did the student suggest it?

2. Did the student work on the project as part of a team or a group?
   If so, how big was the team, what kind of a team was it (students, group of adult researchers, etc.), and what was the student's role on the team?

3. How independently did the student work on the project?
   What parts did the student do on his/her own, and what parts did he/she receive help with (the experimental design, choice of techniques, use of special instruments or equipment, construction of equipment, gathering data, evaluation of data, arriving at conclusions, etc.)?

4. What did the student do that showed creativity and ingenuity?
   Do you know of any examples? If so, were they creative in terms of science; or what is more likely, was it creative for a high school student? Was it in experimental design, construction or use of equipment, evaluation of data, etc.?

5. Has the student received a salary or other compensation for doing his/her research?

6. Other comments?

____
Scientist's Signature   Title

______________________________   ____/____/____
Institution   Date

DESIGNATED SUPERVISOR FORM (3)

Required if the Qualified Scientist is unable to supervise the experiment

Student's Name ______________________________

High School ______________________________

Title of Project ______________________________

TO BE COMPLETED BY THE DESIGNATED SUPERVISOR

Your N.,me ______________________________

Position ______________________________

Institution ______________________________

Address ______________________________

____

Phone ______________________________

I certify that I have been trained in the techniques to be used by this student prior to the start of experimentation and that I will provide direct supervision.

______________________________ Designated Supervisor Signature

_____/_____/_____ Date

ADULT SPONSOR SECTION

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Who Is Involved in a Science Project?

Teachers, scientists, parents and adult volunteers inspire and encourage students to explore and investigate their world through hands-on research. Those of you who work with these young people are too rarely recognized, and never can be adequately thanked. Without you, science projects and science fairs would not be possible. Science Service applauds your commitment and appreciates your hard work. We sincerely hope that our efforts to streamline the ISEF Rules will become a continuing dialogue and will assist you in some small way. The following descriptions identify the players:

The Adult Sponsor

Who is an Adult Sponsor? An adult sponsor may be a teacher, parent, university professor, or scientist in whose lab the student is working. This individual must have a solid background in science and should have close contact with the student during the course of the project.

What does an Adult Sponsor do? The Adult Sponsor is ultimately responsible not only for the health and safety of the student conducting the research, but also for the humans or animals used as subjects. The Adult Sponsor must review the student's research plan to make sure that a) experimentation is done within local, federal, and ISEF guidelines, and b) that forms are completed by any other adults involved in approving or supervising any part of the experiment.

The Adult Sponsor must be familiar with the regulations that govern potentially dangerous research, including chemical and equipment usage, experimental techniques, research involving human or nonhuman animals, and cell cultures, microorganisms, or animal tissues as they apply to the specific projects under supervision. These issues must be discussed with the student when drafting the research plan.

Some experiments involve procedures or materials that are regulated by state and federal laws. If the Adult Sponsor is not thoroughly familiar with them, he or she should help the student to enlist the aid of a Qualified Scientist to navigate those waters.

The Adult Sponsor is responsible for making the student's research eligible for entry in the International Science and Engineering Fair.

The Qualified Scientist

Who is a Qualified Scientist? A Qualified Scientist should possess an earned doctoral degree in science or medicine. However, a master's degree with equivalent experience and/or expertise is acceptable when approved by a Scientific Review Committee (SRC). The Qualified Scientist must be thoroughly familiar with the local, state, and federal regulations that govern the student's area of research.

The Qualified Scientist and the Adult Sponsor may be the same person, if that person is qualified as outlined above.

In some cases, students may work with a Qualified Scientist in another city or state. If that is the case, the student also must work with a Designated Supervisor (see below) who has been trained in the techniques the student will use.

The Designated Supervisor

Who is a Designated Supervisor? The Designated Supervisor is an adult who supervises a student's experiment if the Qualified Scientist is unable to do so. The Designated Supervisor need not have an advanced degree, but should be thoroughly familiar with the student's project, and must be trained in that particular area of research.

The Adult Sponsor may act as the Designated Supervisor if trained to do so.

If a student is experimenting with live vertebrates, and the animals are in a situation where their behavior or habitat is influenced by humans, the Designated Supervisor must be knowledgeable about the humane care and handling of those animals. If the Designated Supervisor is not knowledgeable, the Adult Sponsor must ensure that the student enlists the help of an Animal Care Supervisor.

The Animal Care Supervisor

Who is the Animal Care Supervisor? This individual must be familiar with the proper care and handling of laboratory animals and is required for all nonhuman vertebrate animal projects. The Qualified Scientist can usually serve as the Animal Care Supervisor.

The Institutional Review Board (IRB)

An Institutional Review Board (IRB) is a committee that evaluates the potential physical or psychological risk of research involving human subjects. An IRB at the school or affiliated fair level must consist of at least three members, and include a science teacher and an administrator, and a psychologist, medical doctor and/or Registered Nurse. **All proposed human research must be reviewed and approved by an IRB before experimentation begins.** For subjects under 18, student researchers must obtain written informed consent from those subjects and their parent/guardian except for 1) observational research where subjects cannot be identified, and 2) situations in which no interaction takes place between the subject(s) and the researcher. **We very strongly recommend that informed consent be obtained in all cases.**

Scientific Review Committee (SRC)

What is an affiliated fair Scientific Review Committee (SRC)? The SRC is a committee with a minimum of three members, including at least one biomedical scientist (Ph.D., M.D., D.V.M., D.D.S., or D.O.) and one science teacher. One member must be familiar with proper animal care procedures when animal research is involved.

What is an SRC's purpose? An SRC reviews and approves all projects prior to competition to make sure ISEF Rules and any applicable laws have been followed. Certain projects involving restricted areas of research must be approved by an SRC before experimentation is started (see Adult Sponsor Checklist, p. 11). Local SRCs may be formed to assist the affiliated SRCs in reviewing and approving projects in restricted areas of research. The operation and composition of the local level SRCs must fully comply with ISEF Rules.

The ISEF Scientific Review Committee (SRC)

A Scientific Review Committee exists at the ISEF level as well. The ISEF SRC reviews the forms and research plans for all projects.

The ISEF SRC, like a regional SRC, is made up of a group of adults knowledgeable about regulations concerning experimentation in restricted areas. The SRC reviews and approves **Research Plan (1A)** and **Approval Form (1B)** in addition to all other required forms for students who enter the ISEF. They also identify problems local fairs may be having and work with fair directors and teachers to resolve them.

If a Fair Director or regional/local SRC member has any questions concerning the process, feel free to contact Science Service or the ISEF SRC. (See p. 3 for numbers). The ISEF SRC is the final authority on projects that are eligible to compete in the ISEF. In some cases, the ISEF SRC may have questions about particular projects. In many cases, after students further explain their procedures to the SRC, a simple corrective measure is often prescribed, such as contacting the Designated Supervisor to confirm a detail, or rewriting an abstract to clarify the procedures used.

We cannot stress enough the importance of students retaining signed copies of <u>all</u> paperwork to take to the ISEF. Even though copies may have been sent with entry papers, having them on hand for SRC interviews will be helpful.

Human Subjects

An Institutional Review Board (IRB) must review and approve all research involving human subjects before experimentation begins. The ISEF Rules, which follow federal regulations, exist to safeguard the rights and welfare of individuals who participate as research subjects. When students conduct biomedical or behavioral research, they are directly responsible for protecting the rights and welfare of the participating human subjects.

Sources

1) CFR, Title 45 (Public Welfare), Part 46-Protection of Human Subjects (45CFR46)
2) CFR, Title 45 (Public Welfare), Part 5b-Privacy Act Regulations (45CFR5b)
3) Public Health Service Act 42 U.S.C. S 241(d)
   (Protection of Privacy of Individuals who are Research Subjects)

Above documents available from:
Dr. Joan P. Porter, Office for Protection from Research Risks
National Institutes of Health, Building 31, Room 5B59
9000 Rockville Pike, Bethesda, MD 20892
(301) 496-7005

Rules

1) According to federal regulations, certain areas of human research are exempt from IRB review. However, the ISEF Rules do not permit these exemptions. **All human research projects (including surveys, questionnaires, and studies in which the researcher is the subject of his/her own research) are subject to a complete IRB review before experimentation begins.**

2) Student researchers must assess the risks to their human subjects when developing research plans. Any risks must be described in **Human Subjects Form (4)** for review and approval by an IRB before experimentation is started.

3) Precollege student research conducted at federally registered research institutions (e.g., university labs, medical centers, NIH, etc.) must be reviewed and approved by that institution's IRB.

4) If the IRB requires any protocol changes, the student must incorporate those changes into the research plan **before the IRB signs for approval**.

5) Any proposed changes by the student after initial IRB approval **must have subsequent IRB approval before such changes are made**.

6) After an IRB has approved the research proposal, the student may begin experimentation. Additional review by a regional/local SRC is not required.

7) A student may observe and collect data for analysis of new procedures and medications only under the direct supervision of a licensed professional. Students are prohibited from administering medications to human subjects. The IRB must ascertain that the student is not violating the medical practice act of that particular state or nation.

8) It is illegal to publish information in a report that identifies the human subjects directly or through identifiers linked to the subjects, including photographs. Names or photographs of human subjects may not be displayed with a project without informed consent. (Public Health Service Act, 42 U.S.C., 241(d)).

Notes on the Institutional Review Board (IRB)

A) Institutional Review Boards (IRBs) already exist at federally registered research institutions. For research not performed at one of these facilities, the sponsoring research organization (high school, local or affiliated fair, etc.) must appoint an IRB to review and approve any proposed research involving human subjects.

B) Only three members are required for a school or affiliated fair IRB. An IRB must include a science teacher and an administrator, and a psychologist, a medical doctor or registered nurse. When the project concerns behavioral research, the IRB must include a psychologist or psychiatrist.

C) **Neither the Adult Sponsor nor the Qualified Scientist who oversees a specific project is permitted to serve on the SRC or IRB reviewing that project**. Consequently, neither the Adult Sponsor nor the Qualified Scientist may sign the SRC portion of **Approval Form (1B)**.

D) An IRB generally makes the final determination of risk. However, if an SRC judges an IRB's decision as inappropriate and placing human subjects in jeopardy, the SRC may override an IRB's decision.

Choosing a Study Group and Assessing the Risks

When choosing a study group, the criteria for selecting the subjects should be clearly defined. In other words, students should ask questions that will define the exact study population. For example, if students want to study nondiabetic males, they should make sure to ask the appropriate questions that would eliminate diabetic individuals.

Once a population is chosen, the ISEF Rules require students to assess any potential risks when developing research plans. Any possible risks should be explained on **Human Subjects Form (4)**. The student must submit **Human Subjects Form (4)** with **Research Plan(1A)/Approval Form (1B)** to an IRB for review and approval before the beginning experimentation.

In evaluating risk, students should use the federal definition of minimal risk as a guide:

> ***When the probability or magnitude of harm or discomfort anticipated in the research is not greater in and of itself than that ordinarily encountered in daily life or during performance of routine physical or psychological examinations or tests.***

The following are examples of activities or groups that may contain risks a student researcher might overlook:

1) **Exercise**

2) **Emotional stress** resulting from invasion of privacy (See Privacy Act of 1974 45CFR5B). Questions on sexual activities or preferences, AIDS testing and results, suicide attitudes, divorce and its effects on psychological well-being all may be judged as overtly invasive or high-risk. Student researchers should always carefully evaluate controversial questions for compliance with federal regulations. Photographs that physically identify individuals are illegal without informed consent.

3) **Ingestion of any substance** or physical contact with any potentially hazardous materials. This rule applies to the student researcher as well as the human subject(s).

Groups

1) Any member of a group that is naturally at-risk: pregnant women, individuals with diseases such as cancer, asthma, diabetes, cardiac disorders, psychiatric disorders, AIDS, etc.

2) Special vulnerable groups covered by federal regulations (i.e., children, prisoners, pregnant women, handicapped or mentally disabled persons, economically or educationally disadvantaged persons). Additional safeguards are applied to these subjects because they have been judged as vulnerable to coercion or undue influence.

Required Forms

A) **Research Plan (1A)/Approval Form (1B)**: Must be submitted to an Institutional Review Board (IRB) for review and approval before experimentation student begins experimentation.

B) **Human Subjects Form (4)**: Must be submitted to an IRB for review and approval before experimentation is started.

If the IRB determines there are no physical or psychological risks involved and checks the "No risk" box on ***Human Subjects Form (4)****, no additional forms are needed. If risks are determined by the IRB, the following additional forms are required:*

C) **Qualified Scientist Form (2A)**: Required if any risk to the subjects is determined. Should the student anticipate that risk might be involved, this form should be provided to the IRB together with Form 1A/1B and Form 4 above at the time of original review by an IRB.

D) **Designated Supervisor Form (3)**: If the Qualified Scientist is unable to supervise the experiment, a Designated Supervisor who is knowledgeable about the project and its risks must supervise. This individual must have training in the procedures and methods used by the student to achieve the specific aims of the project.

E) **Informed Consent Form (4A)**: This form is recommended in all cases, but required if any risk to subjects is determined. Subjects 18 years and under require consent from a parent or guardian, except in a) observational research where subjects cannot be identified, and b) in situations in which no interaction takes place between the subject(s) and the researcher.

Note: **If work was conducted at a registered research institution during the summer, part (2B) on the reverse side of Qualified Scientist Form (2A) must be completed.**

Nonhuman Vertebrate Animals

Students proposing research on nonhuman vertebrate animals should explore all possible alternatives. If vertebrates are used for research and testing, the student researchers and Adult Sponsors are responsible for granting the animals every humane consideration for their comfort and well-being before, during, and after the research.

The three Rs of animal experimentation:
Replace vertebrate animals with invertebrates or lower life whenever possible.
Reduce the number of animals whenever possible. (Do not reduce numbers beyond statistical validity.)
Refine experimental protocols to lessen the pain or distress to the animals.

Sources *(Additional sources are listed at the end of this section, after Required Forms.)*

Guide for the Care and Use of Laboratory Animals
(The Guide, NIH Publication 85-23)
Office for Protection from Research Risks (OPRR)
National Institutes of Health, 9000 Rockville Pike
Building 31, Room 5B59, Bethesda, MD 20892
(301) 496-7163

Federal Animal Welfare Act (AWA), 7 U.S.C. 2131-2157
Sub-chapter A - Animal Welfare (Parts I, II, III)
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
Room 756, Federal Building
6505 Belcrest Road, Hyattsville, MD 20782
(301) 436-7833

Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (Agri-Guide)
American Dairy Science Association
309 West Clark Street
Champagne, IL 61820
(217) 356-3182

Rules

NOTE: Although certain research is permissible for professionals in research institutions, it may not be appropriate for precollege students. Please review the limitations below.

1) **Alternatives**: Alternatives to vertebrate animals for research must be explored. We encourage any nonintrusive studies (i.e., observational, behavioral and natural history studies) that do not affect an animal's health or well-being by causing stress or discomfort. The ISEF Rules allow intrusive studies on vertebrate animals and invertebrate animals that have advanced nervous systems only when lower vertebrates or other alternatives are not suitable. Examples of possible alternatives are listed below:

    a) Cells and tissue cultures
    b) Plants (including lower plants such as yeast and fungi)
    c) Mathematical or computer models
    d) Invertebrates with either no nervous systems or primitive ones (i.e., protozoa, planaria, insects)
    e) Primary tissue or cell explants from humanely euthanatized animals (see page 23, #10)
    f) Chicken embryos prior to three days of hatching

2) The ISEF defines an animal as any live, nonhuman vertebrate, mammalian embryo or fetus, bird eggs within three days of hatching, and all other vertebrates at hatching or birth.

3) Students performing animal research must follow local, state, and federal regulations as closely as possible. Registered research institutions (e.g., university lab, medical center, NIH, etc.) follow federal guidelines. Although high schools follow the federal guidelines, the schools are not registered and approved. Therefore, prior SRC approval is necessary.

4) **Procurement**: All animals must be legally acquired from reputable animal breeders.

   a) Common laboratory animals must be obtained from licensed laboratory animal breeders. Pet store animals are inappropriate because their genetic and nutritional background and disease status are unknown.

   b) Animals should be healthy and free of diseases that can be transmitted to humans or other animals.

   c) Animals may not be captured from or released into the wild without approval of responsible wildlife officials and public health officials.

   d) All animals are classified as laboratory animals on the first day of study and, as such, proper forms must be completed and approved before experimentation is started.

5) **Housing**: The ISEF accepts two basic animal care guides on the care and use of laboratory animals: *Federal Animal Welfare Act*, and the *Guide for the Care and Use of Laboratory Animals*. For farm animals, use the *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching* (*Agri-Guide*). Any deviations from these guides must be approved by an Animal Care Supervisor and the governing SRC.

   a) Animals must be housed in clean, ventilated, comfortable environments compatible with the standards and requirements appropriate for the species used. Animals must have adequate lighting, humidity and controlled temperature (with as little variation as possible), and have sanitizable cages of adequate sizes for the typical activities and social interactions of the species (unless individual housing is dictated by experimental protocol).

   b) Because the conditions above are critical, experiments involving small common laboratory animals (e.g., mice, rats, hamsters, guinea pigs, gerbils, rabbits) are allowed in an **institutional setting only** and not in a student's home environment. Home environments are not as tightly controlled as institutional settings and therefore are not appropriate for experimentation. Exceptions for behavioral research may be granted by the governing SRC under special circumstances.

6) **Husbandry**: Animals should be treated kindly and cared for properly.

   a) Animals must be given a continuous, clean (uncontaminated) water and food supply. Food should meet the nutritional requirements of the particular species. Standard laboratory formulations should always be used for common laboratory animals (unless prevented by experimental protocol). Watering and feeding devices should be cleaned frequently.

   b) Proper care must be provided at all times <u>including weekends, holidays, and vacation periods</u>. Animals must be observed daily to assess their health and well-being.

   c) Cages, pens, and fish tanks must be cleaned frequently. A highly absorbent bedding should be used in cages and pens. Hardwood (not cedar) chips are recommended and can be obtained from local pet or feed stores. Do not use newspaper or paper towels because inks are carcinogens and adversely affect liver enzyme function.

   d) If unexpected illness or emergency occurs, animals must have proper veterinary medical and nursing care.

7) Research on animals involving anesthetics, drugs, thermal procedures, physical stress, organisms pathogenic for humans or other vertebrates, ionizing radiation, carcinogens, tumors, or surgical procedures must be directly super vised by a Qualified Scientist or Designated Supervisor within a hospital, school, or clinical/research institution approved by the governing SRC. Students are prohibited from doing such research in a home environment.

8) Experimental procedures that cause unnecessary pain or discomfort **may not be attempted** on any vertebrate animals (e.g., mammals, birds, reptiles, amphibians, fish).

9) Research in nutritional deficiency, ingestion, inoculation or exposure to hazardous or reputedly toxic materials or drugs is permitted to proceed only to the point where signs or lesions of the deficiency or toxicity appear. Appropriate measures must then be taken to correct the deficiency, toxicity, or drug effect, if such action is feasible. If not, the animal(s) must be euthanatized. **Experiments designed to kill vertebrate animals are not permitted**. However, experimental designs incorporating humane euthanasia are permitted.

10) Stress research is permitted only when it causes no permanent alteration in the psychological or physical well-being of the animals.

11) Proper euthanasia at the end of experimentation for tissue removal and/or pathological analysis is permitted.
   a) Acceptable Methods of Euthanasia: administration of barbituric acid derivatives in conformance with applicable laws; inhalation of gas anesthetic in a well ventilated area; induced narcosis with carbon dioxide or nitrogen for common laboratory animals; use of MS-222 or a combination of hypothermia and CO_2 narcosis for aquatic species.
   b) Unacceptable Methods of Euthanasia: injection of air, or any product containing strychnine, curare, succinylcholine or other neuromuscular blocking agents; guillotine, decapitation and cervical dislocation without prior anesthesia; exhaust fumes; chloroform; stunning blows to the head; microwaves.

12) Only the Animal Care Supervisor, Qualified Scientist, or the Designated Supervisor may perform euthanasia. **Student researchers may only perform euthanasia in an emergency.**

13) LD means **lethal dose** or death rate. **A death rate of 50 percent or greater in any group or subgroup, whether by design or as an unexpected result of experimental procedure, is not permitted.**

14) Weight loss is one significant sign of stress or toxicity, and maximum permissible weight loss or growth retardation (compared to controls) of any experimental or control animal(s) is 15 percent.

15) Acid rain, insecticide, and herbicide toxicity studies on live vertebrates are prohibited. Tissue culture, chicken embryos up to three days before hatching, and invertebrate studies are recommended as alternative models for testing.

Special Note About Research Plan (1A)

Question #2 on the Research Plan And Approval Form asks for a description of methods and procedures. Projects that involve vertebrate animals require an extremely detailed research plan for SRC review purposes. Although most of the following information is requested on Vertebrate Animal Form (5), the SRC requires a comprehensive plan detailing the specifics listed below:

1. Describe in detail how the animals will be used. Include methods and procedures, such as experimental design and data analysis. Identify the species, strain, sex, age, weight, source and number of animals proposed for use.

2. Justify why animals must be used, including the reasons for the choice of species and the numbers used. Describe any alternatives to animal use that were considered, and the reasons these alternatives cannot be used. Explain the potential impact or contribution this research may have on the broad fields of biology or medicine.

3. Provide detailed information on the animals' housing, husbandry, and environment. Also, provide information on the veterinary medical/nursing care in the case of illness or emergency.

4. Describe the procedures that will limit any unavoidable discomfort, distress, pain and injury to the animals during the course of experimentation. **Note**: The ISEF discourages any procedures that will cause discomfort to animals.

5. Describe any analgesic, anesthetic or tranquilizing drugs (show dosage in **mg/kg of bodyweight**) and comfortable restraining devices used to minimize discomfort, distress, pain, and injury.

Example: Dose a 20 gram mouse with 40 mg of saccharin (using Sweet-n-Low). How many mg/kg (of bodyweight) is this dosage? **Note**: **A one-gram (1,000 mg) packet of Sweet-n-Low contains only 40 mg of active ingredient saccharin**. The rest of the packet contains inert ingredient(s). This condition is true for many foods and pharmaceutical products.

Step 1: Establish the weight of the variables. In this example, the mouse weighs 20 g and the saccharin dosage is 40 mg.
Step 2: Convert the weight of the mouse into kg.

$$1 \text{ kg} = 1{,}000 \text{ g}; \ \frac{20 \text{ g}}{1{,}000 \text{ g}} = 0.02 \text{ kg}$$

Step 3: Compute the ratio between the weight of saccharin to the weight of the mouse using the following formula:

$$\text{dosage} = \frac{\text{weight of saccharin (mg)}}{\text{weight of mouse (kg)}}$$

Thus,

$$\text{dosage} = \frac{40 \text{ mg}}{0.02 \text{ kg}} = 2{,}000 \text{ mg/kg}$$

6. Explain what will happen to the animal(s) after the project is finished. If euthanasia will be performed by a Qualified Scientist (**students are not permitted to perform euthanasia except in an emergency**), describe the method and reasons for selection. Methods should comply with the Panel of Euthanasia of the Veterinary Medical Association.

Required Forms

Note: If your project is a continuation from a previous year(s), attach **signed** copies of all forms from those year(s) to the current year's research plan and forms.

A) **Research Plan/Approval Form (1A)/(1B)**: Must be submitted along with the following forms to a Scientific Review Committee (SRC) for review and approval before student begins experimentation.

B) **Qualified Scientist Form (2)**: Required for any project involving nonhuman vertebrate animals.

C) **Designated Supervisor Form (3)**: If the Qualified Scientist is unable to supervise the experiment, a Designated Supevisor who has thorough knowledge of the student's research project must supervise. The Designated Supervisor need not have an advanced degree, but must have training in the standards of nonhuman vertebrate animal research.

D) **Vertebrate Animal Form (5)**: Students must enlist an adult who is knowledgeable about animal care to oversee the care and handling of animals. The Animal Care Supervisor must sign this form.

Note: **If work was conducted at a registered research institution during the summer, part (2B) on the reverse side of Qualified Scientist Form (2A) must be completed.**

Other Sources for Alternative Research and Animal Welfare

1. The National Library of Medicine provides computer searches through MEDLINE under the key phrase Animal Welfare.

   Dr. Fritz Gluckstein
   National Library of Medicine
   8600 Rockville Pike
   Bethesda, MD 20894
   (301) 496-6097

2. National Agriculture Library (NAL) provides reference service for materials that document a) Alternative Procedures to Animal Use and b) Animal Welfare.

   Ms. Jean Larson
   National Agricultural Library
   Beltsville, MD 20705
   (301) 344-1215

   National Agriculture Library
   Room 304
   Beltsville, MD 20705
   (301) 344-3704

3. Institute of Laboratory Animal Resources (ILAR) provides a variety of information on animal sources, housing and handling standards, and alternatives to animal use through annotated bibliographies published quarterly in ILAR News.

Dr. Thomas L. Wolfle
Director, Institute of Laboratory Animal Resources
National Research Council
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, DC 20418
(202) 334-2590

Quarterly bibliographies of Alternatives may be obtained from:
Dr. Po-Young Lu
Toxicology Information Response Center
Oak Ridge National Laboratory, P.O. Box 2008
MS 6050, Oak Ridge, TN 37831-6050
(615) 574-7587

4. Euthanasia Guidelines
1986 Report of the AVMA Panel on Euthanasia published in the *Journal of the American Veterinary Medical Association* (JAVMA), Vol. 188, No. 3: 91-105, 1986

Other Federal Laws that May Apply

1. Marine Mammal Conservation and Protection Act (16 U.S.C. 1361)
Department of the Interior
Fish and Wildlife Service
18th and C Streets, N.W.
Washington, DC 20240
(202) 343-5634

2. Lacey and Endangered Species Acts

a. Lacey Act (16 U.S.C. 701) applies to interstate transport of wild animals captured in any state.

b. Endangered Species Act (16 U.S.C. 1531) applies to specified species of animals and may apply to captive-bred and wild-caught members of listed species.

Other Guidelines and Regulations that May Apply to Animal Research Projects or Laboratory Safety

1. Carcinogens, Chemicals and r-DNA
National Institutes of Health
Division of Saf-ty
Building 31, Room 1C02
Bethesda, MD 20892
(301) 496-13572.

2. Infectious Agents
Centers for Disease Control
Office of Biosafety
Atlanta, GA 30333
(404) 329-3883

3. Isotopes
U.S. Nuclear Regulatory Commission
Medical, Academic, and Commercial Use Safety Branch
WF1, Mail Stop 6HO6
Washington, DC 20555
(202) 492-0640

4. Radiation and Medical Devices
Food and Drug Administration
Center for Devices and Radiological Health
HFZ-311
1390 Piccard Drive
Rockville, MD 20850
(301) 427-1165

5. Safety and Health
Department of Labor
Occupational Safety and Health Administration
200 Constitution Avenue, N.W.
Washington, DC 20210
(202) 523-7075/8063

Pathogenic Agents

The ISEF allows students to experiment with pathogenic agents as long as the students adhere to federal regulations and guidelines, which are designed to protect the safety of the researcher. Carelessness and improper techniques in working with pathogenic agents can lead to laboratory-contracted infections.

Sources

CDC-NIH Biosafety in Microbiological and Biomedical Laboratories HHS Publication #NIH 88-8395
Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

Rules

1) Pathogenic agents are disease-causing or potentially disease-causing agents such as bacteria, viruses, rickettsia, fungi, and parasites. When using pathogenic agents, student researchers and their Adult Sponsors are required to follow standard microbiological practices, as defined in Biosafety in Microbiological and Biomedical Laboratories.

2) Student research with pathogenic agents may be performed **only** under the direct supervision of an experienced and Qualified Scientist or Designated Supervisor in an institutional laboratory.

Required Forms

A) **Research Plan (1A)/Approval Form (1B)**: Must be submitted along with the form(s) below to a Scientific Review Committee (SRC) for review and approval before student begins experimentation.

B) **Qualified Scientist Form (2)**: Students using pathogens must enlist the expertise of a Qualified Scientist to oversee their projects.

C) **Designated Supervisor Form (3)**: If a Qualified Scientist is unable to supervise the student's experiment, a Designated Supervisor who is thoroughly knowledgeable about the student's research project must supervise. The Designated Supervisor need not have an advanced degree, but must have training in the standards of good microbiological practices and a working knowledge of the organisms.

Note: If work was conducted at a registered research institution during the summer, part 2B on the reverse side of Qualified Scientist Form (2A) must be completed.

Controlled Substances

Controlled substances must be acquired and used according to existing local, state and federal laws.

Sources

Prescription Drugs
U.S. GPO
(202) 783-3238
21 CFR 200-499

Alcohol and Tobacco
The Bureau of Alcohol, Tobacco and Firearms
Distilled Spirits and Tobacco Branch
650 Massachusetts Ave., N.W.
Washington, DC 20226
(202) 927-8210

Narcotics and Addictive Drugs
*The Drug Enforcement Administration
Registration Department
Washington, DC 20537
(202) 307-7255

*Contact appropriate state agencies concerning additional laws.

Rules

1) Student researchers must adhere to all federal regulations governing controlled substances. For further information, contact the regulatory agencies listed above.

2) Production of alcohol is federally regulated and students must contact the Bureau of Alcohol, Tobacco and Firearms for regulations (see above).

3) Only under the direct supervision of a Qualified Scientist or Designated Supervisor may a student use any federally controlled or experimental substance for therapy or experimentation, including over-the-counter drugs and potential new therapeutic substances.

Required Forms

A) **Research Plan (1A)/Approval Form (1B)**: Must be submitted with the form(s) below to a local or regional SRC for review and approval before experimentation is started.

B) **Qualified Scientist Form (2)**: Students using controlled substances must enlist the expertise of a Qualified Scientist to oversee all projects their projects. The Qualified Scientist should have a thorough knowledge of the student's area of research.

C) **Designated Supervisor Form (3)**: If a Qualified Scientist is unable to supervise the student's experiment, a Designated Supervisor who is thoroughly knowledgeable about the student's research project may do so. The Designated Supervisor need not have an advanced degree, but must have training in working with controlled substances.

Note: If work was conducted at a registered research institution during the summer, part (2B) on the reverse side of Qualified Scientist Form (2A) must be completed.

Recombinant DNA (rDNA)

The ISEF, following federal regulations, allows students to conduct recombinant DNA (rDNA) research. When using rDNA and host organisms, students and supervising adults are urged to proceed in a safe and responsible manner in the laboratory.

Sources

[(National Institutes of Health (NIH); Centers for Disease Control (CDC)]

NIH Guidelines for Research Involving Recombinant DNA Molecules
49 CFR 46266
Office of Recombinant DNA Activities
National Institutes of Health
Building 31, Room 4B-11
Bethesda, MD 20892
(301) 496-9838

CDC-NIH Biosafety in Microbiological and Biomedical Laboratories
HHS Publication # NIH 88-8395
Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

Guidelines for the Use of Recombinant DNA in Secondary School Science Classrooms (in press)
National Association of Biology Teachers
11250 Roger Bacon Drive #19
Reston, Virginia 22090
(703) 471-1134

Rules

1) The ISEF adheres to NIH Guidelines and accepts the following definitions as recombinant DNA molecules:
   a) Molecules that are constructed outside living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in a living cell.
   b) Molecules that result from the replication of those described above.

2) Student researchers working with any microorganisms, whether or not they involve DNA, must always follow standard microbiological practices.

3) All student research proposals involving rDNA must be reviewed and approved by a Qualified Scientist and Scientific Review Committee (SRC) before experimentation is started.

4) Students may conduct studies on both exempt and non-exempt rDNA and host organisms.
   a) Non-exempt rDNA studies must be conducted in a federally registered research institution (e.g., university lab, medical center, NIH, etc.) under the direct supervision of a Qualified Scientist. Copies of the institution's review and approval forms must accompany the required ISEF forms to the regional fair for the SRC to review after experimentation but before competition.

   b) Exempt rDNA studies may be conducted in non-federally registered laboratories, but must follow federal regulations. Exempt host organisms include the following:
      1) bacterium *Escherichia*
      2) bacterium *Bacillus subtilus*
      3) yeast *Saccharomyces cerevesiae*

c) Exempt DNA insert molecules include the following:
   1) DNA molecules that are not in the DNA of organisms or viruses
   2) DNA from single non-chromosomal or viral sources
   3) DNA that is entirely from a prokaryotic host, including its indigenous plasmids or viruses when propagated only in the host.

d) The ISEF Rules recommend the following DNA molecules and host organisms, based on NABT *Guidelines*:
   1) DNA molecules: vectors (pAMP, pKAN, pUC, pBR322, M13)
   2) Host organisms: *E. coli* K12 strains: MM 294, HB 101, JM 101
   3) Inserts: *Bacteriophage lambda, Bacteriophage T4, E. coli* sequences, recombinants of any of the above listed plasmids.

5) Any significant changes in the research plan must be approved by the Qualified Scientist and the SRC before they are implemented.

Required Forms

A) **Research Plan (1A)/Approval Form (1B)**: Must be submitted along with the following forms to a local or regional Scientific Review Committee (SRC) for review and approval before student begins experimentation.

B) **Qualified Scientist Form (2)**: Students using rDNA or host organisms must enlist the expertise of a Qualified Scientist to oversee their projects.

C) **Designated Supervisor Form (3)**: If a Qualified Scientist is unable to supervise the student's experiment, Designated Supervisor who is thoroughly knowledgeable about the student's research project may supervise. The Designated Supervisor need not have an advanced degree, but must have training in the standards of good microbiological practices and a working knowledge of the organisms.

Note: If work was conducted at a registered research institution during the summer, part (2B) on the reverse side of Qualified Scientist Form (2A) must be completed.

Human and Animal Tissue

Research involving human or nonhuman tissue must be approved by a Scientific Review Committee (SRC) before experimentation is started.

Sources

American Type Culture Collection
12301 Parklawn Dr.
Rockville, MD 20852
(301) 881-2600

Carolina Biological Supply Company
Main Office and Laboratories
2700 York Rd.
Burlington, NC 27215
(919) 584-0381
(800) 334-5551

Rules

1) Tissue Form (6) is required for all research projects using human or nonhuman vertebrate animal tissue when such tissue is obtained by the student from any research institution, biological supply house, or biomedical scientist.

2) Human blood and blood products must be documented free of Human Immunodeficiency Virus (HIV) and hepatitis B or C virus before the student receives them. Please note that tests to determine virus-free blood can sometimes give false negatives.

3) Students using their own blood do not need the HIV or hepititis certifications (see #2).

4) Several types of tissue are exempt, and do not require Tissue Form (6) or prior SRC approval.
   a) Plant tissue
   *b) Established cell and tissue cultures (e.g., those obtained from American Type Culture Collection)
   c) Meat or meat by-products obtained from food stores or restaurants.

   *Identify strain source and number in **Research Plan (1A)**.

Required Forms

A) **Research Plan (1A)/Approval Form (1B)**: must be submitted to a local or regional SRC for review and approval before student begins experimentation.

B) **Tissue Form** (6): This form is not required for prior SRC review. However, an SRC must review this form <u>prior to judging</u>. Students should display this form with the project.

Flow Chart

NOTE: 1) If work was conducted at a registered research institute during the summer, part **(2B)** on the reverse side of the **Qualified Scientist Form (2a)** must be completed. 2) Every student must write an abstract for review by an SRC prior to competition.

All Projects:

Step 1

Research Plan (1A) / Approval Form (1B)

*Student completes **Research Plan (1A)** and **Approval Form (1B)**, and reviews with Adult Sponsor to determine if SRC/IRB approval is necessary before experimentation begins.

Step 2

Approval Form (1B)

*If prior approval is necessary, student checks appropriate box on **Research Plan (1A)** and completes the necessary forms. (See appropriate section(s) below.)

Human Subjects:

Research Plan (1A) / Approval Form (1B)

*Student completes Steps 1 & 2 (above).

Human Subjects Form 4

*Student completes **Human Subjects Form (4)** and submits along with **Forms 1A and 1B** to an Institutional Review Board (IRB) for risk assessment and approval before experimentation begins.

IRB
if risk determined

*If IRB determines possible risk to human subjects, see below.

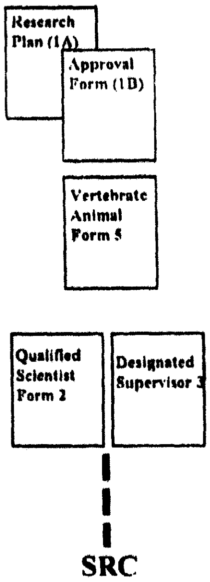
Qualified Scientist Form 2 / Designated Supervisor 3

*Student enlists a Qualified Scientist to oversee the project and complete **Qualified Scientist Form (2A)**. If Qualified Scientist cannot be present during experimentation, a Designated Supervisor must supervise and complete **Designated Supervisor Form (3)**.

Informed Consent Form (4A)

*The student must also obtain **Informed Consent Form (4A)** for each test subject. Subjects 18 and under are required to have consent from parent/guardian.

Nonhuman Vertebrate Animals

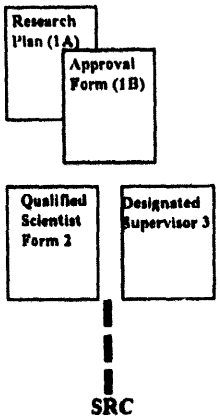


*Student completes Steps 1 and 2

*Student completes **Vertebrate Animal Form (5)**. Animal Care Supervisor agrees to supervise the care and handling of the animals and sign the bottom section of **Form 5**

*Student enlists a Qualified Scientist to oversee the project and complete **Qualified Scientist Form (2A)**. If the Qualified Scientist cannot be present during experimentation, a Designated Supervisor must supervise and complete **Designated Supervisor Form (3)**.

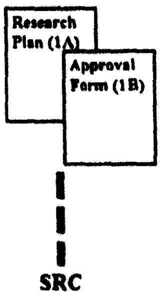
Pathogenic Agents, Controlled Substances, Recombinant DNA



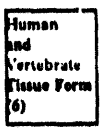
*Student completes Steps 1 and 2

*Student enlists a Qualified Scientist to oversee the project and complete **Qualified Scientists Form (2)**. If the Qualified Scientist cannot be present during experimentation, a Designated Supervisor must supervise and complete **Designated Supervisor Form (3)**.

Human or Animal Tissue



*Student completes Steps 1 and 2.



*After SRC approval, student completes **Human and And Animal Tissue Form (6)** and submits to regional/state/ISEF for review prior to competition.

HUMAN SUBJECTS FORM (4)

Required for all research involving humans.

Student's Name ______________________________

School ______________________________

Title of Project ______________________________

TO BE COMPLETED BY STUDENT RESEARCHER

1) Explain why human subjects are proposed or necessary for this research:

2) Describe and assess any potential risk (physical, psychological, social, legal or other):

3) Describe consent procedures to be followed (attach sample of completed form to be used):

4) Describe procedures to minimize risks:

5) Describe benefits to the individual or society:

6) Explain how the benefits exceed the risks:

TO BE COMPLETED BY INSTITUTIONAL REVIEW BOARD PRIOR TO EXPERIMENTATION

☐ No risks involved: Informed Consent (Form 4A) for all human subjects recommended.)

☐ Acceptable risks involved: Qualified Scientist, Designated Supervisor, Informed Consent (Forms 2, 3,4A) required.

☐ Unacceptable risks involved: Project must be revised.

			Chairperson	
______________________ Signature: Member of IRB	______________________ Position: Scientist/Medical/Nurse	___/___/___ Date	yes	no
______________________ Signature: Member of IRB	______________________ Position: Science Teacher	___/___/___ Date	yes	no
______________________ Signature: Member of IRB	______________________ Position: Administrator/designated others	___/___/___ Date	yes	no

Please circle to the right of the signature the person who served as Chairperson: (Circle one)

NOTE: The Adult Sponsor or Qualified Scientist cannot serve on the SRC/IRB for their particular project.

INFORMED CONSENT FORM (4A)*

Required when the IRB has determined possible risk to human subjects.

***Use a separate form for each test subject.**

Student's Name ______________________________

School ______________________________

Title of Project ______________________________

TO BE COMPLETED BY STUDENT RESEARCHER

1. What are the research procedures in which the subject will be involved?

2. What are the possible discomforts or risks that may reasonably be expected by participating in this research?

3. What procedu.es will be used to minimize the risks?

______________________________ Qualified Scientist's Name

______________________________ Title

______________________________ Institution

( ) ______________________________ Telephone

______________________________ Qualified Scientist's Signature

____/____/____ Date

If the subject of this experiment has any questions about this experiment, he or she should contact the Adult Sponsor.

______________________________ Adult Sponsor's Name

______________________________ Telephone

TO BE COMPLETED BY HUMAN SUBJECT PRIOR TO EXPERIMENTATION

☐ I have read and understand the conditions stated above, and I consent to participate in this research procedure. I realize that I am free to withdraw my consent and to withdraw from this activity at any time without prejudice toward me.

☐ I consent to use of visual images involving myself.

______________________________ Participant's Signature

____/____/____ Date

If participant is under 18, a parent/guardian signature is needed.

______________________________ Parent's/Guardian's Signature

____/____/____ Date

NONHUMAN VERTEBRATE ANIMAL FORM (5)

Required for research involving nonhuman vertebrate animals.

NOTE: If nonhuman vertebrate tissue is used, this form is not necessary if the tissue was acquired by someone other than the student.

Student's Name ______________________________

School ______________________________

Title of Project ______________________________

TO BE COMPLETED BY STUDENT RESEARCHER

Genus, species, common name of animal(s) used ______________________________

____

Where will animals be obtained? (Pet store animals not appropriate) ______________________________

How many animals will be used? ______________ Average Weight ______________

Cage size ______________ Number of animals per cage ______________

Type of food ______________________________

How often fed and given water? ______________________________

Type of bedding used? (Do not use cedar chips, newspaper, or towels.) ______________________________

Where will animals be housed? ______________________________

Who will provide medical and nursing care in case of illness or emergency? You must provide the name of a D.V.M.

Name of D.V.M.: ______________ Name of Facility: ______________

Will euthanasia of animals be necessary? ☐ Yes ☐ No

By what method? ______________ What will happen to animals after experiment?

By whom? ______________ ______________

TO BE COMPLETED BY ANIMAL CARE SUPERVISOR OR QUALIFIED SCIENTIST

Name ______________________________

Position ______________________________

Institution ______________________________

Address ______________________________

Office phone ______________________________

I certify that I have discussed this research with the student prior to its start and will supervise and will accept primary responsibility for the quality of care and handling of the live vertebrate animals used by the above named student. I further certify that I am knowledgeable in the proper care and handling of laboratory animals, meet prevailing animal care supervisory requirements and, when an animal must be euthanatized, I certify that I will be present and will perform or direct the procedure, using such agents as are recommended.

______________________________ ___/___/___

Animal Care Supervisor's or Qualified Scientist's Signature Date

HUMAN AND ANIMAL TISSUE FORM (6)

Required for all projects using tissue, organs, human parts or animal parts, including blood, blood products, teeth, cell cultures, and body fluids. (Plant tissue is excluded.)

Student's Name ____________________

School ____________________

Title of Project ____________________

TO BE COMPLETED BY STUDENT RESEARCHER

1. What are the tissue(s), organ(s), or part(s) used?

2. Vertebrate Tissue:

   a. Where was the tissue obtained?

   b. Why had the animal been euthanatized?

TO BE COMPLETED BY PROVIDER OF TISSUE

Human blood and blood products have been tested and documented free of AIDS and hepatitis B and C antibodies and antigens. Human teeth are certified free of blood and blood products.

____________________ ____/____/____

Signature Certifying Authority **Date**

I certify that the above listed materials were provided by me and that the student listed was not involved in the direct acquisition of the samples provided or purchased.

____________________ ____/____/____

Signature **Date**

____

Title

____________________ ____/____/____

SRC Chairperson's Signature **Date**

Appendix K: Bibliography of Publications Related to Science Fair

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