Science Fair Project Guide

for Students and Parents

From the Science Fair Committee
Compiled for the students of Fruchthendler Elementary
Tucson, Arizona

WHAT IS A SCIENCE FAIR PROJECT?

Every year the Tucson Unified School District and Fruchthendler Elementary hold a Science Fair. A Science Fair is an organized exhibit of student investigations and experiments in the science and engineering field. It is held to teach and encourage the processes of good experimentation as a means for accomplishing scientific research.

The Science Fair is held in conjunction with the Southern Arizona Regional Science and Engineering Fair (SARSEF), sponsored by the University of Arizona in March of each year. Every school in southern Arizona is invited to sponsor a limited number of student entries to the exhibition held at the Tucson Convention Center. Representatives for the Tucson Unified School District elementary schools are selected from the winners of their school Science Fair.

For the student, the Science Project is many things:
It is deciding to make a commitment to see a project through from start to finish.
It is choosing a topic that seems interesting to you.
It is finding useful information about your topic from libraries, colleges, teachers, and scientists.
It is deciding upon a purpose for your project and making guesses, or hypotheses, about the outcome of your experiments.
It is experimenting to test your hypotheses, making observations, recording your facts (data)... and then repeating your experiments to verify your results.
It is analyzing your findings and making conclusions.
It is preparing your exhibit.
It is presenting your project to an audience of your classmates, the judges, and the public at the Science Fair.

Completing a Science Project should give you the feeling of accomplishing something very worthwhile.

CREATIVE THOUGHT AND GREAT IDEAS

All outstanding science projects usually have one thing in common— they are the result of creative thought. Creative thought means contributing a new approach, a new idea, or a new solution to a problem.

The CREATIVE PROJECT is:
INNOVATIVE: something that has not been proven before, or shown in that way before.
UNDERSTANDABLE: similar results can be generated by following your experimentation.
USEFUL: solves a problem or advances knowledge.

Creative people use a method for finding new ideas or solving problems, before they get that "AHA!! THE ANSWER!!" feeling. Creative people begin with a PREPARATION period, where they learn as much as they can about a topic or a problem. They CONCENTRATE on what they have discovered to make sure they understand it. Then there is usually a REST PERIOD. They take time to let the idea incubate, like a bird must do with an egg, sometimes doing other things while they think about the BEST answer. Then... "AHA!!" They get the answer or idea. It's now time to seek help from others to test the idea. This is the stage of hard work.

So, if you want to have a creative project, you have to be creative yourself. That means you must prepare, concentrate, and incubate for that "AHA!!" feeling to arrive.

SAFETY RULES AND PRECAUTIONS

A science project will be a rewarding learning experience for everyone involved if you remember to always use your common sense concerning safe behaviors. You might be using glassware, chemicals, or electrical equipment that could be dangerous to your health. Be alert whenever you are experimenting to possibly harmful situations. It really is "better to be safe than sorry."

The Science Fair is an exciting event. Hundreds of Students and parents visit each year to view the results of your hard work and effort. Many people become fascinated by the displays and demonstrations you design. It is very important that you consider their safety too when you are making your presentation.

The Science Fair has certain safety rules which must be followed. Projects that do not meet these rules will not be allowed in the Science Fair. Please read these carefully:

1. To display anything which could be hazardous to the public is prohibited. This includes:
live animals
live disease-carrying organisms which are pathogenic to man or other vertebrates
open flames
highly flammable display materials
dangerous chemicals such as caustics and acids
combustible solids, fluids, or gases

2. No live vertebrate animals may be displayed. Projects involving the use of vertebrate animals may display photographs, drawings, charts, or graphs to illustrate the conditions, developments, and results of the investigation.

3. Proper attention to the safety of the exhibit is expected of all Science Fair participants. All operating exhibits should meet the following requirements:
All wiring must be properly insulated. Nails, tacks, or uninsulated staples must not be used to fasten wiring. High-voltage wiring, switches and metal parts must be placed out of reach of observers and designed with an adequate overload safety factor.

4. All containers should be unbreakable whenever possible. (No glass, ceramic, stoneware, etc.)

For more complete details, see the attached SARSEF "Unacceptable for Display" page.

YOUR EXHIBIT

The purpose of your exhibit is to communicate the results of your experimentation clearly and attractively. Your display must also be strong enough to stand by itself and sturdy enough to withstand many days of viewing by hundreds of people.
Please consider these suggestions when making your display:

1. Make the title large, clear, and neat.
2. Labeling should be neat and informative.
3. Make large and clear explanations.
4. Make your project tell the story of your experimentation. Be sure to include a clear statement of your purpose, materials, procedures, results and conclusions.

5. Make your exhibit so that it will fit a table space of 75 centimeters (approximately 30 inches) front-to-back, by 90cm (approximately 36 inches) side-to-side, or smaller. Maximum height is 106cm (approximately 42 inches). The exhibit must be freestanding. (See Science Fair Presentation Guidelines or Handout on the school website.)
6. Make your exhibit durable. Use heavy cardboard, pegboard, or similar material for support.
7. No electrical power is provided at display tables!
8. Print your name, grade level, teacher's name, and category you are entering on a 3"x5" index card. Attach the card to the back of your project. Names should not appear anywhere on the front of the exhibit.

CHOOSING YOUR TOPIC

If you already have an idea of what you want to investigate, that's great! Be sure to read "Good Topics— Poor Topics." If you cannot decide on a topic, begin by looking through books or magazines, or by talking to people. Your teacher, parents, or a friend may have a good idea for you. The Internet has many useful sites about science projects and categories for further research in your specific topic. (See attached page with possible Internet sites.) Since you are going to work on this project for a long time, you should pick a subject you are genuinely interested in.

Places to Look:

Science Books
Encyclopedias
Educational T.V. Programs
Talk with Teachers
Visit Museums
Visit the University

Talk with Librarians
Newspaper Articles
Science Magazines
Talk with Parents
Visit Zoos
Talk with Scientists

Internet
Find a Science Mentor

Whatever the topic you choose, it must be one that you can experiment with yourself. A good topic can be stated as a question that can be answered only by experimenting. Here are some examples of good topics and poor ones for use in a Science Fair:

GOOD TOPICS— POOR TOPICS

"THE EFFECTS OF CHEMICAL FERTILIZERS ON BEAN GROWTH"
This could be a good topic because it suggests experimentation. The student must use the scientific method to demonstrate a conclusion.

"WHICH BREAKFAST CEREAL DO CHICKENS MAKE NO. 1?"
This could be a good topic because it too suggests an experiment will be run to arrive at the conclusion. Asking a question in the title of the project is a good approach to developing your topic.

"VOLCANOES"
This topic is too broad. If the student makes a model that erupts as part of his topic, then he is doing a demonstration, not experimentation. This would be a poor topic for the Science Fair.

"HOW ELECTRICITY WORKS"
This again usually results in a demonstration, not an experiment.

Please remember that the purpose of a Science Fair project is to answer a question about your topic through experimentation. You will have to choose a topic, then narrow it down to a specific question that you can investigate.

EVERY PROJECT MUST HAVE A PURPOSE

Now that you've chosen your topic, try to state the purpose of your experiments in two or three sentences. You might start with: "The purpose of my project is..." Your purpose may include any hypothesis (scientific guess) that you have as to the outcome of your experiments.

Here's an example of a student's purpose statement:
"The purpose of this project is to determine the effect of soil composition on water-caused soil erosion."

The student has described what he is attempting to find out experimentally and what his test conditions will be. If you have stated your purpose clearly, you will have little trouble creating a title for your project that is brief but clearly describes your problem.

The project title of this example might be:
"What Effect Does Soil Composition Have on Soil Erosion?" or "The Relationship of Soil Composition to Soil Erosion"

Try writing several titles before you decide on one.

RESEARCHING YOUR TOPIC (UPPER GRADES)

No matter what the topic or purpose of your project, the next step should be research. You need to find books, magazines, and any other source that contains information about your topic. Before you begin your experimentation, you should find out what is already known.

At first you should look for general information. If your topic deals with plants, for instance, you should find out the basic things about plants: their structure, nutrients needed for proper growth, scientific names, and other general characteristics of plant life. Your teacher or your librarian may be helpful in suggesting what you need to know about your topic and where you might look to find it.

After you have gained a general background knowledge of your topic, you should look for specific books on your subject, or seek professionals in the field who work with your topic in their own investigations.

It is important to take good notes and to summarize what you have found before you begin. It will help you to do a better job of designing and running your experiments.

GATHERING YOUR MATERIALS

As you outline your experiments, begin listing the materials you will need. Materials do not have to be expensive. Many times you can substitute similar items for very expensive laboratory materials and still have a successful project.

You might need to purchase or order some items well in advance. Special items that are not found in a hardware or drug store often take weeks to get from scientific suppliers. This is another reason to make a good plan and begin well in advance of the Fair.

When performing your experiment, keep an accurate record of what, how much, and what kind of materials you used. When writing your list of materials and your description of your experiment for your report, keep in mind that quantities are important.

POOR LISTING OF MATERIALS	GOOD LISTING OF MATERIALS
water	25 liters of water
thermometer	1- 0 to 100 degrees C thermometer
test subjects	40 test subjects:
	8 boys, Ages 5-7
	8 girls, Ages 5-7
	12 boys, Ages 8-9
	12 girls, Ages 8-9

EXPERIMENTING

Your project should include "controlled experimentation." In other words, if your experiment is done under carefully controlled conditions, what will happen? You, as the experimenter, will change certain conditions and observe how the condition of your subject is affected or changed. The experiment should provide a method for testing your hypothesis.

Whatever the experimentation or subjects you use, there will probably be many variables. Two types of variables in simple controlled experiments are:

INDEPENDENT VARIABLE
The experimenter changes something to observe what will happen. The "thing" he changes is the independent variable.

DEPENDENT VARIABLE
The experimenter changes something to observe what will happen. These "things" that he changes may cause something else to happen. The "something else" is the dependent variable.

A variable is something that is changed or shows change in an experiment. So, how does one control these variables? There are a number of ways to control variables. In a simple experiment, you might have an Experimental Group and a Control Group. Simply stated, in a Control Group, you do not change any variable: all conditions during your experiments remain the same. You change variables in the Experimental Group, usually one at a time, to see what they will do to your answers.

Does your experiment test your hypothesis? Are you recording data and testing conditions that will help you to fully understand the cause-effect relationship in your project? If the answer to both these questions is yes, you're on your way to success!

What about models? Students often build models to demonstrate some aspect of their project. Working models are wonderful ways to test scientific concepts. The field of engineering is based on man's ability to construct models to test his ideas. A model is an excellent addition to your science project as long as it is used in your experimentation to generate data for your hypothesis.

EXPERIMENTING: MEASURING AND COLLECTING DATA

MEASURING

Perhaps you've heard the expression, "Seeing is believing." Well, quite often your eyes can fool you. A science project requires observing things or events. Seeing is one way of observing. Using all of your senses will help you to observe even more.

In addition, your senses can be aided by using instruments that magnify, such as microscopes, telescopes, or stethoscopes. You will also need the aid of measuring devices to find out exactly what you have observed. Meter sticks, thermometers, balances, and clocks are just a few aids that give meaning to what we see and allow us to compare one observation to another accurately. Besides paper and pencil, your observations could be recorded by using a camera or a tape recorder.

Two types of observations can be recorded: Qualitative and Quantitative. Qualitative observations are made without the use of measuring devices. For example, "The water was cold." Quantitative observations are made with the use of measuring devices, such as, "The water was 3 degrees Celsius." You should make quantitative observations in your project whenever possible.

Remember, observations all by themselves are not really data. If necessary, qualitative observations can be made more objective by creating some type of scale that is clearly defined. The scale can be an invented one that then is used as the measuring tool for all your observations.

For example, an experiment was done to measure the amount of dye absorbed by material left in a dye-solution for different lengths of time. To judge the color of the dyed material, the student invented a color scale using 1 to 10 drops of dye in test tubes with the same amount of water. She rated the tubes 1 to 10 and compared her dyed materials to that scale to judge the effect of her experiment.

All measurements in a science project should be in metrics. Scientists in the United States and all people in most of the world use the metric system. Do not attempt to convert to the metric system at the end of your project. Find instruments that are calibrated in metrics to do all your measurements. Use a meter stick rather than a yard stick, a gram balance instead of a pound scale, and a Celsius thermometer instead of a Fahrenheit thermometer. Your teachers can be of help in finding you the right tools to use.

RESULTS

What do you do with the data that you collect during your experimentation? If your observations are in words, organize a neat log or chart. If your results are in numbers, organize the data in tables and graphs. There are many ways to construct tables and graphs.

Three types of graphs that may apply to your experimentation are line graphs, picture graphs, and bar graphs. Line graphs are best for demonstrating changes in your measurements over a period of time. An example would be the data collected on height of a plant over a two week period. Picture graphs are eye-catching and are best used to show quantities of things. Bar graphs are best used to emphasize the difference between one set of data or experimental condition and another.

Whatever method you choose, the presentation should be neat, clear, and easily understood.

DRAWING CONCLUSIONS

Your data will either support your original hypothesis or not. You must state this in your conclusion.

Now that you have completed your experiment and collected your data, what have you proved? You must be careful when drawing conclusions. If you have done your experiments well, your conclusions will simply be the summary of your results.

If your conclusion gives you an idea for a different experiment, or a new idea to investigate, be sure to state that in your summary.

GETTING PROFESSIONAL HELP

Professionals, such as scientists, doctors, nurses, and veterinarians are eager to help students with Science Fair projects. However, it is important that you not wait until the last minute to call them.

The best way to ask for their help is to call them a few weeks in advance to let them know exactly what it is you need. When the day comes to meet with the professional, make sure you are prepared: write down your questions ahead of time, take accurate notes or tape record your conversation.

If you cannot meet with professionals, try contacting them by mail or phone. (Again, make sure your questions are prepared before you call.) Professionals may be found at Universities, museums, nature centers, industries, local businesses, zoos, government agencies, clubs, hospitals, and environmental organizations. By using the Yellow Pages of your phone book you can locate professionals at local greenhouses, pharmacies, photography stores, television stations, computer centers, and all kinds of places.

Help can be found if you look for it!

MAKING A PLAN

The best way to insure that you will do your best on your project is to make a plan many weeks, even months, in advance of the science fair. Your plan can be a simple list of the steps involved or a schedule of the tasks you should accomplish each week. Here is an example of a project plan for starting eight weeks before the Science Fair. This is the average amount of time a good project takes.

1st Week: Think about your project. Talk to teachers, friends, family. Read. Collect ideas. Become specific. Decide on your project title. Write a description. Find out what your teacher thinks. Begin now if plants or animals are involved (remember to check the rules and get the required permission for using any live animals). Otherwise, results may not be obtained in time.

2nd Week: Change title if necessary. Collect information. Do some research. Take notes. Write outline of information or questions for your project. List all sources of information. Conduct experiments. Collect data.

3rd Week: Continue experiments. Test many times to be sure of your answers. Make appointments with resource people (men and women professionals who may help you with your idea).

4th-5th Weeks	Continue experiments. Check outline. Collect and check your data (answers) to see that your experiments are working. Write a rough draft of what you've done. Get parent or teacher opinion.
6th Week	Chart your results. Graph your data. Look for patterns in your answers.
7th Week	Write a summary of your experiments and a conclusion about your results. Begin drawings, posters, written report and exhibit for fair. Get all your materials for your display.
8th Week	Finish your reports. Assemble your exhibit. Show it to classmates, friends, family. Ask for ways to improve your exhibit. Make sure the topic and your results are easy to understand.

There is no substitute for good planning!

YOU ARE THE WINNER!

Winning is nice, but it is not everything. There are many prizes awarded in the Science Fair, including ribbons for every participant. However, there is only one first place in each category.

The enjoyment of working on the project, doing the experimentation, and exhibiting your accomplishments should be your reason for being in the Science Fair.

Judges are human beings and sometimes they make mistakes. You have to accept this. On the other hand, it could be that there are things that you might have done better. Listen carefully to the suggestions of your judges, your teachers, and your parents. Improving your project next time will improve your chances of receiving special recognition.

CRITERIA FOR EVALUATING A SCIENCE FAIR PROJECT

Criteria	**Points**
1. Does the project reflect true curious investigation?	30
2. Statement of the problem and background research	15
3. Was the procedure appropriately chosen, clearly explained, and adequately applied? Is a conclusion stated and discussed?	30
4. Organization and evidence of a learning experience.	25
Total	100

See the attached page for a sample judging form. Note that these criteria change slightly for Middle School and High School where more research is required. Refer to **www.sarsef.com** for more specifics on judging in Middle School and High School and for general information on the Southern Arizona Regional Science and Engineering Fair.

Science Fair Judging Form
Fruchthendler Elementary Grades K-5

Project#__________ Project Title__________________________________ Judge___________________

Points	Criteria	Points & Comments
(30 total)	**<u>Does the project reflect true curious investigation?:</u>**	
15	**Original idea? Creative? Novel approach?** **Project journal enhances originality?** **Expression of student's interest?**	
15	**Experimental and/or computational methods applied?**	
(15 total)	**<u>Statement of the problem, and background research:</u>**	
10	**Clear hypothesis or problem statement?**	
5	**Background research—appropriate and with enough depth for grade level?** **Adequate bibliography included?**	
(30 total)	**<u>Was the procedure appropriately chosen, clearly explained and adequately applied?</u>** **<u>Is a conclusion stated and discussed?:</u>**	
15	**Good experimental design or computational approach to address purpose?** **Procedure well explained?** **Good controls used if applicable?** **Variables recognized and discussed if necessary?** **Good data collection? Adequate study size?** **Project journal used and presented?**	
15	**Evidence the student understood results?** **Thorough analysis of data?** **Intermediate steps or results given in display or journal?** **Results explained based on background research or learned material?**	
(25 total)	**<u>Organization and evidence of a learning experience:</u>**	
5	**Presentation board well organized, neat and legible?**	
5	**Logical graphs, charts or illustrations used?**	
10	**Logical and complete progression of idea from initial question to conclusion?**	
5	**Project journal adds to information on display board?**	