The Successful Science Project

Grades 8-10

A. Topic Selection & Research of Literature

1. You will choose from a list of topics presented to you in the science discipline you are studying with the option to present for approval another topic in this area or another discipline of science. You will submit a written proposal of your topic in the format determined by your teacher by the appropriate due date.

2. Once your project topic has been approved, **begin to read in the general area of your topic.** Use this time to familiarize yourself with general knowledge about that area. *Don't give in to the temptation to skimp on this step. You are only limiting the depth of your Discussion of Literature and the creativity of the final project if you do so.*

3. All research used is to be recorded carefully. Be sure to back up your notes so as to not loose your work. Look up definitions and scientific concepts you learn about. Record these items in your notes as well. Remember; properly cite all of your sources of information as you take notes, this includes making note of page numbers. At the onset of your research, develop the habit and skill of taking careful notes.

4. Research notes must be submitted via Moodle following your teachers instructions. Research notes should be uploaded as a WORD doc and be in 12 pt Times New Roman - double spaced. Information should be preceded with source information in proper MLA format. Information should be presented as bullet points taken from the aforementioned source.

5. You may not repeat a project which you have done previously.

B. The Research Paper

Using what you have learned through your research, write a paper of your findings. (Minimum length requirements are as follows: 8th grade, 4 pages; 9th grade, 5 pages; 10th grade, 6 pages.) This paper should flow in a logical order, not just be a jumble of facts and statements. All pages must be typed in 12pt New Times Roman font and double spaced. Use 1-inch margins on top, bottom and right side. Use a 1.5-inch margin on the left side. Paper should be submitted in both electronic and hard copy formats. Print on one side only.

→ An important note: **You must use MLA citations** with any information or ideas that are not your own or are not common knowledge. This includes quotations, summaries and paraphrases. If you do

not, it is considered plagiarism and is against the law. Plagiarism is using someone else's thoughts or materials without giving proper credit. It is illegal and unbiblical. All quotes should be carefully chosen and be thoroughly discussed.

→ Works Cited: This should be on a separate sheet(s) and is the last part of the formal Research Paper. Do not skimp on this part! Use proper MLA format. You must have at least 5 valid sources, two or more must be non-internet. The Bible and dictionary do not count as non-internet sources.

→ Please note that listing the works cited at the end of the research paper is not the same as using citations. These are two separate and distinct items. **You need to do both. Check your MLA handbook for examples.**

Be sure to submit your paper in the required format by the appropriate date due.

C. The Experiment

1. **PROBLEM.** Now that you have thoroughly researched the branch of science you will explore, it is time to move forward with your experiment. Your problem (the question you wish to answer) has already been approved by your teacher.

2. **HYPOTHESIS**. Now, develop the hypothesis. This is a statement that describes what you think you will find to be true as a result of your experimentation. The hypothesis is sometimes called an "educated guess" because it is not just a stab in the dark, but is based upon the study and research that you have already done prior to this point. The hypothesis should begin with a phrase: *"It is expected that.....because the literature indicates……"*

3. **EXPERIMENTAL DESIGN - Procedure**. It is now time to design an experiment to test your hypothesis. Write out in a step by step fashion (numbering your steps) the procedure you will use in completing the experiment. Be sure to include all necessary steps, but don't write down obvious things like sharpen the pencil (unless it has something to do directly with your project). Reread what you have written. Will someone else be able to pick up your procedure and follow it like a recipe? Another person should be able to precisely follow your steps and come up with the same experiment and results. **Be sure to submit your procedure in the required format by the appropriate due date. Your procedure must be approved before you begin your experiment.**

Include:

a) **Control** (include how many subjects you will use) this is the standard against which you will judge all changes which you make. The control or *control group* in your experiment is often identified as the "normal" condition:
    i. Untreated soil from your yard
    ii. Response of a plant, animal, or person before you seek to *enhance* or *inhibit* the results

iii. A surface that has not been treated
iv. Solubility before the heating, cooling, or supplying additives

→ Note: Sometimes you will not have a "control group" but, rather, a controlled situation. Ex. Testing fish in different colors of light. All the fish may be tested in the different colors with white light being the control.

b) **Variable** (include how you will manipulate the variable and how many subjects you will use for each form). You should pick **ONE** variable to work with. Decide how many ways you will manipulate (vary) this variable. Example: In performing an experiment to determine the optimal temperature for bean seed germination, the variable would be three or more differing *temperatures*. Everything else in the experiment must remain constant. For one set, the plants will be at 72°. (This is the control –the normal way of growing plants.) Another form of the variable would be germinating some seeds at 35°. A third form would be to try some at 85°. Notice that in all three sets everything else must be the same -- the amount of light, the humidity, the type of soil, etc. Only one variable is changed in order to see if it affects the germination of bean seeds. When describing your variable be specific with amounts, temperatures, etc. (ex. Don't just say hot and cold water; say rather, water at 70° and 20° C.)

c) **Number** of trials/subjects (how many times you will perform the experiment)
d) **Measurement** (how you will numerically measure the results and the metric units to be used.)

A few other pointers: Give yourself plenty of time to repeat the experiment. The more times you do the experiment, the more valid your results will be. (Example: If I eat ice cream once and get sick, I can't be sure if it was the ice cream, the flu, or something in the air, etc., that caused my sickness. If I try ice cream five more times and every time I get sick, I can be reasonably sure that the ice cream is causing my sickness.)

Note: You may even have to start completely over if something goes wrong. So don't wait to do the experiment until near the due date. Be wise and get finished early! Please note that your experiment, unless otherwise approved, must be the type in which there is a control and a variable. It is best to work with only one variable unless you are an experienced experimenter. See your teacher if you have questions. (Surveys, kits, collections, models, etc. are unacceptable for the science project.)

Under no circumstances should a student begin their experiment prior to receiving permission from their instructor.

4. **MATERIALS.** List every piece of equipment and every supply that you will need to complete the experiment. Be sure that you can secure these items. Be realistic. Keep the cost factor in mind. If you must order items, don't procrastinate.

5. **DATA.** Now you are ready to begin your experiment. You need to set up an experimental log. This is a journal of your actions and observations once you begin your experiment. Your log may be

written (and transferred to computer later) or recorded directly into a spreadsheet program (such as Excel). If using a computer, be sure to save and backup your work! If written, this must be done in ink and be very detailed **using proper units**. Prior to recording data, you will need to set up tables in which you can place numerical values and written observations. Be as observant as possible. It is better to record too much than too little! All entries must be dated. The exact conditions that exist when you make your observation must be noted (e.g. time, lighting, temp., etc)

Example: **Table I- A**

Height of Plant A – Sunlight

Date	**Room Temperature °F**	**Relative Humidity %**	**Water Added (ml)**	**Height of Plant A (cm)**	**Observations Made**
12/20/2010	**70**	**34**	**30**	**0**	
12/21/2010	**69.5**	**28**	**0**	**0**	
12/22/2010	**71**	**47**	**35**	**0.5**	**Sprout light green**
And so on…					

Be sure you have found a location in which the general environment stays the same over the course of the experiment. In some experiments, this is absolutely crucial, in others, it doesn't impact as much, but it is still necessary to record. Certainly, you don't want someone to accidentally mess up your experiment, so plan ahead. **This recorded information will form the basis of the <u>RESULTS</u> section of your formal <u>Project Notebook</u>.**

Remember, during the period of experimentation, you *<u>must</u>* carefully record every observation you make and any results that are forthcoming. Be precise and accurate in all your measurements. Use numbers to describe results whenever possible.

For example: set up a color scale, if that is part of what you are observing. Instead of saying, "the leaves look light green," set up a scale:

5 = very dark green; 4 = dark green; 3 = medium green;
2 = light green; 1 = very light green; 0 = transparent.

You can then use these numbers to get an average color for each trial of the experiment.

D. The Project Notebook

The Project Notebook is the compilation of all the science fair components and is to be housed in a three ring binder. This binder will be displayed at the science fair. Great care should be taken in preparation of the Project Notebook, for this is what others (including the judges and your teacher) will examine to see if you have approached your problem in a scientifically sound manner. As this is a scientific research project, it should be written as such, using **proper terms and reporting all information in the third person**. The Project Notebook is the complete story of your project -- how you approached solving the problem you selected, what the results of your experiment were, how your findings can be applied to the real world in which we live, and most importantly, what valid conclusions can be drawn from the results of your literature research and experiment. This may seem like a monumental task at this point, but let's break it down into bite-sized pieces. You will see that it is not quite as big as it seems!

Note: Notebook pages must be typed in 12 pt. New Times Roman and double-spaced. Use 1 ½ inch margin on left side and 1-inch margins for the other three. Print on one side only.

Title Page - This is the first page of your Project Notebook and should contain **only the title of your project**. It should be placed about one third of the way down the page. The title should be related to the problem you are trying to solve. It can be catchy or just straightforward. Be sure you spell every word correctly! Do **not** include your name or any information about your school on the title page.

Table of Contents - you will not be able to create this page until your entire Project Notebook is completed. This sheet will follow the Title Page and include the following topics as part of the table of contents listing:

These page numbers are for example only.

Abstract

While the first thing in your Project Notebook (after the table of contents), the abstract is actually the last thing you will write and as such should be **written as a summary in the past tense**. An abstract is comprised of two hundred fifty (250) or less words stating: 1) purpose, 2) summary of procedure, 3) summary of data and 4) the conclusion. It wraps up the whole learning process. This must tie in directly to the statement of problem and hypothesis. Two copies are needed, one for the Project Notebook and one for the display.

Introduction

This relatively brief section tells what problem you are trying to solve and what your hypothesis is. It also discusses what prompted you, the experimenter, to examine this particular problem and what you (the experimenter) hoped to achieve.

Discussion of Literature

This is **the corrected final written report,** of the general and specific research you did back at the beginning of the project.

Materials

List (in one or two columns) all the necessary equipment and supplies needed to complete the experiment. Give total amounts needed where applicable. Be specific - for example: don't just say "40 plastic cups," Specify the size of the cups. Indicate any items which were made and include detailed instructions within the procedure.

Procedure

In numbered steps, describe in detail how to perform the experiment and record the results.

Results

Record the actual results of the experiment. Avoid simply describing the results with words. Use photographs**, charts**, and **graphs** as much as possible. Much of this information should come directly from your Experimental Log. Look back at the explanation for that section for more detail on how to present your results. Remember, numbers give the most concrete and accurate information. You can hardly overdo this part of your paper!

Discussion of Results

This is the heart of your Project Notebook although it is probably only one or two pages long. A clear, simple explanation of your results [your Experimental Log] shows that you understood your project. Avoid being too simplistic and brief. You absolutely must know why your hypothesis was correct or incorrect. Were there factors you should have considered, or corrections you should have made earlier? Did you assume something you should not have? Why did the experiment come out the way it did How did your results compare to the theoretical values, published data, commonly held beliefs, or expected results? In other words, how do you results compare with what you learned in your research? This is where you demonstrate your skill at research and reasoning. Discuss possible errors and explain what changes you would make if you were to conduct the same experiment.

Avoid saying: "The experimenter should have tried harder," or "The experimenter wasted too much time," etc. *That will be obvious to your teacher.* When you have finished this section, reread it. Does it tell a story in a logical flowing fashion? You may have to cite sources (i.e. documentation: author page) in this section if you refer to information from your sources which you apparently overlooked or misunderstood. End your discussion of results with a concluding statement.

Be careful! Conclude only what is ***valid*** based upon your results. Be sure your conclusion ties directly back to your hypothesis.

Biblical Application

In this section you will tie your project into its biblical foundation. Since God is the Creator of the universe and is the Author of science, it is important that you establish His perspective on what you have studied. Use clear thinking and applicable scripture. Explain in four or five sentences how the Bible treats your subject. Look for principles. Find truths about God, attributes of God, and acts of God which may shed light on the relevance of your topic to our understanding of His world.

Works Cited

This is the corrected final Works Cited from your Research Paper. This should be on a separate sheet(s) and is the last part of the formal Project Notebook.

E. The Display

This is what will be presented at the science fair. Your name, picture, or school information may not appear on the display at any place. The display includes the following parts:

- **The Project Notebook**

- **The Display Board**

  This provides the background for your whole display. Make this as attractive as possible. A large title should draw people into your project. This title should match that of your project notebook. On the board, include: **Abstract, Problem, Hypothesis, Procedure, Results (charts, graphs, photographs etc.), Conclusion and Biblical Application.** (Do not include list of materials on display board). All headings should be **easily seen and understandable.** Bright complementary colors, posters, charts, pictures, descriptive cards, etc. are a real must. **Be sure to spell correctly and use proper grammar.** Remember, for most people the first impression sets the tone.

- **The Experiment or Any Part of It**

  Display anything which helps show what your project was all about. For some, you will display plants or part of the apparatus you used. For others, you will only be able to display photographs, graphs, drawings, etc. You may not display any liquids, chemicals, animals, sharp or dangerous objects **without specific prior written permission.** Check with your teacher if you have questions.

The size limitations for your project display:

- 30 inches (76 cm) front to back
- 4 feet (122 cm) side to side

These are the maximum limits for your project display. You may certainly keep it smaller.

Criteria for Judging

Fidelity to the Scientific Method

Defined control and experimental groups
Clearly stated hypothesis
Kept a complete Experimental Log
Accurately recorded the data

Depth of Project Notebook

Varied bibliography: not just encyclopedias;
should have books, periodicals, internet articles
Clear procedure
Should include tables/charts/graphs
Should include citations
Scientific value of the question

Validity of Conclusion

Has a clearly stated conclusion
Results support the conclusion

Display

Logical order in presentation
Artistic appeal used in backboard
Neatness
Tables, charts, graphs displayed
Includes: Abstract (less than 250 words) and
information, such as, Problem, Hypothesis, Experimental details, Conclusion,
and Biblical Application

Attention Parents and Students

It is science project time once again. This is an important part of our curriculum and should be approached with seriousness and diligence.

Much may be learned about the nature and character of God through science. Beyond that, science affords the learner a unique opportunity to develop the skills of research, observation and critical thinking. It is for these and other reasons that much emphasis is placed on this project.

At the Upper School level, all 8th through 10th students will do a science project to be included in the Science Fair held at the end of January. This is part of their class grade. Teachers will make a judgment based on work to date whether a student is to be a participant or an entrant. Entrants are judged and receive bonus points. Students are encouraged to enter the North Museum Science and Engineering Fair. Additional paperwork is required.

To help facilitate a successful and valuable experience, the faculty has set up a schedule and evaluation check sheet for your project. Please note these deadlines.

Parents should note that each student has been given specific instructions as to how to complete each requirement. Ask to see these instructions which are in the student's science fair handbook.

If you have any questions, please don't hesitate to ask.

Sincerely,

Michael R. Myers, Headmaster

* Please note: Christmas vacation is an excellent time to complete the science experiment. Please be sure to have teacher approval prior to the start of the vacation.