Science

Honors Project

MP 1: "Science Fair"

Overview of Project: Design and conduct a science experiment that includes a testable research question, hypothesis, materials, procedures, data/results, and conclusion. Then, put together a tri-fold presentation board to display your experiment and its results.

Considerations:

1. The honors project extends what we are learning in class by applying the "Elements of Good Experimental Design" to real world observations and data gathering that interest YOU.
2. The honors project is completely independent of school (there will be little to no time given in class to complete it).
3. Don't procrastinate! It takes time and effort to submit a project that is worthy of "honors" distinction.
4. Complete all work on your own. It is permissible to ask questions, but not to have someone do your work for you.

"Science Fair" Project

The information below will walk you through the basics of a science fair project. It reminds you of the steps taken when solving problems through an experiment. Often this is called "the Scientific Method" or "**Experimental Design**". You will be required to write a lab report that is much more detailed than in science class. Using the "boxes" lab sheet will help you to brainstorm, but ultimately you will be expected to type it up and elaborate in paragraph form.

The Basics of Experimental Design

Before getting started on your science fair project, there is one important thing to keep in mind: keep it simple! Sometimes people think that a complicated science fair project will score higher with the judges and be much more impressive. The opposite is actually true.

A good project focuses tightly on one thing so that you can determine if changing only one variable results in a measurable difference. By doing this, you will be able to repeat the results in a consistent way, thus proving or disproving your hypothesis.

With this idea in mind, let's see what steps are involved in your science fair project.

The Research Question

A science fair project begins with the Research Question. "What if", or "How will something be affected by something else?" The research question is the foundation for everything that follows with your project.

For example, "I wonder if temperature affects the growth of mold on bread" is a good example of a research question. Perhaps you've observed the bread in the cupboard, and noticed that during certain times of the year it molds faster than others (building on previous research). You're curious if temperature is a factor, which leads to your research question.

The research question should lead to an experiment. In other words it should not be a "yes or no" question, nor one that can easily be answered without an experiment.

The Hypothesis or Prediction

A Hypothesis is basically an educated guess. It's a statement of what you think is going to happen with your experiment, and perhaps why you think it will happen.

A Hypothesis should not be worded in a general way. For example, don't use "temperature affects the growth of mold" for your hypothesis. Instead, use something like "I expect that bread will mold faster at higher temperatures." Or "If I place the bread in higher temperatures, then the bread will mold faster."

Whatever your hypothesis is, make sure that you can prove it in a measurable way. In our moldy bread experiment, we can measure time and temperature. This is important for generating data.

Keep in mind that your experiment may disprove your hypothesis. There is nothing wrong with that; your hypothesis is just your best guess. In fact, some of the best science fair projects are the ones that have their hypothesis proven wrong!

The Materials

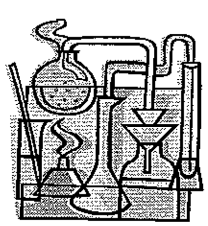
The Materials used in your experiment are important because if anyone wants to test your research, they can see exactly what items you used. This will keep all testing the same.

List out what you used and include exact sizes and quantities. For example, the list of materials used for our moldy bread experiment might look like this (notice how detailed!):

Quantity	Item Description
3	Slices of Magic Flour brand bread, expiration date of April 20, 2005 on the wrapper.
3	Quart size Sealable Plastic Bags
1	Digital Thermohygrometer from **ScientificsOnline.com**

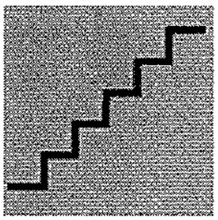
The Procedure

The Procedure is the step by step process that you will use to conduct your science experiment. The purpose of your procedure is to generate data which is the Result of your experiment.



Your experiment will usually consist of three types of variables: Constants, a Manipulated Variable, and a Responding Variable. For example, in our moldy bread experiment, the Constants would be humidity, location, materials used, etc. These are the things we are trying to keep the same for all samples. Our Manipulated Variable is temperature, the one thing we are changing intentionally. The Responding Variable is mold growth, which is what we are expecting to change according to the Manipulated Variable.

Remember to keep your procedure simple and tightly focused. Your experiment should only have one Manipulated Variable. Having more than one manipulated variable makes it very difficult to prove which variable is causing changes in your experiment. It also makes it nearly impossible to measure the effect of each variable. It's imperative to keep it simple.



For example, in our moldy bread experiment, if we decide to do an experiment which varies the temperature **and** the moisture in the air, you really can't tell how each is affecting the rate at which the mold is growing. It's much better to keep all the conditions the same, and just vary the temperature **or** the moisture.

You should be able to list the steps of your procedure in sequential order, or diagram them in a flow-chart. That way you, or someone else, can reproduce and validate your experiment by following these exact same steps.

It's important that you repeat your experiment several times, or create several batches of the same experiment. With only one test or sample, an unseen variable can affect the outcome of your experiment. However, with many samples or trials, you confirm the results each time you conduct the experiment. A larger sample size will make your data far more accurate and reliable. Make sure you have plenty of time to generate enough data for the science fair!

The Results

The Results are the data that you collected. The data must be objective (no opinions) and measurable. The results are usually always quantitative in nature (use numbers).

In our moldy bread experiment, we wouldn't say that "on the 15th day there was a lot of mold on the bread." Instead, we would write in our experiment notebook that "Sample 3 had 95% of its surface covered in mold" or measure it the area it covers in centimeters (scientists always use the metric system).

Using a Data Table is probably the easiest way to keep track of your data:

	Sample 1 45 degrees F.	Sample 2 70 degrees F.	Sample 3 110 degrees F.
Day 5	0%	0%	15%
Day 10	5%	20%	50%
Day 15	20%	50%	95%

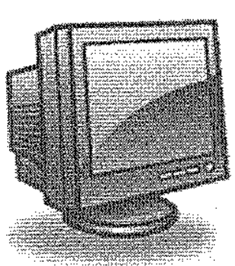
After collecting all of the data, you should present it in a way that is easy to visualize. Graphs are a great way to do this, and they can really help you draw a conclusion from your results. Nice looking graphs and charts are a key element of your science fair display. Make sure what you are trying to show with your graph is easily understood, even from a distance.

The following website can help you create a graph:
http://nces.ed.gov/nceskids/createAgraph/default.aspx

The Conclusion

The Conclusion is where your Research Question is answered using the results of your experiment. This is where you state whether your Hypothesis was proven correct, partially correct, or entirely wrong based on the data collected during your experiment. The conclusion is where you summarize what you learned and use evidence from your data to support it.

For example, you might say that "Bread left at higher temperatures mold faster than bread left at lower temperatures. I accept my hypothesis which states that I expect bread will mold faster at higher temperatures, because the sample that was kept at 45 degrees F grew mold very slowly, while the samples that were kept at higher temperatures grew correspondingly faster."



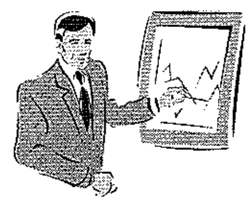
You should also explain why you think things happened the way they did, and describe and problems that occurred that might have affected the outcome. Finally, you need to discuss if there were questions that your research brought up, or further research that should be done because of your experiment. For example, you might ask "how high does the temperature have to get before it begins to destroy mold."

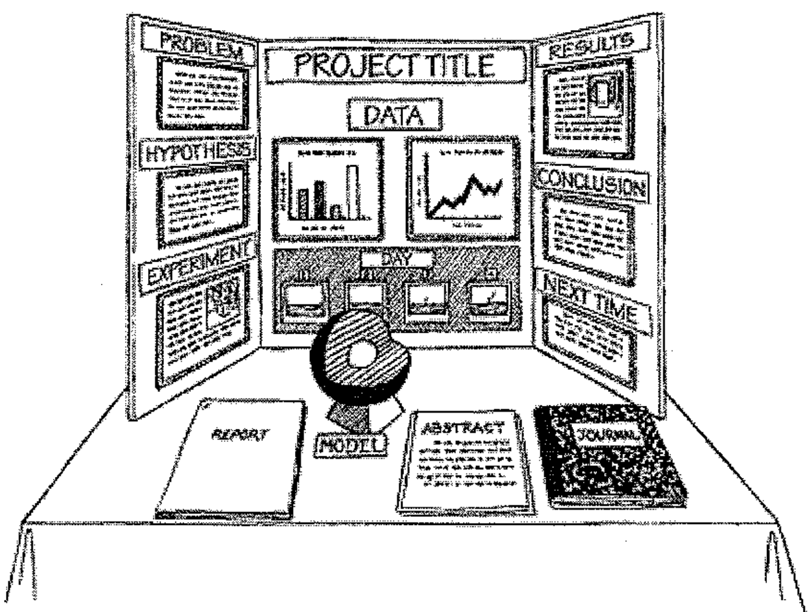
Remember, whether or not your original hypothesis is correct is NOT important. What is important is what you learned from your research. That's what makes doing a science fair project fun! You're conclusion will be a major part of your grade for this project.

Presentation

Once your experiment is complete, it is time to show it off! You must make a poster, or more preferably a tri-fold presentation board, that includes all six sections above. As you educate your audience, you want to walk them through your experiment. Each section should have a heading (such as Research Question, Hypothesis, etc.) and information. Ideally, you would take your lab report and blow it up to a size that can be seen from a distance. Add some color and decorative touches as well as pictures from the experiment (if possible)! Neatness counts.

If you are presenting in front of the class, make sure you are speaking clearly and loudly! Do not read from your board, but definitely refer to it and point to it. Also be ready to answer any questions about the experiment from your teacher and peers.





Miscellaneous

Your project will also require additional information, such as a Bibliography to cite any information you obtained from the internet or books, Acknowledgement of Assistance (if and how much your parents helped you), and so forth.

Be sure you consult with your teacher if you have any questions. Keep notes on everything; when it comes to science, you can almost never have too much information!

Have fun with your project, and pick something that you are actually interested in, but don't know what the outcome will be. If you already know the answer to the research question before you begin the experiment, it really isn't very much fun. But, when you don't know for sure what is going to happen, then your science fair project will be interesting and rewarding.

Modified from: The Free Science Fair Projects Network ©2006, 2010 http://free-science-fair-projects.com

Name: ______________________ Block: ______ Date ______________

Lab: ______________________

Question
What do you want to find out?

Hypothesis
What do you think will happen?

Procedure
Design your experiment! Write the steps for your experiment in the space below.

Safety Rules
What safety rules do you need to follow during your experiment?

Data

Create a table, chart, or graph to record your data.

Conclusion/Analysis

What did you find out? Did your results support your hypothesis? Are your results reliable?

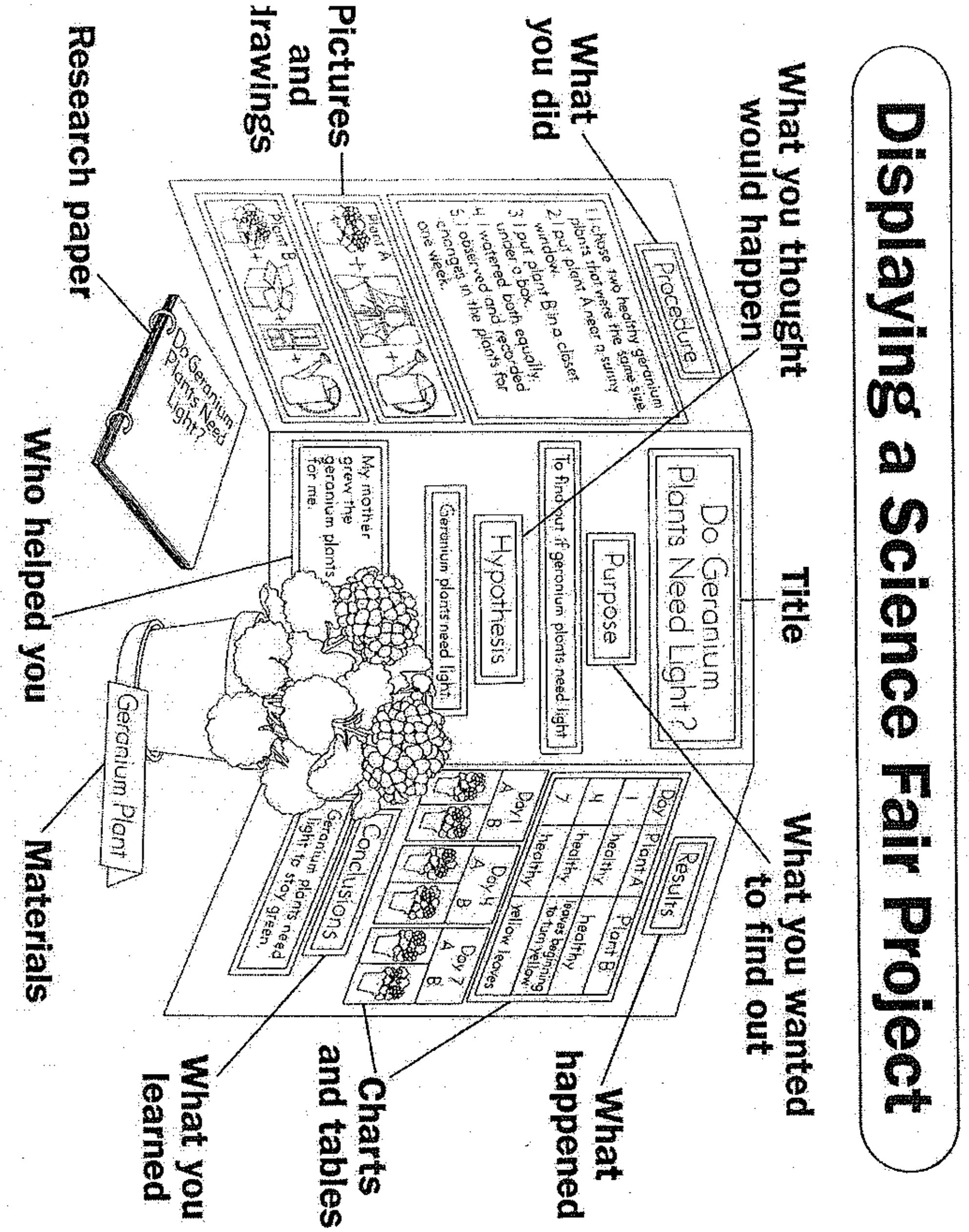
Elements of Good Experimental Design

Be sure to check that your experiment
includes all applicable "elements".

1. Builds on previous research
2. Describes all steps in procedure clearly and completely
3. Describes all data to be collected
4. Keeps all variables, except the one being tested, the same
5. Includes a control (or placebo) for comparison
6. Uses an appropriate group of subjects
7. Includes a large sample size (# of people tested or # of trials)
8. Can be reproduced by other investigators to give similar results
9. Respects human and animal subjects

** Elements may vary, depending on the problem being studied**

Anatomy of a Display Board



Teacher: Reproduce this page and the "Science Fair Time Line" page. Send them home with students to inform parents about the science fair and to help students prepare their projects. You may wish to use this chart with Frank Schaffer's *The Scientific Method* bulletin board set (FS-9492) and *Work Like a Scientist* chart (FS-2427).

Scoring Rubric

	0 Unacceptable	3 Minimum	4 Good	5 Excellent
Question and Hypothesis	Are irrelevant or not included	Are included but are not measurable	Is measurable in a quaLitative way	Is measurable in a quaNtitative way
Materials and Procedures	Are too vague, incomplete, or not included	Are Included but are not written as step by step	Procedures are written as step by step instructions	Are detailed, clear, and complete in a way that someone else could reproduce the experiment and get similar results
Data/ Results	Are not organized logically, are irrelevant, or not included	Are logically organized in some other way	Are quantitative and organized logically and neatly in a data table	Are quantitative and organized logically and neatly in a data table AND visually using graphs or charts
Conclusion	Does not answer research question, is irrelevant, or is not included	Answers research question	States whether hypothesis was correct or incorrect, answers the research question, and supports claim with evidence from data table.	States whether hypothesis was correct or incorrect, answers the research question, supports claim with evidence from data table, AND attempts to explain why things happened the way they did or further testing that can be done.
Overall Creativity, Presentation, and Adult Assistance	There was little or no originality, presentation board was incomplete, and/or much adult assistance was evident.	Presentation board was complete but some adult assistance was evident.	Experimental Design was creative, presentation board was complete, and little to no adult assistance was evident.	Experimental Design demonstrates originality and creativity, presentation board is neat and eye-catching, and little to no adult assistance was evident.

Total Score: _______ out of 25 points

***Must score at least 21 out of 25 to be considered "honors"= 84%**