

# Judging Handbook

## Kern County Regional Science Fair



## **The Science Fair: What it is and your role in it**

The following is from the introduction to the Kern County Regional Science Fair Official Rules and Entry Forms booklet:

*Scientists do some of the most important and interesting work in our society. They ask questions about nature and try to find the answer to those questions by observing and doing experiments. They then think about what they observe and the results of their experiments. Sometimes they get a definite answer to their questions; sometimes the results lead to new questions and new experiments. As this process goes on, they understand more and more. The Science Fair will give you a chance to actually do the kind of things scientists do. You will find out that it really is possible to ask questions about our world and get answers to those questions. And most of all, you will learn a lot and have fun doing it.*

As you can see from this introduction, the purpose of the science fair is to give young people the opportunity to actually do some science. Along with your role as an evaluator of student projects, you will also have the job of reinforcing that purpose as well as encouraging and motivating the participants. Even those whose projects are of modest quality should finish the day with a sense of accomplishment and pride. Clearly, you have a critical responsibility in the success of this enterprise.

## **The Kern County Regional Science Fair**

The Kern County Science Fair includes about 600 student participants from grades 4 through 12. They come from throughout Kern County, from the Bakersfield metropolitan area to the Eastern desert communities. They are almost all selected after competing in local school science fairs. First and second place winners in the middle and senior high school divisions (grades 6–12) may be invited to compete in the California State Science Fair.

## **Your relationship with the students/participants**

**What to expect from the students** As stated above, the students you meet probably already have won or placed in their school science fairs. They will be proud of their accomplishments and should be able to explain their projects clearly and concisely. This explanation should include what they did as well as their results and conclusions. Their displays should clearly show the intent and outcomes of experimentation, and they should be able to answer questions about their projects at levels appropriate to their ages and grade levels. In addition, they should describe the methodology and equipment employed and the thought processes that were used to develop their hypotheses, experimental designs, results, and conclusions. Although it is not required, students frequently will discuss further hypotheses and experimentation based on their results. You may ask about that if you choose.

You should not be surprised to find that projects vary widely in quality and sophistication. Some projects, particularly at the high school level, may occasionally be comparable to college level work. The vast majority, of course, will be more elementary.

Some displays will be elaborate while others may be relatively simple. The purpose of the display is to clearly communicate the project's purpose, hypothesis, methodology, results, conclusions, and other information relevant to the investigation. A simple, clear, and well-organized display is to be preferred over one that is ornate but falls short of accomplishing this purpose. Although the fact that a display is attractive should be taken into account, scientific content and the ability to communicate that content is of primary importance.

**Confidentiality** The judging process must remain confidential. Judges should not disclose any information regarding their findings and conclusions except to those on their judging panel and Science Fair officials.

**Conflicts of interest** If you find that you are acquainted with a student you have been assigned to judge or you think another kind of conflict of interest (real or perceived by others) may be present, inform Science Fair officials as soon as possible so that you can be assigned to another judging panel.

**Rules and regulations** It is not your role to enforce Science Fair rules or other regulations (local, state, or federal) regarding the projects you are judging. If you think that a project has violated a rule or regulation, do **not** bring up the matter with the student(s). Rather, discuss the matter later with the Science Fair Coordinator or Judging Director. Since all projects were screened before being accepted into the Science Fair, you should assume that projects you judge are in compliance with all relevant rules and regulations. Therefore any allegations of rules violations should not be part of the judging process and should not be discussed when deciding on awards.

**Treating students with respect** In most cases, Science Fair projects represent a significant enterprise on the part of the student participants. Although a project may have flaws, you should treat it as the serious project it is meant to be. In doing so, listen carefully to the student's description and explanations, ask questions in order to reveal his/her understanding of the project and its conclusions as well as the relevant science, and while evaluating the project fairly and candidly, provide praise for the accomplishments demonstrated along with your appraisal.

**Educational value of interviews** As stated above, the completion of a Science Fair project should result in significant learning. Although the primary purpose of the questions asked during judging will be to evaluate the project and its results, the student should emerge from the process with further insights, understanding, and even ideas about additional investigations. In other words, the best questions will cause the student to think more deeply about the project and become aware of issues not previously considered. Questions which may cause the student to further pursue the subject are encouraged.

Judges often want to help the student with information about the subject of the project, particularly if the judge finds that certain points require clarification or correction. This is commendable, but if information is provided by one judge, the student may use that information in his/her interview with the following judges. This could result in a distortion of subsequent ratings. If you wish to correct misconceptions or errors, it is best to do this by asking questions (e.g., "Have you considered the effect of air pressure on the speed of a baseball?") and/or suggesting to the student that he/she reexamine the areas in question. If a student is recommended for participation in the California State Science Fair, the judging form will have a section for comments and suggestions for the students. This would be a good place for providing additional information or suggesting that certain facts or concepts require some additional work.

### **The Judge-Student Relationship**

*The following was taken from the Judging Handbook, California State Science Fair, 2002 and adapted by Robert Allison of the Kern County Science Foundation*

Not infrequently, a judge is especially impressed with a student or project and would like to offer help or advice, or even a job. If you wish to do this, contact the Judging Director or Science Fair Coordinator. If direct contact between a student and judge after the Science Fair would result in further benefit to the student, such contact will be facilitated by the Kern County Regional Science Fair, but only with the approval of the parent or guardian. Judges may not ask students for their phone numbers or initiate or propose any future contact.

Inappropriate comments by a judge to any participant are unacceptable. Such behavior is sufficient grounds for barring that judge from future science fairs. Judges must adhere to the highest standards of professionalism in all cases.

It is important to remember that students participating in the Fair are elementary, middle, and high school age. They are not adults. The relationship of student to judge is that of a minor to any adult in a position of authority. It is the responsibility of all judges to ensure that all interactions between themselves and the students are in the best interests of the students.

## The Judging Process

### Preparing for judging

During the fair, things will go pretty quickly. It is therefore important that you are prepared when you arrive. It is suggested that you do the following in the days before the Fair.

- Read this manual and become familiar with the judging guidelines and worksheet.
- If possible, read the abstracts of the projects you will be judging. You will have time to do this before the judging during the day of the Science Fair.
- Prepare preliminary interview questions.

### Pre-Judging Activities

- Orientation Meeting – Upon your arrival, and after you have time to partake of coffee and doughnuts (or other refreshments), there will be a meeting to review procedures and provide the latest information.
- Judging panel meeting – Immediately following the orientation meeting, your judging panel will meet. The chair will go over any special issues and procedures involved in the categories you will judge and will assign the project interview rotation for each member of the panel. The most important purpose of this meeting will be to formulate questions to be asked of all students. Although some variety in questioning is fine, the judges must agree on a primary set of questions in order to establish a common basis for ranking the projects. Finally, the average length of time for each interview will be established. It is important to adhere to this as closely as you can.
- Following the meeting, and before the students come to the floor, you will have time to begin to familiarize yourself with the projects you will judge. You should read the abstracts and review hypotheses, experimental procedures, results, and conclusions. The purpose of this time is to preview the projects so that your judging is more effective and efficient. This is **not** the time for judging, however. You might want to take some notes to help guide your later questioning, **but you should draw no conclusions about project quality, nor should you rank or judge the projects in any way.** A number of copies of abstracts will be available at each student station.

### Judging Procedures

- Begin by introducing yourself and putting the student at ease.
- Ask the student to explain the project. He/she likely will have prepared a brief (not more than a minute or so) presentation.
- Following the initial presentation, ask questions designed to clarify aspects of the project and to determine how the student got the idea for the investigation and her/his level of understanding of both the project itself and its underlying science.
- As indicated above, you should ask questions to determine the student's understanding of the scientific principles that form the basis for the project. These questions should be appropriate to the student's age and grade level, but do not hesitate to probe the student's depth of knowledge. Often you will be surprised at the scientific sophistication demonstrated even by elementary and middle school students.
- Sometimes students will have received help with their projects. This is acceptable as long as the help is limited and the project really was conceived, developed, and carried out by the student. If the student demonstrates good understanding of the project as well as its scientific basis and conclusions, it is likely that

he/she did not receive unwarranted assistance. If the project required equipment, understanding of scientific concepts, or knowledge of procedures which are unlikely to be available to someone at that grade or age, it is appropriate to ask how he/she acquired the equipment or came to understand those concepts or procedures.

- Judging should be done by one member of the panel at a time rather than by the whole group at once. This is more likely to put the student at ease during the interview and affords a greater level of individual interaction with panel members.
- To the extent possible, each judge should interview every student in the assigned category. If this cannot be done, at least three interviews should be conducted with all students, and each potential winner must be interviewed by all judges.
- The time taken for each interview should be reasonably uniform.
- Proceed from project to project in the sequence determined by the panel chair. If the next student is still being interviewed by another judge or is occupied with the media, skip that project and come back to it as soon as possible.
- After the first round of judging is completed, or at a time designated by the panel chair, the panel will meet to determine potential winners and to ascertain that each student has had a sufficient number of interviews. Panel members will then complete the interview process, making certain, as mentioned above, that all potential winners are interviewed by all judges.
- Following the completion of interviews, the panel will meet again to determine the first, second, and third place as well as any honorable mention winners the panel wishes to designate. This process **must** be completed and results turned in to Science Fair officials no later than the designated time. This is essential in order to prepare for the awards ceremony.
- It is up to the judging panel to determine the method by which it reaches its decisions about project rankings and awards. It is important, however, that this process is collegial in nature, involving all of the panel members. No one member, not even the panel leader, should be seen as the final authority in making these decisions. Sometimes ranking decisions will be determined quickly and unanimously. In other instances considerable discussion will be required. After discussion is completed and a decision reached, all panel members should feel that their opinions were heard and seriously considered even if those opinions did not always prevail. Finally, if consensus cannot be reached after discussion, the fairest way to reach closure is through a vote. Needless to say, all panel members should treat each other with courtesy and respect.

## Judging Criteria

It is critically important that judging be based primarily on the scientific merit of the projects. This includes the project itself, the student's knowledge of the scientific and/or engineering principles underlying it, and his/her comprehension of the project's basis, experimental design, outcomes, and implications. A good project must consist of an **investigation** and not be merely a collection or demonstration of technology or scientific principles, however impressive. Sometimes displays will be elaborate and polished. This should be given credit only to the extent that its elaborate nature results in more effective communication of the purpose, hypothesis, methods, results, and conclusions reached in the investigation. A polished display is not a substitute for good science.

## What makes a good science fair project?

*The following was written principally by Anita Gale with assistance from the California State Science Fair Judging Policy Advisory Committee and was revised and condensed by Robert Allison of the Kern County Science Foundation*

A good Science Fair project involves the student in a journey of discovery, driven by curiosity. It typically starts with an interest in some scientific subject, such as biology or geology. As a result of learning about the subject, the student may propose a *hypothesis* and then do further background research. The student then develops an experimental procedure that will produce data, from which

she/he can draw conclusions to prove or disprove the hypothesis. More often than not, new *hypotheses* will result from the experiment, leading to new experiments, which might be done in the future.

A hypothesis typically takes the form of “If I do this, then that should happen.” **A good hypothesis is not just a guess about what might happen if something is done, however. It is based on some knowledge of the subject, usually gained from reading and observation.** A quality Science Fair Project directs the student’s efforts toward a particular result or expectation; undirected experimentation just to find out what happens is play, not science (although notable discoveries have been made in this manner, they are notable because they were “accidents”).

A science fair project should include the following steps:

- Conduct background reading and study.
- Write a hypothesis.
- Do further reading and study.
- Develop an experimental procedure to investigate the hypothesis.
- Obtain or construct the apparatus needed for the procedure.
- Operate the apparatus or conduct the procedure to collect experimental data. Record the data as you collect it.
- Repeat the procedure and record new data to make sure that you are getting reliable results.
- Analyze the experimental data.
- Arrive at conclusions.
- If necessary, propose new hypotheses and new experiments that result from your conclusions. These might even be part of a future science fair project.

The final step before coming to the Science Fair is to prepare a display to illustrate all of the above and to rehearse (but not memorize!) the following:

- An explanation of the hypothesis.
- A description of the experimental procedures and how you conducted the experiment(s).
- How you developed the experimental results and conclusions.
- An explanation of the results and conclusions.

It is important to understand that proving your hypothesis is NOT the purpose of a Science Fair project. It is the intent of the Science Fair that you go through the process of asking questions and performing experiments in an attempt to find answers. You may not get an answer to your question, but that doesn’t mean you have not done good science. Real scientists often do many experiments before they begin to get answers to scientific questions.

Teachers and Parents are advised to encourage students to develop a project that genuinely interests them. Judges will occasionally ask students why they chose to do a particular project, and it usually turns out that the best work is done by students who are motivated and inspired by their curiosity about what they are investigating. Students who developed a project simply because a teacher or parent expected them to do so often will produce mediocre results.

**Types of Projects to Avoid** The following types of projects are unlikely to receive awards at the Kern County Regional Science Fair and will not be invited to compete at the California State Science Fair.

- Artwork, photographs, or replicas (physical or computer-generated) that illustrate concepts

but were not used or are not useful as experimental apparatus to collect comparative data. Depictions of known scientific concepts are in this category.

- Experiments that indicate the students have not done rudimentary background research (e.g., they could have seen the experiment described in a textbook).
- Displays of collections of things (unless the collections are used for comparative research that leads to scientific conclusions).
- Experiments that merely find out “What happens if I do this?” without having a scientific reason for performing the procedure.
- Presentation of theories with no credible attempt at proof (e.g., using literature search of quotes to provide evidence for the theory).
- Experiments that present results without analyses that predict, quantify, show why those results occurred, or explain how they occurred.
- Experiments that do not check data points for repeatability or neither resolve nor explain widely divergent results.
- Experiments using apparatus so crude that measurements could not be realistically acquired to show the intended results.

### **Specific Judging Criteria**

The following criteria can be used as guidelines to judging. Since the criteria are closely related, the elements included in them can overlap.

- **Originality/Creativity**

Science Fair projects are not expected to be publishable research (although some are). However, originality or creativity is possible even if the project is relatively trivial scientifically or covers well-trodden ground. It is important to take the grade level and age of the student into consideration, too. What is new and creative for a 4<sup>th</sup> grader might well be superficial for a high school senior. Some aspects of originality/creativity include:

- Original problem or original approach to an old problem.
- Creative approach to experimental design.
- Materials and equipment used ingeniously.
- Creative or original thinking in application and/or interpretation of data.
- Understanding of unanswered questions demonstrated.
- Project goes beyond textbooks at student’s grade level.

- **Scientific Thought and Understanding**

This is the one most important criterion for judging a project’s merit. The major purpose of the Science Fair is to provide a vehicle for the student to engage in the process of science. Although that process includes physical acts such as data gathering, such physical processes are meaningless if they are not accompanied by scientific thinking. Once results are obtained, it is the interpretation of those results which are significant, whether or not the hypothesis is confirmed. Some aspects of scientific thought include:

- Clear, well-stated hypothesis, based on reading, study, and/or observation. Not only study, but depth of study is a factor here.
- Experimental procedure effective in testing the hypothesis.
- Results and conclusions clear, honestly stated, logical, relevant, and address the hypothesis.
- Implications of the experimental results discussed; one or more additional hypotheses and experiments suggested.
- Demonstrates depth of knowledge of scientific and/or engineering principles involved.
- Student can extrapolate what was learned from the project to the subject in general or to related subjects.

- **Organization and Completion**

Good organization is part of conducting an effective investigation. This includes a clear objective, a plan for carrying out that objective, well-organized and comprehensible data, and a lucid discussion of experimental conclusions and implications. This means, too, that the investigation will have been completed and not simply ended because the student may have run out of time. In other words, the project should represent a completed body of work even if the results do not support the hypothesis. Finally, the implications of the project need to be addressed. Some aspects of organization/completion include:

- Well-defined goal/objective. This can be embodied in the hypothesis or consist of additional statements regarding the project goals.
- Well-organized and executed experimental procedures.
- Data recorded in orderly manner.
- Experiments repeated as needed.
- Project represents a completed body of work.
- Implications of the project fully addressed.
- Well-organized display board.

- **Effort and Motivation**

One measure of this is the amount of time spent on the project, including background reading and project execution. More difficult to determine, but possibly more important, are the *depth* of reading and resulting project quality as well as what the student learned from his/her experience. An additional measure of effort is the quality of the display, particularly its effectiveness in communicating. To the extent that an attractive display may communicate more effectively and indicate greater effort, that aspect also may be considered. Some aspects of effort and motivation include:

- Amount of time spent on project.
- Amount of time spent on background reading and study.
- Extent to which the depth of background reading and study was reflected in the project.
- What student learned.
- Display board informative and attractive.

- **Clarity**

Although clarity is a theme found in all of the judging criteria, it applies specifically to certain elements such as notebooks. Some aspects of clarity include:

- Original project notebook available for inspection.
- Project notebook clear, well organized and accurate.
- Hypothesis, purpose, procedures, results, and conclusions clearly stated.
- Project title accurately portrays the project.
- Abstract clear and well written.
- Oral presentations are clear.
- Audio-visual materials, including the display board, clear and relevant.

For your convenience, a judging worksheet is available. It includes the above criteria as well as the relative point value to be assigned to each category. A copy of the worksheet follows.

## Judging/Criteria Worksheet

Student name(s) \_\_\_\_\_

Project title \_\_\_\_\_

Project number \_\_\_\_\_ Grade level(s) \_\_\_\_\_ Category \_\_\_\_\_

1. Originality/creativity (30 points)

- a) The problem is original or a unique or unusual approach to an old problem.
- b) Experimental design shows creativity.
- c) Resources – materials and equipment – are used ingeniously.
- d) Application and interpretation of data demonstrate student’s creativity and original thinking.
- e) Student shows understanding of unanswered questions.
- f) Project goes beyond textbooks found at the student’s grade level.

<b>Poor</b>	<b>Weak</b>	<b>Average</b>	<b>Strong</b>	<b>Exemplary</b>	Score _____
<b>0-11</b>	<b>12-17</b>	<b>18-22</b>	<b>23-26</b>	<b>27-30</b>	

2. Scientific thought and understanding (35 points)

- a) The hypothesis is well stated and based on reading, study, and/or observation.
- b) Project demonstrates depth of study.
- c) Student demonstrates depth of knowledge regarding the scientific and/or engineering principles involved.
- d) The experimental design is effective in testing the hypothesis.
- e) Results and conclusions are clearly and honestly stated, and are logical, relevant, and related to the hypothesis.
- f) Implications of the experimental results are discussed, and one or more further hypotheses and experiments are suggested.
- g) Student can extrapolate what was learned from the project to the subject in general or to related subjects.

<b>Poor</b>	<b>Weak</b>	<b>Average</b>	<b>Strong</b>	<b>Exemplary</b>	Score _____
<b>0-13</b>	<b>14-20</b>	<b>21-25</b>	<b>26-31</b>	<b>32-35</b>	

3. Organization and Completeness (15 points)

- a) The project has a well-defined goal/objective.
- b) Well-organized and executed experimental procedures.
- c) The scientific literature (considering grade level) has been searched.
- d) Experimental data recorded in a careful and orderly manner.
- e) Experiments have been repeated as needed.
- f) Implications of the project fully addressed.
- g) Well-organized display board.

<b>Poor</b>	<b>Weak</b>	<b>Average</b>	<b>Strong</b>	<b>Exemplary</b>	Score _____
<b>0-5</b>	<b>6-8</b>	<b>9-11</b>	<b>12-13</b>	<b>14-15</b>	

4. Effort and Motivation (10 points)

- a) Amount of time spent on project.
- b) Amount of time conducting background reading and study.
- c) Extent to which depth of background reading and study was reflected in the project.
- d) The student learned a considerable amount about the subject on the project.
- e) The display board was informative and attractive.

<b>Poor</b>	<b>Weak</b>	<b>Average</b>	<b>Strong</b>	<b>Exemplary</b>	Score _____
<b>0-3</b>	<b>4-5</b>	<b>6-7</b>	<b>8-9</b>	<b>10</b>	

5. Clarity (10 points)

- a) Original project notebook is available for inspection.
- b) Project notebook is well organized and accurate.
- c) The purpose, hypothesis, procedures, results, and conclusions are clearly stated.
- d) The project title accurately portrays the actual project.
- e) The abstract is clear and well written.
- f) Oral presentations are clear and reflect knowledge of the problem and the basic science underlying it.
- g) Audio-visual materials, including the display board, are clear and relevant to the project.

<b>Poor</b>	<b>Weak</b>	<b>Average</b>	<b>Strong</b>	<b>Exemplary</b>	Score _____
<b>0-3</b>	<b>4-5</b>	<b>6-7</b>	<b>8-9</b>	<b>10</b>	

Total score \_\_\_\_\_  
Rank (top 5) \_\_\_\_\_

## Other judging issues

- **Comparing projects with widely different levels of sophistication**

Sometimes students have access to sophisticated laboratories, have advanced scientific equipment available to them, and/or carry out their projects under the guidance of a professional scientist. Comparing such projects with those done in a home environment can be difficult. As a judge, you should not be in the position of assuming that a project would have been better or worse with or without the advantages of better equipment or instruction.

The critical issue here is not the level of the tools used. Rather, it is what the student has done with the resources at his/her disposal. If advanced instrumentation is used to further a strong scientific investigation, and that is clearly communicated in the interview, such a project should do well. However, a student who does better science and has superior understanding but used only items found in an ordinary kitchen deserves a better rating. The mere use of sophisticated equipment in a weak project and/or by a student who does not understand the scientific principles involved should receive little or no credit.

Finally, it is important that the student's knowledge should be appropriate to the project and its goals. If advanced instrumentation is used, for example, the student should be conversant with the principles underlying that use, and how results obtained from the equipment relate to conclusions reached.

- **Team vs Individual projects**

The criteria for judging team projects are the same as for those done by individuals. It is important, however, that each member of the team demonstrates her/his significant contributions to the project and comprehensive understanding of it. This can be accomplished through statements made in the interview by each team member and/or by questions asked by the judge. In conducting the interview, the judge should direct questions to individual team members to make sure that each one has an opportunity to speak. This is especially important if the team has chosen to have one member make the formal presentation about the project or to direct certain questions to the team member with expertise in that area.

Because a team will have more physical and possibly brainpower resources than an individual, it is appropriate that teams be expected to produce higher quality projects than those working alone. Further, team projects should show evidence that team interactions had positive results, a synergistic effect, in other words. You should expect team projects to exceed individual efforts in at least the following:

- Background research
- Data collection – quantity and quality
- Number of experimental repetitions

***Remember that the best project should win, whether it is an individual or team effort.***

**Good luck and thank you for contributing your time and expertise for the benefit of Kern County young people.**

*This booklet was prepared by Dr. Robert Allison of the Kern County Science Foundation. (Revised August, 2007)*