High School Science Project[1] Expectations

***Project Completion Date*: 1st Monday in February**

Suggested Sequence of Events, Checklist & Timeline

- ☐ Purchase composition notebook to use as a science project journal/log-book.[2]
- ☐ Research topic ideas
- ☐ Topic Approval
- ☐ Project Question/Problem Approval

- ☐ _____ **LOGBOOK CHECK #1** with:
  - o Written Research Question/Problem & Purpose
  - o Written review of Background Information
  - o Bibliography (5-6) sources
  - o Clearly written Problem & Hypothesis
  - o Typed Background Information & Typed Bibliography
  - o Typed Problem & Hypothesis

- ☐ _____ **LOG BOOK CHECK # 2** with:
- ☐ Written Experiment materials list and amounts & Experimental Procedure
- ☐ Variables & Controls identified
  - o Typed Experiment Design
  - o Typed Materials List
  - o Typed Procedure
  - o Typed Variables & Controls

- ☐ _____ **LOG BOOK CHECK # 3** with:
- ☐ Conduct the Experiment / Investigation
- ☐ Record Observations in Log Book
  - o Recorded Data Observations
  - o Date, time, and location of each entry
  - o Data Tables & graphs created

- ☐ _____ **LOG BOOK Check # 4** with:
- ☐ Data Analysis & Graphs
- ☐ Conclusion/Results
- ☐ Abstract written in log
- ☐ Table of Contents
- ☐ Title for each page & numbered
- ☐ Acknowledgements/Credits
  - o Typed Graphs/ Tables

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[1] A great website that gives a good overview of the entire process included in this "timeline can be found at http://www.sciencebuddies.org/mentoring/project_topic.shtml starting with picking a topic.

[2] Every step of your science project is to be noted in your science project journal/log book. Each entry will be expected to have an entry date, time and place (ex. 11/21/03, 2:30 pm, MRC Library)

- Typed Data Analysis
- Typed Conclusion/Results
- Typed Table of Contents
- Typed Abstract
- Typed Bibliography
- Typed Acknowledgements

***Project Completion Date*: 1st Monday in February**

□ **FINAL RESEARCH PAPER COMPLETED!**

□ **PROJECT DISPLAY BOARD COMPLETED!**

The Basic 6 Steps of a Science Project

Step 1. **Topic**: You must pick a topic related to the subject of the science course you are currently taking. After picking the topic conduct some primary research related to the topic you picked.

Step 2. **Question or Problem**: Ask a significant question[3] that can be answered by observation and/or experimentation.

Step 3. **Hypothesis**: Develop and state an educated guess or hypothesis for the question you are asking. In doing this you are ***predicting*** what an outcome will be after an investigation/experiment is conducted, based on your experience and/or information collected from available resources.

Step 4. **Procedure**: Design an experiment/investigation that will produce data that can be used to prove your hypothetical solution to the problem as either correct or incorrect.

A. **Material**: List every item which is needed to do the experiment or investigation. Include equipment as well as the amounts of needed materials.

B. **Method**: List a step-by-step sequence of exactly what will need to be done to complete the experiment or investigation.

Step 5. **Results**: Display a complete record of your observations, data and/or results. Note any accidents, mistakes, unusual or unexpected observations and additional information which surfaces. Use graphs and/or charts to present your data. Analyze these results and discuss why you may have made these observations.

Step 6. **Conclusion**: Using the data from your results, answer the question asked in Step 2. Next, note any additional comments, or explanations of why the results did or did not match your hypothesis. Also note any information, which you learned from your research that would be relevant (include a **bibliography**).

You will need to submit a **project journal/logbook** with your project, which will present the ***basic 6 steps*** in more detail and the **bibliography**. Although some or all of the information may be displayed on your exhibit, you will need to display your project journal/logbook as part of your exhibit.

- For a good explanation of what science can be found online @ http://www.sunspot.noao.edu/sunspot/pr/science-main.html
- A good example of the ***basic 6 step scientific method*** outlined above can be found online @ http://www.isd77.k12.mn.us/resources/cf/ExmSciProj.html

Beginning Your Science Project…

[3] This question needs to be related to the science subject that you are currently studying in school.

Project journal/logbook ~ Get a 100-page composition notebook[4] to record each step of your science project from picking the topic to formulating your conclusions. Each entry needs to be hand written and accompanied with a time, date and place.

Choosing a topic ~ There are many topics to choose from, and countless experiments to perform; how do you choose one? Consider the following questions:

- The best way to "discover" an interesting project topic is to use your natural curiosity to lead you to an observation about the world around which makes you say, … "I wonder why?"
- Next, consider what is possible and affordable?
- You can always pick a topic related to the science course you are presently enrolled in that way you can turn to your new understandings, text book and instructor for help

You will not need to come up with an original idea; you can even choose an experiment from a book (as long as it is an experiment and not a demonstration).

Conduct preliminary research ~ This will help you understand your topic better and make a more educated guess or prediction (hypothesis) of what might happen during your experiment/investigation. Conduct your research by using:

- Encyclopedias
- Recent books
- Scientific journal articles
- The Internet
- People: Contact companies who do research in your field and ask them to send information, or interview a scientist.

Notes and a bibliography from all of this research should be recorded in the project journal/logbook. This preliminary research, written up in the form of a short paper, becomes the bulk of the introduction of your project research paper.

Formulating a question & hypothesis ~ Once you know a little more about your topic, you can ask a question in the form of, "What would happen if…?" Your hypothesis is your prediction of what the answer might be.

Ask a **question** based upon your primary research. Books or websites can give you ideas, but be careful! Some may suggest science fair questions that are really demonstrations. An example of a good question might look like, "How does temperature affect blood pressure?" A **hypothesis** is an educated guess (based on you primary research) about what will happen as a result of your experiment/investigation. For example, "I believe that blood pressure increases at higher temperatures."

Developing an experimental procedure to test your hypothesis ~ Design your experiment and list of all the steps of your experiment in your project journal/logbook.

- Identify the manipulated ~ controlled or "cause" ~ variable(s) and responding ~ experimental or "effect" ~ variable(s) and all other factors that will be held constant or controlled. For example, temperature is our *manipulated variable* and blood pressure our *responding variable*. Everything else must stay constant. (So you could not wear a sweater or drink coffee before while in a cold place; then we would have more than one variable. In this case, what is affecting blood pressure ~ temperature, caffeine, or clothing?)

[4] Do not use a three-ring or spiral notebook.

- Determine what you will measure and what instrument(s) to use. For example, temperature is measured with a thermometer and blood pressure with a sphygmomanometer.
- In your project journal/logbook, list all the materials you will use, including how much and how many of each item, and gather your equipment.
- Plan how the tests will be done, and list each step of the process -- these are your "procedures." This should be done as a step-by-step list, not in paragraph form. Again, be sure to include measurements: how much, how often, how long.
- Prepare pages in your project journal/logbook for recording measurements (i.e., set up blank tables in which to write your data) and for your comments.

Collecting Data ~ Perform your experiment, following your procedures precisely. It is important that you repeat each test several times so that you can be sure of your results. Enter all measurements into your journal/logbook. Carefully observe what happens at all times, and write down everything! Remember to record dates and times accurately. For example, don't measure blood pressure just once at each temperature; measure it several times and average the results.

Results ~ When you perform your experiment, perform it more than three times so you can collect more data and average the results. More data validates your conclusions, making them stronger. Organize all results in your journal/logbook into charts or tables. Make preliminary graphs. If you don't find any trends, you may need to collect more data, or you may need to analyze it differently. Check your project journal/logbook if you notice any “outlying points” or data that does not make sense. You should do your best to explain “wacky” data. ("Blood pressure during trial #5 was very different from BP during every other trial. According to my project journal/logbook, my subject fainted during that trial, so I probably should not include that point in my data analysis...")

Analysis & discussion of the results ~ Formulate some reasonable and logical reason for why you think you got the results you did.

Formulating conclusions from your results and observations ~ Was your hypothesis correct? (Discovering that your hypothesis was incorrect does not mean that the experiment was a failure!) What is likely to happen if someone else does this experiment? How do your results affect real life? For example, perhaps people with high blood pressure should not go out in July...? How could you improve the experiment if you were to do it again?

Science Project Research[5] Paper

After completing your science project experiment/investigation you will next document your efforts in a science project research paper. You paper will need to be either type or hand written. If it is handwritten, it needs to be in ink and very legible. You research paper needs to follow the following outline:

- ☐ Title page
- ☐ Table of Contents
- ☐ Project Abstract
- ☐ Project Question and Hypothesis
- ☐ Review of Literature (background information)
- ☐ Materials and Methods
- ☐ Results
- ☐ Conclusions
- ☐ Acknowledgements
- ☐ Bibliography
- ☐ Table and Figures

Here are the basic elements of a scientific research paper:

- **Title Page[6]**
- **Table of Contents**
- **Abstract [7]:** The Abstract is a short summary of the project and includes the key highlights of your experiment: purpose, procedure, and conclusions. Following are some tips on writing your abstract from the *California State Science Fair*:

  Objectives: State the purpose or hypothesis upon which the project is based.

  Materials and Procedures: Indicate the materials and procedures used in your project. Briefly describe your experiment or engineering methods.

  Results: Summarize the results of your experiment and indicate how they pertain to your purpose or hypothesis.

  Conclusions/Discussion: Indicate if your results supported your hypothesis or enabled you to attain your objective. Discuss briefly how information from this project expands our knowledge about the category subject. If you did an engineering or programming project, state whether you met your design criteria.

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[5] An example of a science project research paper that follows this basic outline can be found online @ http://www.sciencebuddies.org/mentoring/project_sample_research_paper.shtml

[6] For a ***Title Page*** template go online to http://www.lewiscenter.org/force/1070/subprojects/Department/dlsdsss_docs/sci_fair/scifair_tp_template.prn.pdf

[7] For more information on how to write an ***Abstract*** go online to http://www.lewiscenter.org/force/1070/subprojects/Department/dlsdsss_docs/sci_fair/sci_fair_abstract.prn.pdf

- **Project Question and Hypothesis:** The question that you are trying to answer with your experiment. Be sure to clearly state your hypothesis at the end.
- **Review of Literature:** Background information that reflects the knowledge you have acquired, through your research, on the topic of your experiment. You should be providing the reader with useful background information for your project.
- **Materials and Procedure (Research Plan):** This is essentially your research plan. You should be certain to include a list of all materials that were used in your experiment and how they were used. It is best to present your procedure in steps and to include as much detail as possible about measurements and techniques in each step.
- **Results:** A precise recap of what you found out in your experiment, focusing on your observations and data, leaving all interpretation for the Conclusion section.
- **Conclusion:** A summary of your interpretation of the data and results of the experiment. You should restate the hypothesis and whether you found the hypothesis to be true or false. You should also comment on how the results of the experiment satisfied your original purpose.
- **Acknowledgments:** This is your opportunity to thank anyone who helped you with your project, from a single individual to a company or government agency.
- **Reference List / Bibliography.**
- **Table and Figures:** Include tables, charts, and photographs that further help explain your experiment and results.