How to Prepare a Science Fair Project

What is a science project?

A science project is an investigation using the scientific method to find an answer to a scientific problem.

What are the steps of the scientific method?

PROBLEM- The problem is a testable question of your topic. What will you investigate? State this as a question.

RESEARCH- Once you have determined your problem, gather background information on your topic. Use books, magazines, or the internet; or interview an expert who has first hand experience with your topic. Take notes on the information found to write a report and keep a list of the resources used in order to prepare a bibliography (references page).

HYPOTHESIS- The hypothesis is your best guess based upon your research. Explain what you think will happen in your experiment and predict the results.

MATERIALS- Materials is a list of everything you will use to complete the experiment. List what you will need and the amount needed. Use metric units of measurement.

PROCEDURE- The procedure is a step-by-step description of the process needed to complete the experiment. Someone else should be able to follow the steps in order to repeat the experiment. Tell amounts, sizes, times, and the order each step was completed.

DATA & OBSERVATIONS- Daily observations (progress) and/or measurements should be written by hand in the notebook, as journal entries, over time or multiple (repeated) trials recorded. The experiment needs to be repeated at least 3 times. Data is then shown in the form of tables, graphs, or charts. Use a sufficient sample size, especially for human, plant, and animal projects.

RESULTS- Results is a written description (summary) of what happened in the experiment. This should include an analysis of the data.

CONCLUSION-The conclusion is a written description of what was learned by doing the project. When writing the conclusion consider the following questions:

- Based upon the results of my experiment, did I prove or disprove my hypothesis?
- What did not go as I expected?
- What would I change or improve, in attempting the experiment in the future?
- What did I learn?
- How could I use (apply) the new knowledge that I gained?
- What is the importance of this experiment to my life or to the lives of others?
- How could I apply this experiment to real life?
- What further experiments would I try pertaining to this topic?
- What else would I like to know about this topic?

Notebook: The steps of the scientific method, an abstract, research report and bibliography are included in the notebook. The notebook also contains original notes of the data and observations/measurements either written as journal entries over time or records of the multiple (repeated) trials performed. Daily journal entries (daily progress) can be kept in a separate spiral notebook or put in the Notebook in the Data section.

Now that I know the steps of the scientific method, how do I begin my project?

Step 1: Select a **topic**. (Example: plant growth in different types of soil) Look for something of interest, for which you don't already know the answer. Ask yourself, "I wonder how that works? I wonder what would happen if…?"

Write your first daily progress journal entry about why you selected your topic. **Certification forms **must** be completed if using live vertebrate (backbone) animals, or human subjects. See a science fair coordinator or RIMS Regulation Packet http://www.sbcss.k12.ca.us/Cnl/cni_DOST_rimsSciEngr.php for these forms **before** beginning the project, to get it approved.**

Step 2: Design a **problem** to investigate. State the problem as a question.

(Example: Will the stems of bean plants grow taller in potting soil, backyard dirt, gravel or sand?)

Step 3: Begin your **notebook** by recording entries over time as journal daily progress entries. Be sure to explain why you chose your topic and problem. Don't forget to include what you expect to discover by investigating the chosen topic. Every time you work on your project, write in your daily progress journal.

(Example: Nov. 3, 2003-Today I chose my topic. I chose to research about plants because I enjoy working in the garden with my mother every weekend. I would like to see what is the best type of soil to help our garden grow. I will look for information on sprouting seeds, soil types, soil content, and the best conditions for plants to grow.)

Step 4: **Research** the topic. Once you have chosen your problem to investigate, it is important to research the written materials available on your subject.

- Read books and articles on your topic. Go to the library. Use the internet. Check for current events in the newspaper.
- Take notes on the information you find to prepare a research report (2 page minimum).
- Keep a record of the resources (books, articles, internet) used to prepare a bibliography.
- You could even talk to experts that know about your topic or visit places about your topic.

(Example: Check out books from the library, search the internet, talk to professional landscapers or people at your local nursery. Interview university professors.)

Step 5: Form your **hypothesis**. Before you begin your experiment you need to state what you think will happen in the experiment. This is an answer to your problem (question) based upon information found in your research. The hypothesis can be written as an If…Then Statement.

(Example: I think that the bean plants will grow taller in potting soil because it has special nutrients to help plants grow. *Or* If I use potting soil to grow my bean plants then their stems will grow taller because of the special nutrients in the soil.)

Step 6: Planning the **experiment**. Design an experiment to test your hypothesis. (Is there anything you haven't considered that could affect your experiment?) Gather all of the **materials** you will need. Plan enough materials to use various samples in each group that you are testing. Write a materials list. Use metric measurements.

Write the **procedure** (method), the step by step process for doing your experiment. Be specific by including exact measurements and list the steps in order. Control your variables. A variable is anything that can change or vary during an experiment. In an experiment everything should be the same each time you test, except the one variable you are testing. Repeat the experiment at least three times.
(Example: Materials- one package of bean seeds, 20 small 10 cm. clay pots without holes in the bottom, 150 ml. tap water for each pot every day, sunlight, 250 g. of each type of soil for each pot, trowel, centimeter ruler, and 500 ml. liquid measuring cup.

To control my variables I need to put the same amount of soil in each pot, water them the same amount, use the same number of seeds and keep them in the same place in my backyard. The variable I am testing is the different types of soil.)
(Example: Procedure-Step 1- Gather all of the materials. Step 2- Take five pots and place 250 grams of potting soil in each. Label them "potting soil 1," "potting soil 2," "potting soil 3," "potting soil 4." "potting soil 5," Step 3- Repeat the above step with five more pots of sand., 5 pots of gravel, and 5 pots of backyard dirt. . . Step 10-Record data for 6 weeks.)

Don't forget to keep writing your daily progress journal entries.

Step 7: Test your hypothesis. Use the materials to follow your procedures to complete the experiment. Make **observations/measurements** and collect **data** during the experiment. (Measurements must be made using the metric system.) Record this information in your journal. Repeat the experiment through multiple trials or over time. Use a sufficient sample size.

(For example, five plants in each group of the different kinds of potting soil.)
(Example: November 20, 2003-Experimental Day 1- The plants did not sprout today. I watered each plant with 150 ml of water. November 27, 2003-Day 7- I measured each group. The sand group plants are all 4 centimeter tall.)

Step 8: **Organize data**. Make tables or charts as you collect the data. Then use the data to make graphs such as bar, line, or circle graphs. You can average the data from the trials, use percentages, or another form of mathematics to analyze the data. Show your calculations (raw data) in your journal daily progress section of your Notebook.

Example: Plant Growth

Soil Types	Day 1	Day 7		Day 1	Day 7
Potting soil #1	no	6 cm	Backyard #1	no	3 cm
Gravel #1	no	1 cm	Potting Soil #2		
Sand #1	no	4 cm	Gravel #2		Etc.

Step 9: Write a summary/narrative, describing the **results** of the experiment, and analyze the data gathered through your observations and measurements.

(Example: After six weeks, the five plants in the potting soil were 15 centimeters tall on average. etc.)

Step 10: State your **conclusions**. Look at your data and decide what it tells you about your hypothesis. (See the scientific method steps for further explanation of what to include in your conclusion.)

(Example: Based upon the results of my experiment, I proved my hypothesis was correct. I learned that if the soil has enough nutrients the plants grow taller. Next time, I would see how the root systems reacted to different soil types. etc…)

Step 11: Organize your **notebook**. It should include the following sections in sequential order:

- Title Page- This page states the title of your project, name, grade, school, and teacher.
- Table of Contents- This page provides the reader with a list of the different parts of the project and the page number on which each section can be found.
- Abstract-The abstract is just a summary of your whole project. Write it after you finish your project but put it in the front of your Notebook. It also goes on the board on the top left corner of the left side panel.
    - Include the following subtitles:
    - Objectives/Goals:
    - Methods/Materials:
    - Results:
    - Conclusions/Discussion:
    - It should not be longer than one page.
- Problem- This page states the testable question that you are investigating.
- Research & Bibliography- This is the report of all of the background information you collected about the chosen topic, written in your own words. Bibliography- This page lists the resources used to research the project. Books, magazines, and/or internet resources need to be listed in alphabetical order. Experts interviewed needed to be cited here. Use a minimum of three to five resources other than encyclopedias and textbooks. No wikipedia.
- Hypothesis- This page states the hypothesis as previously defined. You make an educated guess about the answer to your testable question.
- Materials- This page states the materials used in the experiment and their amounts.
- Procedure- This page lists and describes the steps to complete the experiment.

- Data & Observations- These pages include the entries of observations/measurements made over time, data from the multiple (repeated) trials of the experiment and the graphs, charts, or tables. All data needs to be in original form and not copied. Your daily progress journal entries may also be put in this section or they can stay in a separate spiral notebook.

- Results- This page describes what happened in the experiment by analyzing the data.

- Conclusion- This page describes what was learned from the project.

- Acknowledgements- This page is where you thank all of the individuals who assisted in the research or development of the project. A description of what each person did also needs to be included. (For example, I would like to thank my mom for helping me put my board in order.)

- Appendix-This section can include any internet articles or other notes used to write your research report.

All sections of the Notebook may be typed with the exception of the journal daily progress entries which should be handwritten. **Please note: You must include handwritten notes of any sections that you choose to type.

Sample Bibliography:

-Citing Books:

Author's last name, Author's first name. Title of Book. City of Publication: Publisher, Year of Publication.

Smith, James. Potting Soil. Los Angeles: Scholastic Inc., 1999.

-Citing Articles:

Author's last name, Author's first name. "Title of Article." Title of Magazine. Volume Number (Year of Publication): Page Numbers.

Jones, Wilma. "Growing Plants." Home & Garden. 44 (2000): 1-7.

-Citing Websites:

Author's last name, Author's first name. (Year of Publication). Title of Article. Retrieved date from the World Wide Web: website

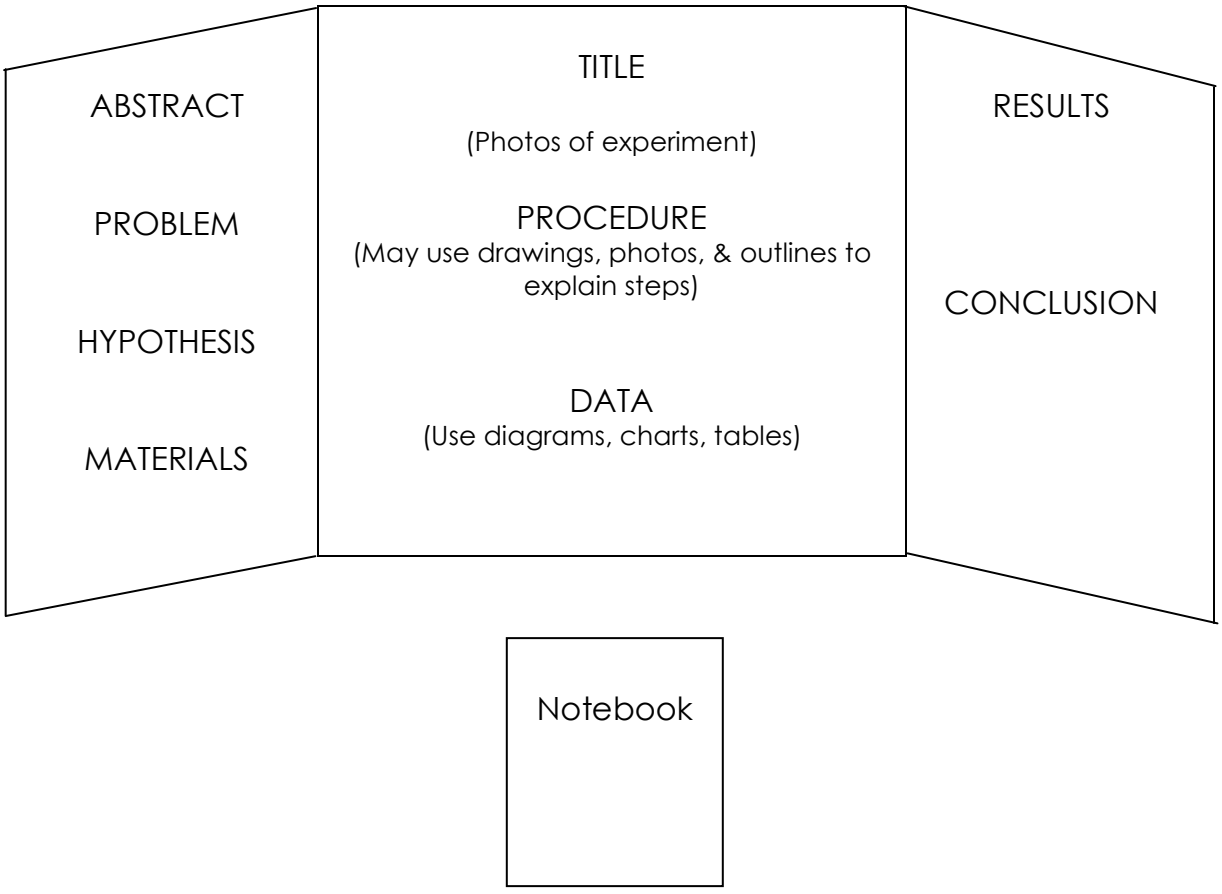
Missene, Beto. (2001). Growing the Best Plants. Retrieved November 22, 2003 from the World Wide Web: http://www.plants.com

Step 12: Designing the **display** board for your project.

- Include a title. This should be something catchy or interesting that has to do with your topic. It is not your problem (question). (Example: Plant Preferences)
- All the steps of the scientific method are included on the board, except the research which only goes in the Notebook. The order of the board needs to follow a logical progression.
- The display needs to be neat, clean and organized. It can be typed or hand written neatly with the steps of the scientific method written separately as subheadings. (See drawing below. Construction paper can be used to border each step of the project. Pictures of the experiment should also be used on the display board. No faces of test subjects or experimenter. Be creative and consider good use of color and design.
- The Notebook needs to be set in front of the project. It may be attached to the board.
- Living or non-living plants, mold, viral or bacterial materials may not be displayed. You can use pictures, plastic, or plaster.

The display board must be able to stand up by itself. It consists of three sides, and the physical dimensions of the display should be such that it occupies a space no longer than 30 inches deep, 48 inches wide, and the top stands (including table) not more than 90 inches from the floor. You may assume that the tables used in the science fair are about 29-30 inches in height.

SAMPLE DISPLAY



Science Project Websites

Don't just use these ideas. Take these ideas and try to add something of your own.

California State Science Fair
http://www.usc.edu/CSSF/
-Ideas to get you started on a science project. Gives you links to other science project websites.

Science Buddies
http://www.sciencebuddies.org/
-Topic selection wizard to help you get ideas for your science project, an Ask an Expert online bulletin board, and topics arranged in science project categories.

NCES Kids' Zone
http://nces.ed.gov/nceskids/
-Create a graph by clicking on the graph icon or take a graphing tutorial.

The Kids' Guide to Science Projects
www.ipl.org/div/**projectguide/** or http://www.ipl.org/youth/projectguide/
-Find project ideas, sample projects, and how to do research. Includes links to project ideas, research sites and links to "ask an expect," for more research information.

All Science Fair Projects
http://www.all-science-fair-projects.com/

Science Fair Central
http://school.discovery.com/sciencefaircentral/
-Everything you need to know about creating a science fair project.

Thinking Fountain
http://www.sci.mus.mn.us/sln/tf/nav/thinkingfountain.html
-Index of ideas in order from A to Z.

Rocks for Kids
http://www.rocksforkids.com
-erosion, soil

Environmental Protection Agency
http://www.epa.gov/students/waste.htm
-environmental ideas, research

CMS Science Fair
http://www.gacps.k12.md.us/cms/sci/fair/IDEASFR.HTM
-Project ideas within their scientific categories.

Sample Abstracts

Project Abstract Examples http://www.usc.edu/CSSF/Info_Genl/Abst_Ex.html

The Frequency of Antibiotic Resistant E. coli in Alimentary Tracts

Objective: The objective is to determine if the average American has ampicillin- and tetracycline-resistant strains of *E. coli* in their alimentary tract.

Materials and Methods: Informed consent was obtained from 100 randomly selected people, 50 men and 50 women ranging in age from 10 to 92 years. An isolate of *E. coli* was obtained from the stool of each subject and grown in the presence of tetracycline and ampicillin. The area of inhibition was measured and compared to that of a non-resistant strain of *E. coli*. The percentage of sensitive and resistant organisms was determined by age and sex.

Results: Thirty percent of the men and 24% of the women were found to have ampicillin-resistant *E. coli*. The majority of the sample population was found to be under the age of 50. Slightly more people age 50 and over were found to be resistant than those under 50. Only 12% of both men and women were found to have tetracycline-resistant *E. coli*, with the older population again having a somewhat higher incidence of resistance.

Discussion: Penicillin and its derivatives such as ampicillin, were the first commercially available antibiotics. Tetracycline was introduced later. The length of exposure to the antibiotics is reflected in the greater percentage of subjects with ampicillin-resistant *E. coli* (24% to 30%), compared to those with tetracycline-resistant organisms (12%). In addition, subjects age 50 and over who would have a longer life-time exposure to both antibiotics were more likely to harbor antibiotic resistant *E. coli*. These data suggest that antibiotics should be carefully dispensed and monitored by health care professionals.

The Effect of Surface Finish on Rocket Drag

Objective: My project was to determine if surface finish has an effect on the drag of a model rocket. I believe that a model with a smooth surface will have lower drag and will reach higher altitudes.

Materials and Methods: Five model rockets with identical size and shape, but different surface preparations, were constructed. One rocket was left with an unfinished surface, three had surfaces finished to various degrees of smoothness, and the fifth rocket had its surface sealed, primed, sanded to 600 grit, painted, and covered with clear gloss. The rockets were ballasted to weigh the same and flown 10 times each with B5-4 motors.

Results: The rocket with the clear gloss finish consistently reached the highest altitudes of all 5 rockets, while the unfinished rocket consistently reached the lowest altitude.

Conclusions: My conclusion is that surface finish has an important role in model rocket drag and rockets with carefully prepared surfaces will reach higher altitudes.

Data & Observations Vocabulary

Control Group-Part of a science experiment that has no variables added. Information from the Control Group is used to compare results.

Experimental Group: the group in which the independent variable is changed.

Variables-Anything in an experiment that is changed from the Control Group in order to solved the problem statement.

Independent variable-the one you change

Dependent variable-the one that you observe or measure (the one that may be affected by the independent variable

Constant variables: other variables which could affect the dependent variable but which you keep constant

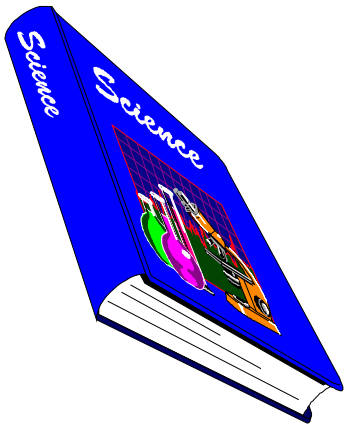
For example: Time is an independent variable. You control the amount of time that it takes to conduct your experiment. Changes that occur over time are the dependent variable. When you change the independent variable, a corresponding change occurs in the dependent variable. The dependent variable is plotted on the **y-axis**. This is the vertical axis. Scale each axis appropriately. Each interval (square on the graph paper) must represent the same amount.

Data-Display your data in the form of graphs, charts, or pictures to show the reader what you observed during the experiment. When constructing a graph, be sure that you give it a title. Label the **x and y-axes** and indicate the unit of the quantity being graphed. The independent variable is plotted on the **x-axis**. This is the horizontal axis. The independent variable is usually the variable controlled by the experimenter.

Line graph-Demonstrates change over time.

Bar/picture graph-Demonstrates a comparison between two or more things.

Circle/pie graph compares parts to the whole.



Acceptance Criteria Checklist:

- ☐ Start journal (daily progress) entries
- ☐ Problem
- ☐ Research & Bibliography
- ☐ Hypothesis
- ☐ Materials
- ☐ Procedure
- ☐ Data & Observations
- ☐ Results
- ☐ Conclusion
- ☐ Abstract
- ☐ Prepare the Notebook
- ☐ Prepare the display board