Part II (After Experimentation)

Data

Data is the information you have recorded during your experiment. It is time to put it into a format that is easy to understand. Data should be recorded in your log book and placed into data tables. Take some time and carefully review all of your data. Charts and graphs are a way to organize your data and look for patterns. You will need to think about what you have discovered and use your data to help explain why you think certain things happened.

Things you should know:

- **Graphs are often an excellent way to display your results. In fact, most good science fair projects have a graph.**
- **Different types of graphs are appropriate for different experiments. These are just a few of the possible types of graph:**

    1. **A bar graph might be appropriate for comparing different trials or different experimental groups. It is 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.")**

2. A line graph or 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.)

3. 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.)

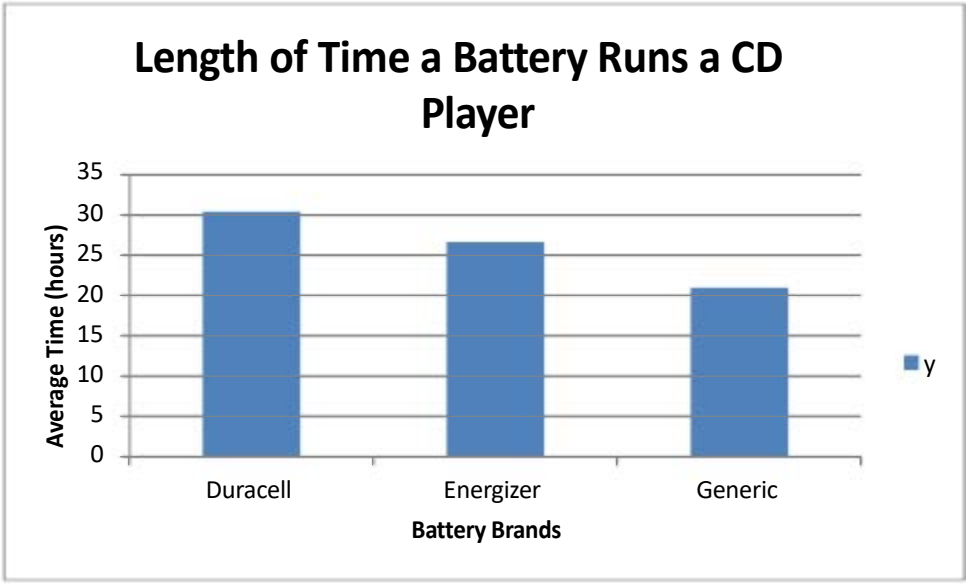
4. An xy-line graph shows the relationship between your dependent and independent variables when both are numerical and the dependent variable is a function of the independent variable. (In Microsoft Excel, choose the "XY (scatter)" chart type, and then choose a sub-type that does draw a line.)

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

6. A pie graph is used when comparing something to a whole. It uses percentages and should end up equaling 100%. <u>Pie graphs are the most misused by students.</u> Most data will not fit properly into a pie graph. Ask your teacher if this will be appropriate for your experiment.

- **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 your graph, give it a title which specifies what your data compares. Label the axes, including correct units of measurement.**
- **Write a one – two sentence explanation of your graph or chart below the chart.**

EXAMPLE: graph for battery data below



The graph above shows how various brands of batteries differ in their usage time.

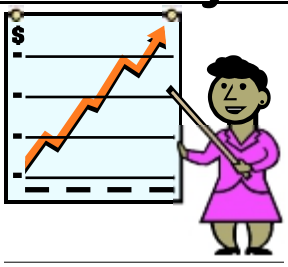
Prepare your data table and plot graphs as appropriate in a spreadsheet program such as Microsoft Excel.

Sample Data Chart

Length of Time a Battery Runs a CD Player

Trials	Duracell (hours)	Energizer (hours)	generic (hours)
Trial 1	30.5	27.5	20.0
Trial 2	29.3	26.0	21.5
Trial 3	31.5	27.8	21.8
Trial 4	30.0	25.3	20.5
Trial 5	30.8	26.5	21.0
Average	30.4	26.6	21.0

Data Analysis



Data analysis is the evaluation of the charts, tables and graphs you prepared for your science fair project. It is time for you to analyze your data and summarize your results. From this data you will extract useful information that will help you when forming your conclusions.

The analysis section should be a separate labeled section, immediately following the graphs and charts. Generally, for every graph or chart presented, the researcher should explain and analyze the data in approximately one paragraph per graph or chart.

Example of Data Analysis: The bar graph shows that Duracell batteries outlasted Energizer and generic batteries with an average of 30.4 hours. The battery which performed the poorest was the generic battery with an average battery life of 21.0 hours. The Energizer battery had an average of 26.6 hours. The data shows a decrease in battery life between the Duracell battery and the Energizer battery of 3.8 hours, and a decrease in battery life between the Duracell battery and the generic battery of 9.4 hours.

Things to Think About: **These questions should help you analyze your data more effectively.**

- **Is your data accurate?**
- **Have you summarized your data with an average if appropriate?**
- **Have you verified that all calculations are correct?**
- **Is all the raw data recorded in your log book?**
- **Have you kept your personal opinion out of the analysis and stuck to the facts?**
- **Is there sufficient data to tell if your hypothesis is supported or not? [if not, you might want to run more trials if possible]**

Name:

Data Analysis- Rough Draft

Directions:

Using your completed graphs and charts, follow the example to generate a rough draft of your data analysis. This portion of your project should focus solely on the data (no conclusions or personal opinions) and should include only information obtained from reading and evaluating your graphs and charts. Do not include conclusions yet! You should look at the averages of the data to explain overall results rather than individual trials.

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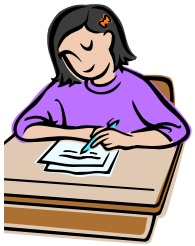
Parent Signature **Date**

Conclusion



The conclusion is a summary of the research and the results of the experiment. This is where you answer your research question. You state whether your data supports your hypothesis or not. Your data may or may not have supported your hypothesis. If the results of your experiment do 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. Scientists often find their results did not support their hypothesis, and will explain why the results are different and what additional changes should be made.

Things you should know:

- **Do not use first person. Use, "The researcher found…"**
- **Restate hypothesis and answer your original research question.**
- **Do not say things like "I was right/wrong" or "My hypothesis was correct/incorrect". Simply state whether your data supports or does not support your original hypothesis.**
- **Summarize your data in a few sentences and use it to support your findings.**
- **Explain how your experiment provides a benefit to society.**
- **State what you could have done differently.**
- **Consider and state any possible error.**
- **Define questions that arose during the experiment and ideas for future research.**
- **Should be about 3-4 paragraphs in length.**

Suggested Organization of Conclusion

Paragraph 1
Restate your research question and hypothesis. Explain how/why the data supports or does not support your hypothesis.

Paragraph 2
Explain how the scientific principles discussed in your background section connect to your results.

Paragraph 3
Consider and state possible sources of experimental error.
If you were to run your experiment again, what might you do to improve the design and/or reduce these experimental errors.

Paragraph 4
What did you learn from your project? What are the benefits to society?
Are there any questions that arose from your project and/or ideas for future research?

CONCLUSION EXAMPLE

The original question was "What is the effect of using different battery brands on how long a CD player will run?". The hypothesis was: If testing three different brands of alkaline batteries (Duracell, Energizer, and generic), then the Duracell batteries will run a CD player for the longest period of time. This was predicted because Duracell contains a compound which has been found in research to extend battery life. The Duracell battery ran the CD player for an average of 30.4 hours. The Energizer battery ran the CD player for an average of 26.6 hours. The generic battery ran the CD player for an average of 21.0 hours. Therefore, my data does support my original hypothesis.

Since a chemical reaction in a battery causes electrons to build up on the anode, this gives it a net negative charge, creating a potential difference between the anode and the cathode. Because like charges repel each other, the electrons want to move away from each other. Because opposite charges attract each other, the electrons want to move toward the positive cathode. This is what creates an electric current. These electrochemical processes change the chemicals in the battery and eventually there are no more electrons available. Thus, the battery has no more power. However, certain chemicals can slow down the chemical reaction and therefore extend the life of a battery. The research showed that Duracell has such a chemical, and Energizer and generic batteries do not. This could explain why the Duracell battery lasted, on average, longer than the other batteries.

During the experiment there were times when the CD player stopped, but the timer was not immediately stopped. Therefore this could have introduced error into the measurements. Although the same CD player was used and the batteries were all bought at the same time, there is no way to know if some of the batteries were older than others. None of the batteries were past the expiration date, however this could be a source of experimental error as this variable (age of battery) was not perfectly controlled. If the experiment were to be repeated, a video camera would have been used to help record the exact time the CD player stopped and batteries with identical expiration dates would be used.

According to the results of this experiment, Duracell is the longest lasting battery of the three types tested. The results of this experiment could be helpful in knowing which the longest lasting battery to buy is. However, it would be interesting to research the relationship between cost and performance. If the longest lasting battery is also the most expensive, is it worth the extra cost? Other topics for further research would be to compare different generic brands to Duracell to see if any generic batteries would give a similar performance to the brand names.

Name_____
Period_____

Conclusion-Rough Draft
(make sure you have 4 separate paragraphs)

Parent Signature_____Date_____

Oral Presentation

- **Create a 10 minute presentation using Power Point in landscape format**
- **Power Point must be saved to a flash drive and uploaded to your account on the PJAS website**
- **Use approximately 12 to 15 slides**
- **No other props are allowed**
- **Have any necessary forms with you**
- **The time cannot exceed 10 minutes – aim for 5 to 7 minutes**
- **There is a brief question and answer period following your presentation**

Oral Presentation Guidelines

Time Limit: 10 minutes [Points may be deducted if the presentation exceeds the time limit]
Presentation Parts:

- **Statement or greeting**
  - **"Good afternoon, my name is…..from Notre Dame of Bethlehem School. The title of my project is _____."**

- **Background Information**
  - **Definitions of scientific terms with examples.**
  - **Introduction of key principles.**
  - **May include terms with photos.**

- **Research Question**
  - **In the form of 'What is the effect of….'**

- **Hypothesis Statement**
  - **Brief and to the point.**
  - **If/then….format.**
  - **scientific reason for your prediction**

- **Presentation of Materials**
  - **List of materials (bullet points), photos if possible.**

- **Procedure**
  - **Numbered step by step.**
  - **Photos are helpful to show experiment progress.**

- **Data/Data Analysis**
  - **Data should be explained with minimal reliance on note cards.**
  - **Slides should display results in the form of appropriate charts, graphs, and/or tables. Only have ONE visual at a time.**

- **Conclusions**
  - **Answer the research question.**
  - **Does the data support the hypothesis?**
  - **Discuss the science you learned and possible sources of error**

- **In Addition**
  - **Discuss unanswered questions and topics for further research**

- **Presentation Ending**
  - **"Thank you for your attention. Are there any questions?"**

Here are some questions/statements you may be asked to respond to in an interview:

1. **Explain what you wanted to find out and what you thought would happen.**
2. **Explain your graphs.**
3. **Summarize your conclusion.**
4. **What did you learn from this project?**
5. **What would you do differently?**
6. **Did you have any possible error?**
7. **How were variables controlled?**
8. **Could you please clarify….?**
9. **Why did you choose this topic?**

Suggested Slide Presentation Organization

Slide 1 – Title of project, Name and School

Slide 2 – Background Info

Slide 3 – Research Question

Slide 4 – Hypothesis

Slide 5 – Materials List/Procedure

Slide 6 – Procedure/ Pictures of experimental set-up*
*some photos should show you performing the experiment

Slides 7, 8, 9 – Data & Data Analysis

Slide 10, 11 – Conclusions

Slide 12 – In Addition

- This is only a general guideline; slides may be adjusted and additional slides may be used as needed.
- You may use note cards to present, but do not read your note cards word for word.
- Make sure that you PRACTICE your presentation many times, alone and in front of others, until you know it well before the day of your actual oral presentation.

Tips for Designing Presentations

- **Every presentation should have a title slide. Make sure the title relates to the presentation content.**

- **Maintain a consistent color scheme throughout the presentation.**

- **Keep the background simple, making sure the text can be seen clearly.**

- **Remember, the slides are 'talking points' Avoid long lines of text.**
  - **Do not write out sentences and long paragraphs. No slide should consist of more than seven lines.**
  - **No line should consist of more than seven words.**

- **Avoid small text.**
  - **Text on all slides should be no smaller than 24 points.**
  - **Title text should be 36 points.**

- **For bulleted text:**
  - **Avoid using a single bullet.**
  - **Don't use more than two levels of bullets.**
  - **Use consistent wording in bulleted lists.**

- **Clip Art:**
  - **Use clip art that relates to the content and doesn't distract from the message.**
  - **Avoid the temptation to "jazz up" a slide show with too much clip art.**

- **Keep charts simple. The most effective charts are pie charts with three or four slices and column charts with three or four columns.**

- **Your final slide should provide a recommendation or summary.**

The following items are NOT allowed with your display board:

[Lehigh Valley Science & Engineering Research Fair guidelines]

1. Living organisms, including plants
2. Taxidermy specimens or parts
3. Preserved vertebrate or invertebrate animals
4. Human or animal food
5. Human/animal parts or body fluids (for example, blood, urine)
6. Plant materials (living, dead, or preserved) that are in their raw, unprocessed, or non-manufactured state (Exception: manufactured construction materials used in building the project or display)
7. All chemicals including water (Exceptions: water integral to an enclosed, sealed apparatus.)
8. All hazardous substances or devices [for example, poisons, drugs, firearms, weapons, ammunition, reloading devices, and lasers
9. Dry ice or other sublimating solids
10. Sharp items (for example, syringes, needles, pipettes, knives)
11. Flames or highly flammable materials
12. Batteries with open-top cells
13. Awards, medals, business cards, flags, logos, endorsements, and/or acknowledgments (graphic or written) unless the item(s) are an integral part of the project
14. Photographs or other visual presentations depicting vertebrate animals in surgical techniques, dissections, necropsies, or other lab procedures
15. Active Internet or e-mail connections as part of display
16. Prior years' written material or visual depictions on the display board. [Exception: the project title displayed on the board may mention years or which year the project is (for example, "Year Two of an Ongoing Study")]. Continuation projects must have the Continuation Project Form (7) vertically displayed.
17. Glass or glass objects unless deemed by the Display and Safety Committee to be an integral and necessary part of the project (Exception: glass that is an integral part of a commercial product such as a computer screen)
18. Any apparatus deemed unsafe by the Scientific Review Committee, the Display and Safety Committee, or Society for Science & the Public (for example, large vacuum tubes or dangerous ray-generating devices, empty tanks that previously contained combustible liquids or gases, pressurized tanks, etc.)

NO FOOD, PLANTS, ANIMALS OR LIQUIDS OF ANY KIND