Parent's Handbook

How to Help Your Child With a Science Fair Project

Kern County Regional Science Fair

The Science Fair is a wonderful opportunity for your child to learn how to ask questions about the natural world and, through experiment and reasoning, get answers - to do, in other words, what scientists do. Your role will be to support your child as he/she takes on the challenges involved in completing a project. You can do this in many ways: encourage an interest in science, help find a project and the resources needed to complete it, make sure that she/he does the project in a way that is safe for her/himself and others, help her/him to stay focused on the objective, and, of course, help your child enjoy the experience. Learning, particularly learning by doing something interesting, should be fun. What you should **not** do is attempt to do the project for your child. Of course, parents want to help their children to be successful, but a true sense of accomplishment only occurs when we complete a task, particularly a difficult one, through our own efforts.

Here are some things you can do to help.

Work with your child to develop an interest in science and mathematics. If she/he has an interest in nature, collecting rocks or insects, for example, supports that. But the heart of science is thinking scientifically. This means, for example, examining the world and asking questions about it, not always taking assertions made by others at face value, and looking for good evidence to back up conclusions about observations. If your child is curious about one or more of the sciences, chemistry, geology, biology, etc., by all means encourage that interest, but every branch of science is based on scientific thinking.

The University of California, Berkeley, Lawrence Hall of Science developed the following suggestions about helping children develop an interest in science. You may find them useful.

First, help children of any age become good problem solvers. Here are some tips:

1. ***Encourage questions**, particularly those which have more than one possible answer, and preferably ones to which you don't know the answer. ("I'm not sure why leaves have different shapes – let's collect some and try to figure out some reasons.")*
2. ***Ask open-ended questions and welcome innovative responses.** ("What do you think these woods will look like a hundred years from now?" "What would children do if there weren't any schools and everyone stayed home and learned from a computer?")*
3. ***Encourage divergent approaches to everyday situations, within reason.** (If your child can think of a reason for setting the table in a new and different way, why not?)*
4. ***Provide toys and games that encourage a variety of types of play which the youngster must create himself:** praise and admire innovative uses of play construction, or game materials.*
5. ***Show your child how to estimate.** ("You have nine pennies in your bank-that's close to a dime." "We have to drive 295 miles to Grandmother's house-that's close to 300 miles.")*

6. ***Practice "guess and test."*** *("I'm not sure what will happen if we put lemonade in the Jell-O instead of water-let's guess some possibilities and then see what happens.")*
7. ***Work hard on helping your child feel secure enough to take sensible risks.***

Practical Math and Science Learning at Home

Next, try some family activities to build numerical and scientific concepts:

1. ***Cooking*** *offers a wealth of possibilities for understanding the important ideas of quantity, measuring, sequencing steps in a problem, following directions accurately, fractions, and testing hypotheses. Here is an enjoyable, meaningful, and delicious learning experience!*
2. ***Family games*** *involving cards, numbers, or money promote an understanding of relative quantity and build computational skills. Games requiring visual organization or strategy are also valuable.*
3. ***Shopping*** *offers chances to compare prices, shapes, learn about decimal places, and practice computation in meaningful situations. Catalog shopping at home can become a math game – figuring out how many items can be purchased for a certain amount, for example.*
4. *Every school age child should have some sort of* ***allowance*** *to manage, however small, and real experience buying small items and getting change. Older children can learn about interest in a natural context from a bank or if they need to borrow from their parents.*
5. ***Travel games,*** *such as license plate bingo, keeping mileage records, or even computing gas mileage can be fun. Working with maps builds graphing and directional skills and can make a child feel very important.*
6. ***Collecting*** *inspires many budding scientists, and* ***exploring nature*** *with an interested adult has kindled the interest of many future biologists.*
7. ***Measuring and weighing*** *activities are appropriate even for young children. Making diagrams of rooms in the house or maps of the yard or neighborhood is fun. You might try introducing nonstandard measurements, such as "How many Daddy-shoe-lengths wide is the kitchen?"* The Guinness Book of Records *is a rich source of relative measurements.*
8. ***Using time*** *is the best way to learn about it. Relate time to events that are meaningful for the child and use appropriate terms ("What are we doing now?"; "What will we do after/while we eat lunch?"). Pasting or drawing pictures of activities on a daily calendar while discussing past and upcoming events makes "then" and "soon" more understandable than using abstract concepts of days, weeks, months, or seasons.*
9. ***Following directions*** *is one of the most important skills from the home. Taking steps in order, planning ahead, and talking about what to do before tackling the task can all be encouraged. Cooking, as noted earlier, treasure hunts, and building models are all sequential step-following activities. For older children, map and compass skills are very helpful.*

10. ***Calendar games*** *are a good source of problem-solving situations with numerical concepts.*

These are only a few of the multitude of activities that are the natural base of math and science learning. They are essentially about the real world, which is the best place to learn about them.

Help your child get started. Finding a good project is the first step. It must be appropriate to your child's grade level and abilities, address a question that is not trivial but also can be completed in a reasonable amount of time, and fit into one of the Science Fair categories. Some ideas:

- Ask your child to observe the world around him/her and try to think of questions about it. As Casey Stengel is alleged to have said, "You can observe a lot just by looking."
- The best science fair projects originate from something that interests the participant. A hobby, for example, might become the basis for a project. Your child might begin by listing some of the things he/she is interested in and exploring how that interest can be made into a scientific investigation.
- Take your child to the library to survey books and magazines for ideas.
- Help him/her find web sites with science fair ideas. An excellent source of support, ideas, and guidelines for creating good projects can be found at the California State Science Fair website, http://www.usc.edu/cssf.
- Discuss ideas with him/her. It is important that a science fair project not simply repeat an experiment or exercise found in a book or on a web site. The student might get an idea for a project from reading about an experiment and then should ask **new** questions that would form the basis of the project.
- Previous science fair projects, particularly winning ones, can be used as models of what a good project looks like, but your child should not attempt to repeat one of these as his/her project.

Finding resources is important. Science fair projects require resources, everything from the display board to equipment needed to complete the investigation. Usually simple, everyday items are all that are necessary for a project, although there is nothing wrong with using specialized scientific apparatus if it is available and safe. You can assist your child greatly by helping find, make, and/or finance the things needed for the project. Some of these items might include:

- Books and periodicals – These do not have to be purchased. Both school and public libraries likely will have what you need.
- Access to websites – If you do not have this access at home, schools and public libraries have Internet connections.
- Equipment and supplies – As stated above, these often already will be available in the home or can be purchased locally. If specialized items are needed, contact your school or the Science Fair Coordinator for assistance.

- Place to work at home – Your child will need a place to work on the project and to rehearse the science fair presentation.
- Mentor – This is someone, often a science professional, who can provide advice and guidance. Having a mentor who is a subject matter expert may be required if the project involves one of the "restricted" categories (see below).
- Mathematical and/or scientific techniques – Your child might learn about any techniques needed by reading about them or being taught them by the teacher, the mentor, or you.

Provide encouragement. This will be a new and sometimes challenging task for many students. Your support and encouragement may be critical to its success.

- Encourage your child to talk about the project and how it is progressing.
- As the project develops, reinforce successes with praise and provide support as he/she works through problems.
- Be a sounding board for ideas.
- You can provide assistance but should not do the project for the child. It is OK, for example, to help find materials, equipment, or information needed.

Other things you can do:

- Make sure that your child understands the rules and complies with them. It would be very disappointing if the project were rejected at the last minute because, for example, he/she violated the display or restricted project rules. It is a good idea to go over the rules with your child before the project begins and then check to see how things are going as it develops. You and your child should read and understand the *Official Rules and Entry Forms* booklet. In some cases, he/she may need your help to understand the booklet. This booklet not only includes the rules, entry forms, and entry categories, it has material about what makes a good science fair project and how to prepare for judging. **Note that the Kern County Regional Science Fair Rules may not be the same as those of your child's school.**
- It is particularly important that you and your child understand and comply with the Restricted Project rules. These rules, outlined and discussed in detail in the *Official Rules and Entry Forms* booklet, refer to the use of human subjects, vertebrates, microorganisms, or any materials or items that may be dangerous. It is critical that these rules be followed exactly. If you have any questions about this, check with the Science Fair Coordinator, your child's teacher, a subject matter expert, and/or a mentor.
- Work with your child to create a project schedule and monitor his/her progress.
- Provide transportation to libraries, local colleges, stores, and other places that your child may need to visit in order to complete the project.
- Act as a consultant to your child.
    - As mentioned above, you can be a sounding board for ideas and provide feedback as he/she tests out different ways to approach the project and its challenges.
    - Review written materials, including the display board, for spelling and grammar errors.
    - You can do some role-playing and ask your child to give his/her presentation to you as if you were a Science Fair judge. As the "judge," you can ask questions

and give your child the opportunity to sharpen his/her explanations and thinking processes.

- Make sure that your child always works safely.
  - Sometimes projects involve chemicals, biological materials, machinery, and/or other situations that could be hazardous if safe practices are not followed. Your supervision may be necessary. If you are not sure about a practice or the use of some material or equipment, get advice from the teacher, scientific mentor, or Science Fair Coordinator. Generally, these kinds of projects will come under the heading of "restricted projects," referred to above.
- Make sure correct research protocols are followed.
  - This refers to compliance with restricted project rules as well as good scientific practices such as honest recording of all data as it is collected.
- If you have the expertise, you can assist your child in learning about experimental procedures and/or analysis of data. Better yet, point her/him in the direction of books and other resources so that she/he can learn for her/himself.
- Providing some help is OK (see below), but the student must be in control; if she/he makes mistakes, they are her/his mistakes. *Remember that it is the student's project, mistakes and all!*

Here are some things you should NOT do.

A Science Fair project must be the work of the student. Therefore, please do ***not***:

- Execute the project, including conducting the experiments or investigations, for your child.
- Do any of the writing, including the abstract or description.
- Complete any of the analyses, including graphs, mathematics, or written materials.
- Perform mathematical analyses on your child's experimental data. It is OK to show him/her how to do a statistical procedure, for example (see above), but the student must apply those procedures to the actual experimental data.
- Provide conclusions about the project, even if they are obvious to you and are seemingly missed by your child. It is his/her project, including any mistakes, perceived or actual.
- Build or otherwise create the display, although you can help your child by acting as her/his assistant. As in all other parts of the project, the display must be primarily her/his own work.
- Provide any impermissible assistance. In this regard, the following passage from the *Official Rules and Entry Forms* booklet may be helpful.

  Help received ---------- *Although the project must be the work of the student, some help is permissible. However, there must be a clear distinction between the work of the student and others. Students participating in a research opportunity in industry, a university, or other institutions other than their school must display only their own research. If a student does a project of this type, the project*

documentation must include a letter from the principal researcher indicating the level of his/her involvement in the student's project.

The Science Fair and State Content Standards

Participation in a science fair is not only a very important learning experience in its own right but provides a way for students to learn material incorporated in the Content Standards for California Public Schools.

Additional information on the content standards may be found at www.cde.ca.gov/standards.

The following is a summary of some content standard areas and their relationship to science fair learning.

Science Content Standards

The science content addressed in grades 4-5 includes physical science, life sciences, and earth sciences. Grades 6 through 8 focus on earth science, life science, and physical science, respectively. At the high school level, the disciplines of physics, chemistry, biology/life sciences, and earth sciences are explored in greater depth. The vast majority of science fair projects fall within one or more of these areas, and students are expected to perform science fair work which goes beyond the material found in their grade-level textbooks. Thus, it would be difficult for a student to complete a science fair project without learning some – and usually a considerable amount of – new science content.

However, each grade level has an additional component (or strand): Investigation and Experimentation. This strand includes such skills as:

- Differentiating observation from inference
- Measurement
- Estimation
- Developing questions about the natural world
- Planning and conducting investigations to answer questions
- Selecting appropriate tools and technology for conducting an investigation
- Identifying experimental error
- Recording data
- Interpreting results
- Drawing conclusions from scientific evidence
- Formulating explanations using experimental data and logic
- Analyzing situations and solving problems by employing concepts and facts from different scientific disciplines

Almost all of the items listed above and the many additional ones found in the *Science Content Standards for California Public Schools* pertain to skills obtained through

activities such as the science fair. Other than direct research participation in a university or research institute setting, few other such opportunities exist for grade 4-12 students.

Mathematics Content Standards

Almost all science fair projects involve some use of mathematics. Indeed, some have mathematics or computer software as their major subject area or category.

Grades 4-7 The five major strands include Number Sense; Algebra and Functions; Measurement and Geometry; Statistics, Data Analysis, and Probability; and Mathematical Reasoning. These are listed below with some examples of content areas which students are likely to learn as science fair participants.

Number Sense

- Computing with very small and very large numbers, understanding relative numerical magnitude, solving problems
- Decimals
- Fractions
- Percents
- Standard operations – adding, subtracting, multiplying, dividing
- Use of ratio and proportion
- Use of formulas, symbols, and simple equations

Algebra and functions

- Use of formulas, symbols, and simple equations
- Solving linear equations
- Application of order of operations

Measurement and geometry

- Measurement
- Precision and accuracy
- Geometric ideas, such as shapes, and calculating perimeters, areas, and volumes

Statistics, Data Analysis, and Probability

- Data analysis and representation
    - Proper use of statistics –mean, median, mode
    - Sample selection and data display
    - Probability and prediction
- Graphs-interpretation/analysis and creation
- Plotting data points

Mathematical Reasoning

- How to approach problems
- Use of strategies and skills to find solutions
- Generalizing to new situations

Grades 8-12 Mathematics content is organized in terms of discipline areas. In the following, some of the content standards relevant to the science fair are listed under each discipline area.

Algebra I

- Students use and know simple aspects of a logical argument.
- Students explain the difference between inductive and deductive reasoning and identify and provide examples of each.
- Students identify the hypothesis and conclusion in logical deduction.
- Students use counterexamples to show that an assertion is false and recognize that a single counterexample is sufficient to refute an assertion.

Geometry

- Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.
- Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.
- Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles.

Probability and Statistics

- Students are familiar with the standard distributions (normal, binomial, and exponential) and can use them to solve for events in problems in which the distribution belongs to those families.
- Students determine the mean and the standard deviation of a normally distributed random variable.
- Students know the definitions of the *mean, median,* and *mode* of a distribution of data and can compute each in particular situations.
- Students compute the variance and the standard deviation of a distribution of data.

- Students organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots.

Trigonometry

- Students are adept at using trigonometry in a variety of applications and word problems.

Advanced Placement Probability and Statistics

- Students determine the mean and the standard deviation of a normally distributed random variable.
- Students know the definitions of the *mean, median,* and *mode of distribution* of data and can compute each of them in particular situations.
- Students compute the variance and the standard deviation of a distribution of data.
- Students find the line of best fit to a given distribution of data by using least squares regression.
- Students know what the *correlation coefficient of two variables* means and are familiar with the coefficient's properties.
- Students organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line graphs and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots.

English-Language Arts Content Standards

The science fair is not just about science. A quality project requires the application of a substantial number of English/language arts skills. Many of these skills, particularly those involving logical reasoning, have obvious application to scientific investigations. However, a successful project also requires writing, reading, and oral presentation skills.

The three major content strands-reading, writing, listening and speaking- are listed below along with examples of skills learned and practiced through science fair participation.

Reading
1.0 Word Analysis, Fluency, and Systematic Vocabulary Development
2.0 Reading Comprehension (Focus on Informational Materials)

- Background and reference reading required for obtaining project ideas/hypotheses and for conducting an investigation.
- Expanded vocabulary – scientific terms as well as new ideas and vocabulary obtained from reading and contact with science fair judges and other officials.
- Develop new reading and literary concepts through work with projects and people.
- Reading comprehension is developed because student must read and understand new, sometimes unfamiliar materials.

- Students must analyze and evaluate materials in order to determine the most appropriate scientific investigations to pursue, to develop an experimental procedure, to evaluate results, draw conclusions, and predict the possible outcomes of future experiments.
- Reading for comprehension as well as location of information is necessary.
- In order to develop an experimental design, students must be able to follow step-by-step instructions, evaluate the resulting procedure, and then use their knowledge gained from reading and evaluation to develop an original approach to that procedure.
- In order to enter the science fair, the student must read and understand a long and complex series of instructions.

Writing
1.0 Writing Strategies
2.0 Writing Applications (Genres and Their Characteristics)

- Writing is central to a successful science fair project. Some of the writing is that of a technical report but one which will be read and should be understood by a general audience.
- Students must focus their efforts, organize the material, and then prepare written materials for judges, teachers, parents, and other students. This includes the description of the project as well as its outcomes and implications, and an abstract of the project.
- Writing must include clear exposition and reasoning, both deductive and inductive. It must include arguments which relate the beginning question or hypothesis to the results and explain the extent to which those results support or do not support the hypothesis.
- The student must fill out a number of complex forms in order to enter the County fair.
- Writing must be based on research and study, sometimes citing authorities for the purpose of establishing the rationale for a particular investigative approach.
- Clarity and logic in writing are central to the success of a science fair project. This includes good mechanics, such as sentence structure and grammar, as well as solid and well-supported content.
- Presentations often must include the use of computer technology to produce text, labels, graphs, graphics, and even sound and video, all of which must be skillfully integrated in order to produce an attractive and informative display.

Listening and Speaking
1.0 Listening and Speaking Strategies
2.0 Speaking Applications (Genres and Their Characteristics)

- Effective listening and speaking are a critical part of a project, such as ones which include interviews and/or surveys or involve a project team in which effective verbal interaction is critical. During these presentations, the students must persuade the judge that his/her project is deserving of an award.
- Students being interviewed by judges during a science fair must be able to present their project clearly, concisely, and in an appropriate manner. Students must be able

to respond to judges' questions in a similar manner. To do this requires that the student listen to and understand the judges' questions before responding.

- Student presentations and responses are rated both for their content and for the clarity of the presentation. Use of detail and examples, as well as variations in volume, pitch, modulation, and gesture can be important in clarifying the message. They include elements of technical reports as well as those of an informative and persuasive argument.
- The science fair gives students the opportunity to make a narrative presentation, relate ideas and observations, provide information, and summarize a series of facts and/or details for the listener.
- Oral presentations may be accompanied by audio-visual materials which often are computer-generated.

A science fair project is a wonderful experience. Best wishes on helping your child on this journey of discovery and learning.

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