Data Analysis

Data Table

Prepare a **data table** in your laboratory notebook to help you collect your data. A data table will ensure that you are consistent in recording your data and will make it easier to analyze your results once you have finished your experiment.

Take some time to carefully review all of the data you have collected from your experiment. Use charts and graphs to help you analyze the data and patterns. Did you get the results you had expected? What did you find out from your experiment?

Really think about what you have discovered and use your data to help you explain why you think certain things happened.

Calculations and Summarizing Data

Often, you will need to perform calculations on your raw data in order to get the results from which you will generate a conclusion. A spreadsheet program such as Microsoft Excel may be a good way to perform such calculations, and then later the spreadsheet can be used to display the results. Be sure to label the rows and columns--don't forget to include the units of measurement (grams, centimeters, liters, etc.).

You should have performed multiple trials of your experiment. Think about the best way to summarize your data. Do you want to calculate the average for each group of trials, or summarize the results in some other way such as ratios, percentages, or error and significance for really advanced students? Or, is it better to display your data as individual data points?

Do any calculations that are necessary for you to analyze and understand the data from your experiment.

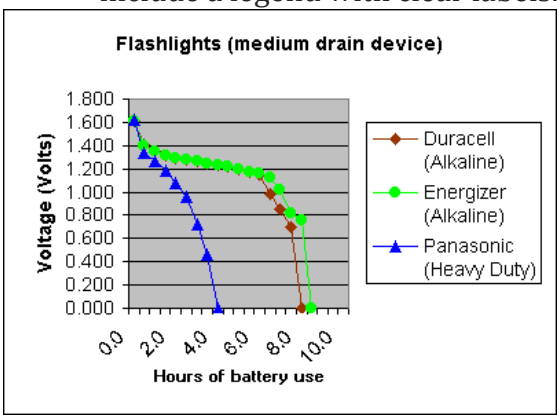
b. Use calculations from known formulas that describe the relationships you are testing. ($F = MA$, $V = IR$ or $E = MC^2$)
c. Pay careful attention because you may need to convert some of your units to do your calculation correctly. All of the units for a measurement should be of the same scale—(keep L with L and mL with mL, do not mix L with mL!)

Graphs

Graphs are often an excellent way to display your results. In fact, most good science fair projects have at least one graph.

For any type of graph:

- Generally, you should place your independent variable on the x-axis of your graph and the dependent variable on the y-axis.
- Be sure to label the axes of your graph— don't forget to include the units of measurement (grams, centimeters, liters, etc.).
- If you have more than one set of data, show each series in a different color or symbol and include a legend with clear labels.



Different types of graphs are appropriate for different experiments. These are just a few of the possible types of graphs:

A **bar graph** might be appropriate for comparing different trials or different experimental groups. It also may be a good choice if your independent variable is not numerical. (In Microsoft Excel, generate bar graphs by choosing chart types "Column" or "Bar.")

A **time-series** plot can be used if your dependent variable is numerical and your independent variable is time. (In Microsoft Excel, the "line graph" chart type generates a time series. By default, Excel simply puts a count on the x-axis. To generate a time series plot with your choice of x-axis units, make a separate data column that contains those units next to your dependent variable. Then choose the "XY (scatter)" chart type, with a sub-type that draws a line.)

An **xy-line graph** shows the relationship between your dependent and independent variables when both are numerical and the dependent variable is a function of the independent variable. (In Microsoft Excel, choose the "XY (scatter)" chart type, and then choose a sub-type that does draw a line.)

A **scatter plot** might be the proper graph if you're trying to show how two variables may be related to one another. (In Microsoft Excel, choose the "XY (scatter)" chart type, and then choose a sub-type that does not draw a line.)

Conclusion

Your conclusions will summarize whether or not your science fair project results support or contradict your original hypothesis. If you are doing an Engineering or Computer Science programming project, then you should state whether or not you met your design criteria. You may want to include key facts from your background research to help explain your results. Do your results suggest a relationship between the independent and dependent variable?

If Your Results Show that Your Hypothesis is False

If the results of your science experiment did not support your hypothesis, don't change or manipulate your results to fit your original hypothesis, simply explain why things did not go as expected. Professional scientists commonly find that results do not support their hypothesis, and they use those unexpected results as the first step in constructing a new hypothesis. If you think you need additional experimentation, describe what you think should happen next.

Scientific research is an ongoing process, and by discovering that your hypothesis is not true, you have already made huge advances in your learning that will lead you to ask more questions that lead to new experiments. Science fair judges do not care about whether you prove or disprove your hypothesis; they care how much you learned.

Your **conclusions** summarize how your results support or contradict your original hypothesis:

- Summarize your science fair project results in a few sentences and use this summary to support your conclusion. Include key facts from your background research to help explain your results as needed.
- State whether your results support or contradict your hypothesis. (Engineering & programming projects should state whether they met their design criteria.)
- If appropriate, state the relationship between the independent and dependent variable.
- Summarize and evaluate your experimental procedure, making comments about its success and effectiveness.
- Suggest changes in the experimental procedure (or design) and/or possibilities for further study.

Final Report

At this point, you are in the home stretch. Except for writing the abstract, preparing your science fair project final report will just entail pulling together the information you have already collected into one large document.

Your final report will include these sections:

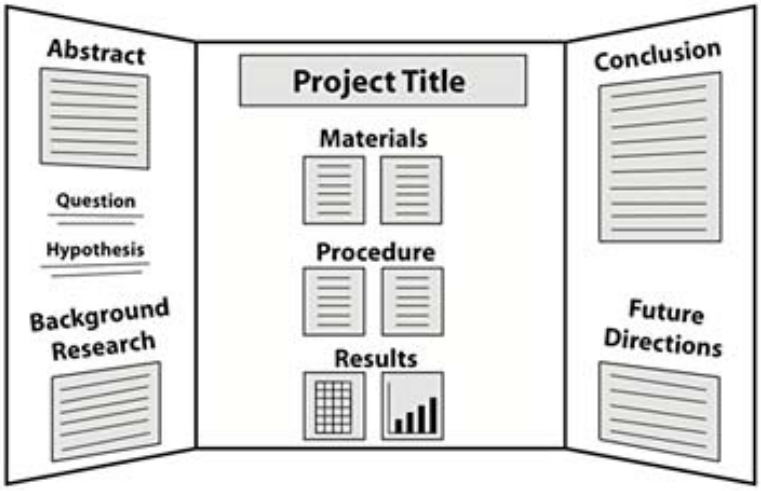
- **Title page**
- **Abstract** – An abstract is an abbreviated version of your final report.
- **Table of contents**
- **Question, variables, and hypothesis**
- **Background research** – This is the Research paper you wrote before you started your experiment.
- **Materials list**
- **Experimental procedure**
- **Data analysis and discussion** – This section is a summary of what you found out in your experiment, focusing on your observations, data table, and graph(s), which should be included at this location in the report.
- **Conclusion**
- **Ideas for future research** – Some science fairs want you to discuss what additional research you might want to do based on what you learned.
- **Acknowledgements** – This is your opportunity to thank anyone who helped you with your science fair project, from a single individual to a company or government agency.
- **Bibliography**

Write the abstract section last, even though it will be one of the first sections of your final report. Your final report will be several pages long, but don't be overwhelmed! Most of the sections are made up of information that you have already written. Gather up the information for each section and type it in a word processor if you haven't already.

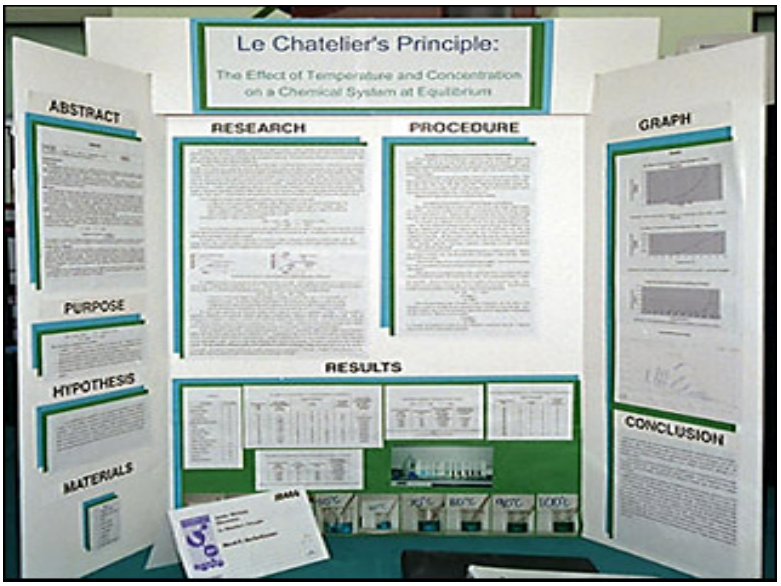
Save your document often! You do not want to work hard getting something written the perfect way, only to have your computer crash and the information lost. Frequent file saving could save you a lot of trouble! Remember to do a spelling and grammar check in your word processor. Also, have a few people proof read your final report. They may have some helpful comments!

Display Board

For almost every science fair project, you need to prepare a **display board** to communicate your work to others. In most cases you will use a standard, three-panel display board that unfolds to be 36" tall by 48" wide. Display boards can be found at Amazon and other retailers. See the Science Fair Project Shopping List for more details.



Organize your information like a newspaper so that your audience can quickly follow the thread of your experiment by reading from top to bottom, then left to right. Include each step of your science fair project: Abstract, question, hypothesis, variables, background research, and so on.



Use a font size of at least 16 points for the text on your display board, so that it is easy to read from a few feet away. It's OK to use slightly smaller fonts for captions on picture and tables. For more details see: Everything You Need to Know About Fonts for Display Boards

The title should be big and easily read from across the room. Choose one that accurately describes your work, but also grabs peoples' attention.

A picture speaks a thousand words! Use photos or draw diagrams to present non-numerical data, to propose models that explain your results, or just to show your experimental setup. But, don't put text on top of photographs or images. It can be very difficult to read.

Check the rules for your science fair. Here is a list of items are allowed (or even require) and:

- Your name on the display board
- Pictures of yourself
- Captions that include the source for every picture or image
- Acknowledgements of people who helped you
- Your laboratory notebook
- Equipment such as your laboratory apparatus or your invention