**Science**

 **Fair Packet II**

**Tips for a Successful Project**

* + Use passive (third person) voice, not “I”, “we”, “us”
	+ Do not copy and paste from the internet – use your own words.
	+ Use at least **five** (**5**) RELIABLE SOURCES for your research (two for elementary) – Wikipedia is NOT considered a reliable source.
	+ Collect data accurately and with detail – record it by hand in your **Project Data Book**
	+ Pick an appropriate sample size – ***to get full credit you must do at least 5 trials***
	+ Always follow safety instructions
	+ Have a parent or adult present when needed
	+ Write down all in the information you collect – both research information and data –

remember *all data is to be recorded by hand in your Project Data Book*

* + Make all graphs and data tables on a computer, or do them neatly by hand- be sure to

*cite your source* for these, even if it is you!

* + Make sure your conclusion parallels your hypothesis
	+ Test more than one subject
	+ Do not wait until the last minute to start your project
	+ Document everything you do
	+ Have your teacher and parent(s) approve your experiment before you begin

**What your final project will include:**

1. Hand written Project Data Book
2. Typed Science Research paper
3. Display board – with official abstract posted on it and photo/graph/charts cited
4. Completed required forms

**Forms to start out with for everyone: Project Topic Information Sheet**

Other forms may be required depending on project topic

Remember, you MUST have approval from your teacher before starting. Final approval will only be given once your question, hypothesis, material list, and detailed procedure have been reviewed and you have all the required paperwork filled in correctly

**The Parts**

Once you know a little more about your topic, you can ask a question in the form of, "What would happen if I changed this?" It should be a *very specific question* and you should *only change one variable*.

Your hypothesis is your prediction of what the answer will be. Remember, your hypotheses should be something that is testable and measureable. *A hypothesis is a prediction or simply an educated guess about the solution to a problem.* It is important to conduct research and consider prior knowledge ***before*** formulating a hypothesis. You will test your hypothesis by performing an experiment. To form a hypothesis, you should focus on the problem and make an “If - then” statement about the problem. **A hypothesis is a single statement about how two factors are related to each other.** A well written hypothesis includes the independent and dependent variables for the experiment. The independent variable is what you are changing as you do the experiment and the dependent variable is what you are measuring.

For example:

“If the temperature in a room is changed, then mold will grow faster on white bread”

(What is changing) (What is measured) OR

“If the barometric pressure drops in a tropical depression, then a hurricane will form***.***” (What is changing) (What is measured)

***Once the hypothesis is written, you need to write several facts from your research that explains why you believe your hypothesis to be correct.***

**Controlled Experiment and Variables**

A good question is just the beginning. The way you design your experiment to find the answer to your question is at least as important as the question itself. You must design a **Controlled Experiment**, which contains variables. A variable is anything that affects your topic and can or cannot be changed in your experiment. There are three types of variables: independent, dependent, and constant variable. The independent variable is the *one thing you change* in your experiment to figure out what impact it has on the topic you are studying. A dependent variable is the change that happens in your experiment or *what you are measuring (your data).* The constant variable is the variable that is not changed; they are all the things that are kept the same for each trial. It is also necessary in a controlled experiment that the variables be **measurable**. Determine what you will measure and what instrument(s) to use before starting your experiment.

An easy way to identify the variables in an experiment is to fill in the blanks of the following sentence,

***“The*** ***depends on*** ***.”***

For example, in an experiment testing the effects of temperature on the growth of bread mold would be…..

***“The growth of mold depends on the temperature of a room.”***

The growth of mold is the dependent variable and the temperature is the independent variable. You will be changing the temperature of the room so the growth of the mold will be affected. A control would be a room that is always at the same constant set temperature with no changes.

**Types of variables:**

* **Independent/Manipulated/Test Variable:** This is the variable *you* will change in your experiment. For example, if you wanted to know how fertilizer affects plant growth, the amount of fertilizer applied is the only variable that you would change. A good experiment will test more than one amount of fertilizer and compare the growth among all groups.
* **Dependent/Responding/Measured/Outcome Variable:** This is the variable that changes as a result of the changes in the manipulated variable. In our fertilizer example, the responding variable would be the size of the plants.
* **Constant Variables:** These are all the things that you will keep the same in your experiment. Constants in our example would include: the origin of the seeds (they must all come from the same package and should be randomly selected), the amounts of light and water each plant receives, the type of soil used (same type, brand, etc.), the size of the pot, and the temperature.
* **Control:** A control is a standard of comparison for checking or verifying the results of an experiment. In an experiment, if you are testing the effect of something (manipulated or independent variable), then you need a control to know what the results should have been had you not made the change. For example if your independent variable is increasing the amount of light a plant get, then you would need a control plant that receives a “normal” amount of light to see what changes occur. It shows what happens when the independent variable is not applied. *Not all projects will have a control group.*

For example:

If the **question** was:

What amount of Miracle-Grow will make the Gerber Daises grow the tallest?

The **hypothesis** may be:

If 4 oz. of *Miracle-Grow is added to a daisy every other day* when it is watered, then it will *grow taller* than the daisies that receive 2oz. or 6oz. of Miracle-Grow when watered.

The **independent variable** would be “*Miracle-Grow is added to a daisy every other day*” because the amount

of Miracle-Grow is what is being changed during the experiment.

The **dependent variable** would be “*grow taller*” because that is what is being measured to what is changed as a result of the experiment.

The **constant variable** would be starting with the same height and type of daisies, having them in the same type of soil, all the daises would get the same amount of sunlight/conditions, and be watered with the same amount of water at the same time each day.

The **control** would be to grow a daisy, in the same conditions, that only receive water and not Miracle-Grow.

**Materials and Procedures**

Repetition and replication (you being able to redo the experiment as well as someone else) is a major part of science. In order for this to happen, material lists and procedures have to be very exact and very detailed.

When you are compiling your material list, it is imperative you list ALL materials as well as EXACT SIZES OR AMOUNTS! For example, if you are using liquids, tell us how much – *100ml or 16L*. When listing materials used, tell us exactly what you are using – *sizes and numbers*. It is recommended you use the **METRIC SYSTEM**. Think of the material list just like a shopping list. If someone were to go to the store and only use your material list, would they end up with exactly the same materials you used?

**Data (aka: Results)**

*Data is what is observed. Data is listed in the form of a table.* The data is then used to make charts or graphs, so you can clearly see the results from the data. The student will use the data table to construct the appropriate type of graph to provide a pictorial representation of what happened during the experiment.

Remember, data cannot be ignored. Even if the data does not support your hypothesis – record it! You are not penalized if your hypothesis is not supported by your data. Your grade will not suffer. It really just shows you learned something!

**Include a Data table in your log book. You may want to include this in you paper as well.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** |
| **Day 1** |  |  |  |  |  |
| **Day 2** |  |  |  |  |  |
| **Day 3** |  |  |  |  |  |
| **Day 4** |  |  |  |  |  |

***Project Data Book: (Include your approved proposal in this)***

A project data book is your most treasured piece of work. Accurate and detailed notes make a logical and winning project. **The student needs to record their data collected through measurements or observations in a clearly labeled data table. *YOUR ORIGINAL DATA TABLE SHOULD BE HAND WRITTEN.*** Good notes show consistency and thoroughness to the judges and will help you when writing your research paper. Data tables are also helpful. They may be a little ‘messy’ but be sure the quantitative data recorded is accurate and ***units are included*** in the data tables. ***Make sure you date each entry***.

**Discussion (Experimental Conclusion)**

*The discussion is a discussion of what you learned from your experiments (conclusion of your labs).* What is the answer to your original question? What your hypothesis correct? A conclusion will answer your problem and your hypothesis based on the data collected during your experiment. Be specific – include data from your experiment. Show the reader you understand your project and the results you gained from it. You will explain any problems and how you would correct them in the future. You will need to explain what you would do differently if you did the experiment again. If your results are different then you expected you need to discuss

**Conclusion (of the entire research paper)**

*The conclusion is the full explanation of what your project and paper was and what it showed you.* It is a summary of the entire paper. What is the answer to your original question? What your hypothesis correct? A conclusion will answer your problem and your hypothesis based on the data collected during your experiment. Be specific – include data from your experiment. Show the reader you understand your project and the results you gained from it. You will explain any problems and how you would correct them in the future. You will need to explain what you would do differently if you did the experiment again. If your results are different then you expected you need to discuss this. ***A conclusion should be a minimum of one paragraph – not one sentence!***

**Abstract**

Have you ever picked out a book and read about the book either the front or back inside flap? If you have, then you know what a basic summary is. An abstract is a scientific summary of that your project is and what you got out of it. Your science fair project abstract lets people determine if they want to read the entire research paper. Consequently, at least ten times as many people will read your abstract as any other part of your work. It is like an advertisement for what you have done. If you want judges and the public to be excited about your science fair project, then write an exciting, engaging abstract!

Since the abstract is short (about 250 words and), each section is usually a few sentences long. Therefore every word is important to conveying your message. If a word is boring or vague, refer to a thesaurus to find a better one! If a word is not adding something important, cut it! But, even with the abstracts’ brief length; don’t be afraid to reinforce a key point by stating it more than one way or referring to it in more than one section. There are 4 basic sections to an abstract: the purpose of the experiment, the procedure, data, and conclusion (which includes addressing your hypothesis). More specific details are located in the sample research paper.

**Bibliography**

A Bibliography (also called a "Works Cited”) is a list of all books, encyclopedias, journal articles, web sites, and other resources you used when researching your experiment. It will appear at the end of your research paper. To get full credit, you must have a minimum of ***5 (3 being books) for middle school students and 3 for elementary (1 being a book)*** reliable resources cited in your bibliography. *Remember, Wikipedia is not a reliable resource*. Starting from when you first chose your topic until its completion, any reliable resource you look to for information should be included in your bibliography. Depending on what type of resources used and the format you choose, not all bibliographies all look the same, but there is some basic information all bibliographies should have: author, title of your source, publication information, and date. Use MLA formatting for the bibliography. (<http://www.easybib.com/> )

Example bibliography entries:

**BOOKS**

Author (last name, first name). Title of the book. City where the book is published: Publisher, Copyright date Smith, J. D. A Study of Plant Life. New York: Johnson Printing Co. 1998.

**SCIENTIFIC JOURNAL ARTICLE:**

Author (last name, first name). “Title of Article.” Name of Journal, Date (day month year): page(s). Foley, J. D. "Interfaces for Advanced Computing." Scientific American, 8 July 2000:127-135.

**WEBSITES:**

Author (last name, first name) “Title of article”. Title of Website or publication. Date of publication (or last

update). On-line. Date of access (when you went to the website). Website address.

Smith, Sally. "One Hit Wonders". Popular Mechanics. June 8, 1999. Online. August 4, 2000. [http://www.popularmechanics.com.](http://www.popularmechanics.com/)

**ENCYCLOPEDIAS:**

“Article Title”. Title of reference book. Edition (if available), year published.

“Microscopes”. Encyclopedia Britanica. 1996

**INTERVIEWS:**

Person you interviewed (last name, first name). Type of interview. Date. Aberwitz, Shelly. Personal Interview. 20 September 2002.

**Preparing Your Exhibit**

Time to get creative again! You have done the hard work – the experiment itself – now show off what you have done! There are some required components which must be included on your display board, but how you display them is up to you! Take your time while creating your display to make sure it represents your hard work. A board that is put together haphazardly may imply an experiment that was done similarly. Look on the internet for examples of students’ science fair display boards. It is up to your teacher if your items have to be in the exact same spots as the example, but make sure they all get on the board. The pages following the sample go over the rules for what can or cannot be displayed. Read them!!! Also pay attention to the section about citing your pictures/graphs/charts. It would be disappointing to lose points because you did not read the rules. Similar to the abstract, the display board gives an outsider a glimpse into what you have accomplished. Make sure they see all the hard work you put into the experiment.

Don’t forget to prepare yourself too! You will have to present your experiment. Topics you will need to discuss are: explaining the project and its procedures, discussing the results, showing an understanding of the research and how it relates to the results, and explaining the importance of your information. It sounds like a lot, but you are the expert. You just did a whole project and put together an amazing display board. No one knows more about this project than you. Take this time to shine!

**Research Paper**

* **Font size 12**
* Double spaced except for abstract
* Margins 1 inch
* Use subtitles below

Documentation of a scientific experiment is necessary whether you're a student researcher or a professional scientist. All participants must submit a ***typed*** research paper for the judges to read. Produce your research paper on a computer, it will look neater and make a better impression on the judges. Before you submit it, ask someone else to proofread your paper. There is no minimum length requirement, although it would be difficult to include all of the necessary parts in fewer than three or four pages. It should be in a report cover or folder. ***Your research paper should be written using third person – NO “I”***

**Your research paper should contain:**

* **Title Page** includes the title of your project, your name, and your grade.
* **Abstract:** This brief (*250-word maximum*) summary should include the (**a**) purpose of the experiment,

(**b**) procedures used, (**c**) data, and (**d**) conclusions. It should be on a separate page with the title of the project at the top. (Do not put your name on this sheet.) See any scientific journal article for an example of an abstract. *This same abstract will be copied and pasted onto your official abstract form.* **Be sure to follow the guidelines on the OFFICIAL ABSTRACT FORM – page 21**

* **Table of Contents**
* **Introduction (Background Research):** *(no more than one page)* The introduction sets the scene for your report. The introduction includes the purpose, your hypothesis, problem or engineering goals, an explanation of what prompted your research, and what you hoped to achieve. It also includes information which you learned from your literature research (bibliography entries).
* **Hypothesis:** A hypothesis is a single statement about how two factors are related to each other. Your hypothesis should be written to include your dependent and independent variables-----If

 (independent variable) (is changed), then (dependent variable)

 (will happen) because \_\_\_\_\_\_\_\_\_\_\_. See “The Parts” page 10 for more detailed information.

* **Variables, Constants, and Controls:** (*on same page as Hypothesis*) define your variables, constants, and controls for this project. Specifically list out your dependent and independent variables and controls. See “The Parts” page 10-11 for more detailed information.
* **Materials:** List all materials and the amounts you used. Be sure to include **exact amounts** in your material list. See “The Parts” page 12 for more information.
* **Methods (Procedures):** (*approximately one page*) Describe in ***great detail*** the methodology used to collect your data or make your observations. Your methods should be detailed enough so that someone would be able to repeat the experiment from the information in your paper. I do not want this in paragraph form; rather listed steps. You may include drawings or photographs. ***5 trials are needed to receive full credit.***
* **Results (Data Collection):** (*approximately one page*) Present your results thoroughly using graphs, charts, tables, or a daily log to help the reader understand what you have discovered. **All the data you collect should also be HANDWRITTEN in your PROJECT DATA BOOK as your original data.**

See “The Parts” on page 12 for more detailed information.

* **Discussion:** (*approximately one page*) This is where you discuss what you learned from your experiments (the conclusion of the lab, not to be confused with the conclusion of the paper.) The discussion, or interpretation of results, is the essence of your paper. What could have caused these results? Compare your results with theoretical values, published data, commonly held beliefs, and/or expected results. Include a discussion of possible errors. Other questions you may want to consider:
	+ How did the data vary between repeated observations of similar events?
	+ How were your results affected by uncontrollable events?
	+ What would you do differently if you repeated this project?
	+ What other experiments should be conducted?
* **Conclusions:** (*approximately one page*) This is a conclusion of your entire research paper, not just your lab. Briefly summarize your learning from this entire research project, including your literature research. What is the answer to your question? Do your results prove or disprove your hypothesis? Be specific; do not generalize. Never introduce anything in the conclusion that has not already been discussed. Conclusions may include your opinions based on measurements. ***Your conclusion should be a minimum of one paragraph – not one sentence!*** See “The Parts” on page 12 for more detailed information.
* **Bibliography – a minimum of *5 sources (3 for elementary)*:** (Sometimes called "Works Cited.") List all books, encyclopedias, journal articles, web sites, etc., you used. Different disciplines often follow different referencing formats; check an article from a scientific journal in your field if you want perfection, but most importantly, be consistent! ***Wikipedia is not a reliable source.*** See “The Parts” page 13 for more detailed information.

Three common reference styles are: MLA, APA, and Chicago style.

* + A **book** reference might look like this:

Smith, J. D. (1989). *A Study of Plant Life*. New York: Johnson Printing Co.

* + A **scientific journal article** reference might look like this:

Foley, J. D. (1987). "Interfaces for Advanced Computing." *Scientific American*, 257:127-135.

* + A **World Wide Web** reference might look like this:

Author. (June 8, 1999). "Title of Page." Title of Site. Online. Available: http://www.etc. Accessed August 4, 2000.

Almost all scientists and engineers agree that an abstract should have the following pieces:

* **Purpose of the experiment -** This is where you describe the purpose for doing your science fair project or invention. Identify the problem you solved or the hypothesis you investigated. Why should anyone care about the work you did? You have to tell them why. Did you explain something that should cause people to change the way they go about their daily business? If you made an invention or developed a new procedure, how is it better, faster, or cheaper than what is already out there? **Motivate** the reader to finish the abstract and read the entire paper or display board.
* **Procedures -** What was your approach for investigating the problem? Don’t go into detail about materials unless they were critical to your success. Do describe the most important variables if you have room.
* **Data -** What answer did you obtain? Be specific and use numbers to describe your results. Do

not use vague terms like “most” or “some”.

* **Conclusions -**State what your science fair project or invention contributes to the area you worked in. Did you meet your objectives? Was your hypothesis supported?

**Things to avoid when writing your abstract:**

* + Do not use the word “I” – keep your writing in the third person.
	+ Avoid jargon or any technical terms that most readers won’t understand.
	+ Avoid abbreviations or acronyms that are not commonly understood unless you describe what they mean.
	+ Abstracts do not have a bibliography or citations.
	+ Abstracts do not contain tables or graphs.
	+ If you are working with a scientist or mentor, your abstract should only include procedures done by you, and you should not put acknowledgements to anyone in your abstract.

**See “The Parts” page 13 for more information.**

**Final projects should include:**

1. Project Data Book, a **HAND WRITTEN** record of data recorded with your approved proposal
2. Research paper (including an abstract), a **TYPED** report (If hand written, then in cursive and in ink.)
3. A copy of the official abstract on your display board
4. A display of the experiment and the results, and
5. A brief (2-minute) oral presentation to and an interview by judges.

**COMPLETING THE ABSTRACT:**

Abstracts are limited to **a maximum 250 words**. The abstract should include the following:

1. *purpose of the experiment*
2. *procedure*
3. *data*
4. *conclusions*

It may also include any possible research applications. Only minimal reference to previous work may be included. An abstract must not include the following:

1. *acknowledgments (including naming the research institution and/or mentor with which you were working), or self-promotions and external endorsements*
2. *work or procedures done by the mentor*

**TIPS ON WRITING A PROJECT ABSTRACT**

A project abstract is a brief paragraph or two (limited to 250 words or 1,800 characters) highlighting and/or summarizing the major points or most important ideas about your project. An abstract allows judges to quickly determine the nature and scope of a project.

* Emphasize these aspects: purpose (hypothesis), methods (procedures used), data summary or analysis, and conclusions.
* Focus only on the current year’s research.
* Omit details and discussions.
* Use the past tense when describing what was done. However, where appropriate use active verbs rather

than passive verbs.

* Use short sentences, but vary sentence structure.
* Use complete sentences. Don’t abbreviate by omitting articles or other small words in order to save space.
* Avoid jargon and use appropriate scientific language.
* Use concise syntax, correct spelling, grammar, and punctuation.

Research Paper Outline:

Page 1…….Title Page

Page 2….…Table of Contents

Page 3 and following: Use the following subtitles in your paper.

* Introduction
* Question
* Hypothesis
* Variables and Controls
* Materials
* Procedures
* Results
* Discussion (Experimental Conclusion)
* Conclusion
* Bibliography (on a separate page)
* Abstract (on a separate page)
* I have received and read Science Fair Packet II.

Parent Signature Date

Student Signature Printed Student Name