Welcome to The Science Fair

Science Project Guidelines

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For the past several years, scientists on the Life Sciences Support Contract at the Kennedy Space Center have participated in judging local school science fairs. Although we are always amazed by the effort and enthusiasm that the students show in working through their projects, we consistently see some problems with how they go about their investigations. Some of the inconsistencies we routinely see in their procedures are unfortunately some of the fundamentals to good scientific research procedures. The lack of these fundamentals then prevents their projects from getting the recognition they deserve. With this in mind, we have written the following guidelines for students and teachers to review before the projects are underway. These are basic steps that should be followed when working through an experiment. Students are encouraged to refer back to these guidelines while they are running their experiments to understand how to deal with any difficulties they might encounter and how to interpret their results. We have also included some hints on how to present these results in a competition once the projects are complete. We hope that by giving students and teachers a chance to review these fundamentals, they can avoid many of the pitfalls we have consistently seen.

Employees of the Biomedical Operations Office/Life Sciences Support Contract participate in local Science and Engineering Fairs, both as advisors/mentors and as judges to aspiring scientists and engineers.

1) Define the problem

You'll want to pick a subject for your science project that you like, and that you want to spend some time looking into. Right at the beginning, do some background research to familiarize yourself with the subject. You'll also want to understand any terms associated with your subject that you're unfamiliar with. If you're not sure what you would like to do, consult with local professionals in the subject area you would like to investigate. Many people would be glad to help, they just need to be asked. Also, continue to keep in touch with these people, as they could give you advice and direction throughout your project. Perhaps you could even review your final project with them and go over how you would like to present your project. They might be able to spot areas you need to improve on and point out the strong points that would be worth emphasizing.

2) Formulate a hypothesis

Come up with an idea about something you want to test. A hypothesis is just an idea of what you think might happen given the understanding you've gained on the subject while doing your background research. You will learn much more about your project as you work through it and your hypothesis can change accordingly. The main purpose of setting a hypothesis at the beginning is to keep you focused on answering a specific question and to keep your experiment on track . It is not intended to lock you into one idea that can't be changed later on when you find that it was incorrect. An example of a hypothesis would be: Does frost have a damaging effect on tropical plant growth?

3) Design your experiment

Simplicity
Keep things as simple as possible. Many students think that they need to have many variables in an experiment to make the experiment valid. This is not the case. It's much better to test only one variable thoroughly than to test many at once. For example, if you're investigating the effects of freezing temperatures on tropical plants, don't add different lighting sources and nutrients as well. Only look at the effect of freezing temperatures.

Controls
All experiments need to have an appropriate control. You need to have a standard to test your experimental results against. For example, if you're studying the effect of freezing temperatures on tropical plant growth, you will probably put some of your plants outside for a few cold nights. When you take them back in your house to see how the cold affected their growth, you'll need to have some plants that were not exposed to those cold temperatures to compare them to. The plants that did not see the colder temperatures are called a "control". All experiments must have controls and it's worth taking time to figure out what a good control would be for your experiment.

Sample Size
You will need to have several "subjects" in your experiment. For example, back to the effects of freezing temperatures on tropicals, you'll need to set several plants out in those temperatures, not just one.

Time
Allow enough time for the experiment to be repeated. Also, allow enough time for complications- things don't always (if ever) go right the first time and you might need to start your experiment over again. Begin early! Understand the project before you begin, and allow 6-8 weeks to complete the experiment.

4) Keep a detailed notebook

Don't cross anything out -- you might need to refer back to it later. Entries should be dated with the date and the number of days into the experiment. Include all observations. Don't assume you'll remember points and particulars. What might not seem important at the time might be an important result later, and might actually support your conclusion, so you'll want an accurate record of it.

5) Collect data

Quantify your results by reporting things in numbers, not just observations. For example, say that your plants grew 1 centimeter. Don't say that the plants "look bigger today than they did yesterday". Words like "bigger" mean different things to different people, so reporting your results using words can lead to confusion. You want to tell people exactly how much your plants grew.

6) Formulate a conclusion

Did your data support your hypothesis? If not, that's a result too. It doesn't mean that the experiment didn't work. Also, consider other possible explanations for your results. Did your treatment kill your plants or was it that you left them outside and some insects ate some of the leaves? You're not out to "prove" your hypothesis. Think more along the lines of "here's what I thought was going to happen and here's what actually happened" and then go on to explain why you think it happened the way it did.

7) The Final Presentation: Tips For the Science Fair

There are several essential elements to a good presentation. Present your data using averages, not individual measurements. Also, don't present the data more than once. Don't make a line graph and pie chart of the same data. Finally, don't include more than one variable on a graph or it gets confusing. Report sample size (n=?). Older students should give some statistical analysis of their data, such as standard deviation, anova or t-test. Have print large enough to read from a distance. Be sure that you understand all the terms and acronyms you present. Think about future experiments and how you could expand on a project. Many students do science fair projects in consecutive years. You should think about expanding and significantly changing your project, not just repeating the same project.