



Science, Engineering and Mathematics Link, Inc.

Experimental Design Handbook

(An Abbreviate Guide for Math and Science Fair Projects for K-12 students)

1. **Select a topic that you are interested in-** This will motivate you to complete your project because you spend time and effort on things that you like and keep your interest.
2. **Investigate your topic (conduct background research)** - You want to be an expert on everything related to your project. Background research is important to understanding the theory related to your project, designing your experiment and predicting and understanding the outcome of your experiment. The background research will help you develop and is a part the research paper that will be completed after you conduct your experiment. The resources that you can use while conducting your background research include books in your local library, the internet and people you know. (for example if you are doing a project on biology you can ask a biology professor at local college or university)
3. **Identify the problem (figure out what you want to know or explain)** - Write a question to address the problem or topic. This will help you decide how to design your experiment and what you will be investigating
4. **Form a hypothesis-** This is where you combine your background research and your topic question to make an educated guess about the outcome of your experiment.
5. **Create an experiment-**Develop a procedure and materials list to test your hypothesis. You should develop a procedure that is reproducible. A good procedure will include the following things:
 - The materials and equipment that are needed to perform your experiment (include the quantity of each material and specific equipment i.e. 40 mL of water, 100 ml beaker)
 - A step by step list of everything you must do to perform your experiment and what will need to be done in each step.
 - If you have control and experimental groups in your project, you must tell how you will change the variable and how you will measure the change
 - If you have control variables, the procedure should explain how they will be measured at constant values
 - The procedure should specify how many times you intend to repeat your experiment
6. **Perform your experiment-** When performing the experiment make sure you do the following:
 - Follow all safety rules and guidelines
 - Follow the steps in your procedure
 - Record all data and observations (you should have a lab notebook for recording data and observations)
 - Repeat your experiment (an experiment should be repeat at least three times)



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7. **Write your report-** Your report should be written in a word processing program; charts and graphs should be made in either Excel or Lotus. Make sure that you get someone to proofread your report. A good report includes the following items:

- Title Page- includes your name, teacher name, topic name, date, etc.
- Table of Contents
- Abstract- This is a summary of your experiment that includes background information, procedure and observations (can be anywhere from a paragraph to one page)
- Materials and Equipment List
- Procedure
- Results- A summary of what you found out in your experiment which includes data and observations. Make sure that your data is in a neat format such as charts, graphs or tables.
- Conclusions- This is where you explain what happened in your experiment and if your hypothesis was right or wrong, and why.
- Acknowledgements- This is where you recognize anyone that helped you with your project.
- Bibliography- Where you got your research from include books, internet sites, magazine articles (make sure you cite your references correctly)

8. **Make your display board-** Your display board is your way to present your work in a creative manner. Your display board should include everything necessary for someone to understand your experiment and your results. Make sure that it is neat, colorful and all the information on it is correct. You will use the information from your paper to make your display board. On your display board you can include pictures. Your paper and lab notebook should be displayed with your project board. Your project board should have:

- Project title
- Hypothesis
- Material and Equipment list
- Procedure
- Data (charts and graphs)
- Discussion of Results
- Conclusions
- Acknowledgements