Workshop #2:

From Data Analysis to Display – Putting It All Together

January 11, 2020

Presented by the
GSDSEF Student Leadership Board

Agenda

- ❏ Putting together your project notebook – the necessary components
- ❏ Organizing and analyzing data – ways to show and summarize results
- ❏ Writing a strong abstract – a tutorial
- ❏ Submitting your project for screening – requirements and instructions
- ❏ Creating your project display – the Do's and Don'ts
- ❏ Mentoring time – one-on-one support

Putting Together Your Project Notebook

Putting Together Your Project Notebook:
Components

- Table of Contents
- Abstract
- Introduction
- Literature Review - Background Research
- Hypothesis / Statement of Purpose
- Materials
- Procedure / Experimental Method
- Findings - Data/Results
- Findings - Data Analysis Discussion
- Conclusion
- Acknowledgements
- Bibliography
- Appendix – raw data, observational notes, etc.

Putting Together Your Project Notebook:
Abstract

- Written after project is completed, but is put in front of the notebook
- Is a brief summary – no more than 400 words
- Contains
  - your hypothesis or statement of purpose
  - an outline of your procedure or experimental design
  - a summary of results
  - your conclusion

Putting Together Your Project Notebook:
Introduction

- Provide a narrative of why and how your project came to be.
- Give a brief overview of the background and goals of your project in no more than a single page

Putting Together Your Project Notebook:
Review of Literature (Background Research)

- Recommended: use a minimum of 5 sources for Junior Division and 10 for Senior Division.

- Contains:

    - 5 to 10+ typed pages summarizing the information you found about your topic
    - an introductory paragraph that generates interest and indicates what is coming
    - information you found while researching your topic.
    - a concluding paragraph that brings it all together.

- Give credit where credit is due! Cite your sources in the bibliography.

Putting Together Your Project Notebook:
Hypothesis

It is a proposed explanation or prediction

- Based on
  - your research
  - the problem you identified
- Must be
  - testable
  - replicable
- Contains the
  - independent variable
  - dependent variable

It can be written as an **If** {these changes are made to a certain *independent variable*}, **then** we will observe { change in a specific *dependent variable*} statement.

Putting Together Your Project Notebook:
Hypothesis - Samples

- Higher concentration of Aloe Vera juice will decrease the regeneration time in planaria. (If higher concentration of aloe vera juice is given to planaria, then their regeneration time is decreased.

- Radish seeds watered with higher concentrations of acidic water and higher concentrations of alkaline water will result in decreased germination as compared to lower levels of concentration and neutral water.

- If temperatures are raised in orange juice, then ascorbic acid concentration levels will decrease.

Putting Together Your Project Notebook:
Statement of Purpose

An engineering or computer science project involves development of materials, equipment, procedures, or models. This a statement of purpose rather than a hypothesis.

Examples:

- The purpose of this computer program is to model the flow of various chemicals through various types of soil and groundwater.
- The purpose of this project is to develop a Remotely Piloted Vehicle (RPV) that uses the cellular telephone network as a transmission system.

Putting Together Your Project Notebook:
Materials and Procedures

- List materials on one page in a bulleted list
- Give a step-by-step description of how you tested your hypothesis. Number your steps.
- Should be complete and specific so that someone else will be able to replicate your experiment or design and get similar results.

NOTE: Use passive voice. (Should be written without using “I.”)

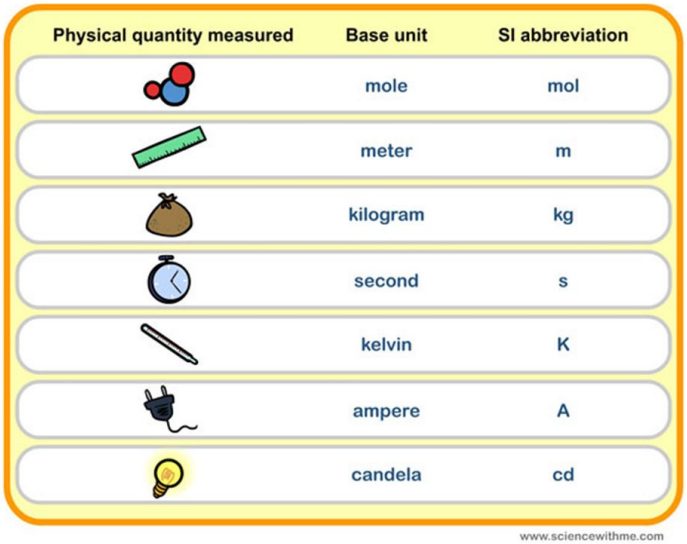
Putting Together Your Project Notebook:
Materials and Procedures

- Make sure you have done enough trials and have collected enough data for each trial to be able to analyze the results and draw a conclusion.
- Number of trials may depend on the type of project, but generally 3 to 8 trials are adequate and each trial should have at least 10 to 30 data points or measurements.
    - For example, if you are working with plants, you need to have at least 30 plants per experimental group and at least 30 plants in the control group.

Putting Together Your Project Notebook:
Materials and Procedures

- Use the International System of Units (SI System):

Examples:



Graphic from http://sciencewithme.com/learn-about-si-units/

- Do NOT use measurements like inches, tablespoons, ounces …
- If you need to convert your measurements, go to our Student Resources page: https://www.gsdsef.org/students/resources (Section D).

Putting Together Your Project Notebook:
Findings: Analyzing the Data

After your experimentation is done, you need to organize your raw results and analyze the data to put in your notebook and put on your display board.

There are three steps to analyzing data in order to draw conclusions:

- Organize the data/results in charts, tables, and graphs
- Review and Interpret the Data/Results – Do the Math!
- Summarize (Discuss) the Data/Results

Putting Together Your Project Notebook:
Findings: Organize the Results

- Organize your raw data into neat, easily understood graphs and tables. Raw data will go in the Appendix of your notebook.
- Don't leave anything out or skip any information. Some of the best science discoveries come from our "mistakes."
- The type of graphs you use depend on the type of data you collected.
- Title your graphs and charts, label your x-axis (independent variable) and your y-axis (dependent variable), and include the units of measurement.

Putting Together Your Project Notebook:
Findings: Organize the Results

What do you want to present?	Which chart to use
Comparison of two or more categories, Binary data (e.g. yes/no responses), Percentages	**Bar chart, Pie (circle) chart**
Change over time	**Line graph, area graph**
Comparing parts of a whole	**Pie chart**
Frequency	**Bar chart**
Correlation between two variables	**Scatter graph**
Changes in two or more related groups that make up one whole category (for example public and private groups).	**Area Graph**
Relationships between 2 different things – the x-axis is used to measure one variable and the y-axis used to measure another variable	**X-Y Plot**
Dispersion (how spread out your data set is)	**Box and whisker plot, bar chart**

Putting Together Your Project Notebook:

Findings: Review and Interpret the Results

Review your data. Look at the results with a critical eye. Ask yourself these questions:

- Do you have enough data?
- What information does the data you collected tell you?
- What trends or patterns do you see?
- Did you get the results you expected?
- If you have unexpected results, try to figure out why. Was there a problem with your hypothesis? Did you make a mistake?

Putting Together Your Project Notebook:
Findings: Review and Interpret the Results

- Identify trends or patterns in the data
- Do the Math!!! You may have to make calculations to interpret your findings.
    - Calculate averages/mean, median, mode, and/or standard deviation as needed.
    - Compare/contrast the trials data.
    - Summarize the data as ratios or percentages.

Putting Together Your Project Notebook:
Findings: Summarize and Discuss the Results

In your analysis:

- Summarize what your data has shown you using your calculations and objective observations.
- List the main points that you have learned without using the word “I” and with no opinions. Use only what you know, not what you think happened at this point.

Note: During judging, be prepared to describe and explain your results or answer questions about your results.

Putting Together Your Project Notebook:
Findings: Summarize the Results

Sample statements to use to summarize your results.

- *The most/least frequent response was __ by give #.*
- *The difference between ___ and ___ was --%, -#- unit of measurement.*
- *The average of ____ was ___.*
- *The graph showed ___.*
- *The ___ increased/decreased by ___(unit of measurement).*
- *The average ___ decreased/increased by __% over the (length of time).*
- *The difference between _ and ___ was __(unit of measurement, %...).*
- *In comparison, ___.*

Use units of measurements in your statements as appropriate!

Putting Together Your Project Notebook:
Findings: Summarize the Results

Example Statements:

- The most **frequent** response for 30 5th grade students was 3 hours per day for TV viewing with an **average** of 2.8 hours.
- The untreated control plates grew on **average** 43.25 ± 29.1 CFUs. The zinc oxide plates grew on **average** 3 ± 6 CFUs, and both the copper and silver nitrate groups had 0 CFUs. …
- Colloidal silver showed an average inhibition zone of 2.13 (Trial 1) and 7.25 (Trial 2) for Staph epi group **compared** to the E. coli group demonstrating an inhibition zone of 1.38 (Trial 1) and 2.0 (Trial 2). Thyme oil group had zones of inhibition **greater** the 20mm in both E.coli and Staph epi. group for both trials.
- The balloons with 1-candle power had an **average** flight time of 14.8 s. Balloons with 2-candle power had flight time average of 13.0 s. The 3-candled balloons had times average flight time of 10.4 s. The number of candles determined the speed at which the balloon rose: three candles were quickest and the single candle balloon the slowest with a **difference** of 4.4 s.

Putting Together Your Project Notebook:
Conclusion

This is where you give the answer to your hypothesis.

- Restate your Hypothesis, and then follow it with a short summary of your findings.
- Describe your interpretation of your results. Write what you think the data shows. You can put your opinions here.

❖ Sometimes the results of your project do not support your hypothesis. This is okay! (Great discoveries can come from what we learn from mistakes and Unexpected findings can often be used for additional experimentation)

Putting Together Your Project Notebook:
Conclusion

In your conclusion, consider the following questions:

- Did your experiment prove or disprove your hypothesis?
- Why did the results occur? Or explain why you may have gotten unexpected results.
- What did your experiment suggest?
- Were there any limitations in your project? Explain. (For example, if your project was to find out something about dogs and you used your dog, you can say “My dog did this. This might not be the same for other dogs.” You can’t say that all dogs would behave the same as yours because you didn’t check all dogs.)
- **How is your project significant or important?**

Putting Together Your Project Notebook:
Recommendations

- Explain possible experimental errors and how you would fix this.
- Explain how you would improve your project.
  - How would you change your procedure?
  - What would you NOT do again?
- If you were to do a continuation project what would you test?
- Are you planning on patenting/publishing your work?

Be prepared to answer these questions, as judges love asking questions like these!

Putting Together Your Project Notebook:
Bibliography

- List of references (books, articles, internet sites, etc.) crediting sources used during research and experimentation process

- Recommended number of reference sources:
  - Junior Division - minimum of 5 different reference sources
  - Senior Division – minimum of 10 different reference sources

- Follow proper citation format (either MLA or APA).

- NOTE: During screening and judging, sources are often checked!

Putting Together Your Project Notebook:
Bibliography

- Internet sources on how to cite your references.

- See examples on:
  https://www.infoplease.com/homework-help/how-write-research-paper-6

- Use a free website to create your citations:
  http://www.citationmachine.net/

  - Click on “I want to only create citations” button
  - Select APA or MLA on top of page
  - Choose type of source (Book, Magazine, Newspaper, Website, Journal,, …)
  - Use proper capitalization when entering information!

Putting Together Your Project Notebook:
Appendix

- Contains information not appropriate in first sections of notebook

- Includes raw data in its original handwritten form, such as
  - Tables and charts of data collected
  - Notes/Logs/observations
  - Pictures and photos
  - Any other evidence collected during your experiment

Putting Together Your Project Notebook:
Appendix

- For Behavioral Science projects, only include a blank survey/response form/questionnaire form and blank consent form, as examples.
- Do not include any signed or completed forms from human participants from your study.
- Human participant names and/or personal information or individual responses are not be displayed during the science fair or in exhibit hall. Keep these materials in a separate folder in a safe location.

How to Write a Strong Abstract

How to Write a Strong Abstract:
A Tutorial

- Written LAST but will be first section of your notebook
- Is limited to 400 words or fewer (ISEF requires no more than 250 words)
- Summarizes your project in 4 brief paragraphs
  - Purpose – Introduction and Hypothesis/Goal
  - General Procedures
  - Results
  - Conclusions
- Written in past tense.

How to Write a Strong Abstract:
A Tutorial

Paragraph 1: Purpose of the Investigation

- An introductory statement to explain reason and background for doing the investigation
- A statement of the problem or hypothesis/goal the research is looking to solve or questions being tested.

How to Write a Strong Abstract:
A Tutorial

Examples of Paragraph 1: Purpose of the Investigation

- Viruses, such as those that cause colds and influenza, spread via droplets of mucus produced when an infected person sneezes or coughs. Using thick and thin mucus and a model sneeze, the hypothesis was that thin mucus will travel farther than thick mucus.

- Worldwide, over 200 million people have significant visual impairment and 40+ million are completely blind. High costs and limitations of current advancements and devices, such as transplants and canes prevent optimal visual aid. The purpose of this project is to create a jacket with built-in sensors and micro-vibration motors for the visually-impaired to efficiently navigate their surroundings.

How to Write a Strong Abstract:
A Tutorial

Paragraph 2: Procedure

- Is a brief overview of how the investigation was conducted - highlight key points, methods, and resources
- Does not include details about materials used (unless they greatly influenced the procedure or were needed to conduct the investigation)
- Include only procedures done by the students(s) of the project (does not include procedures done by a mentor or lab scientist, if project is part of a bigger study)
  - If it is a continuation project, do NOT include procedures from previous year(s).

How to Write a Strong Abstract:
A Tutorial

Examples of Paragraph 2: Procedure

- Thin and thick mucus were represented by 1-milliliter volumes of colored water or a mixture of corn syrup and gelatin, respectively. Fluid was squirted from a plastic dropper with enough force to model a sneeze. Each sample was analyzed for maximum distance traveled and distribution of droplets. Data was analyzed using a two-tailed t test.

- HC-SR04 sensors and vibration motors were connected to an Arduino, coded with a program that instructs the vibration motors and placed on the front, back, and sides of the jacket. The jacket was tested moving towards large objects such as walls and smaller objects such as tables to measure vibration distances.

How to Write a Strong Abstract:
A Tutorial

Paragraph 3: Results

- Provide only key results that lead directly to your conclusions with only important data calculations
- Does not include unnecessary data or observations, nor tables, charts, graphs or other images
- Does not contain any opinions.
  - If it is a continuation project, do not include results from previous year(s).

How to Write a Strong Abstract:
A Tutorial

Examples of Paragraph 3: Results

- Compared to thick mucus (mean distance of 110.8 cm, SD 103.7 cm, n=26/group), thin mucus squirted a greater mean distance (302.4 cm, SD 45.06 cm, n=26/group, $p<0.0001$, Cohen's d 2.395). Thick mucus traveled a maximum of 310 cm. Thin mucus traveled a maximum of 400 cm. Thick mucus also formed fewer visible droplets, and droplets concentrated closer to the origin of the "sneeze."

- The sensors and vibration motors in the jacket detected large objects (walls) from an average distance of 3.2 meters while detecting objects (approximately 500 cm in height from the ground) at an average distance of 410 cm. Detection (jacket vibration) was reduced by 90% for objects that were lower than 400 cm tall.

How to Write a Strong Abstract:
A Tutorial

Paragraph 4: Conclusions

- Short summary in 1 – 2 sentences
- Is a reflection on the research process and results
- May include conclusive ides, important applications, and implications for further research
  - If it is a continuation project, use only results of current year to draw conclusions

How to Write a Strong Abstract:
A Tutorial

Examples of Paragraph 4: Conclusions

- This study showed that thin mucus travels farther than thin mucus in the plastic dropper sneeze model. Thin mucus traveled a maximum of 400 cm, suggesting a potential spread of virus-containing particles of up to 4 meters in our tests. Further experiments will clarify differences in viscosity between thick and thin mucus and potential differences in droplet size.

- The jacket was successful in providing ample notification to the visually impaired when approaching large objects. When objects were 500 cm above ground level, the effectiveness dropped, and there wasn't enough notification for the wearer approaching objects smaller than 400 cm. Further modifications of the jacket needed to be able to detect small objects at lower heights effectively.

How to Write a Strong Abstract:
A Tutorial

Best Practices – Revision is KEY

- Make sure that the abstract includes all parts outlined in this guide
- Leave out unnecessary details and discussions
- Use the past tense in descriptions
- Write in short, but complete sentences
- Avoid extra jargon and any slang
- Use concise wording, especially when expressing concepts and processes with scientific language
- Check for correct spelling, grammar, and punctuation!

How to Submit Your Digital Project for Screening

How to Submit Your Project for Screening:
Requirements

Purpose is to review each project to see that science and engineering principles are followed.

- **Screening Deadlines:**

6th - 7th Grades	Wednesday, January 22, 2020
8th Grade	Wednesday, February 5, 2020
9th – 12th Grades	Wednesday, February 12, 2020
All Project Resubmissions	Wednesday, February 21, 2020

- Create 10 page Digital Project. This will be a much shorter version of your Project Notebook.

How to Submit Your Project for Screening:
Instructions

- To create the digital project, use the templates and read all directions on:
  https://www.gsdsef.org/teachers/screening-teacher

- Keep the slides clean and easy to read. This is not a presentation for your peers or teacher so no fancy fonts, rainbow colors, etc.

- Check for spelling, grammar, and punctuation before saving as pdf and submitting.

- Make sure you click on SUBMIT in order for the screeners to see your project. Projects that remain in DRAFT form cannot be accessed by screeners.

Creating Your Project Display

Creating Your Project Display:
Instructions

- Check the **Project Display Requirements** page for complete and specific information – https://www.gsdsef.org/projectdisplayrequirements

- Size - a standard sized trifold display board. Two display boards attached meets the maximum display size.

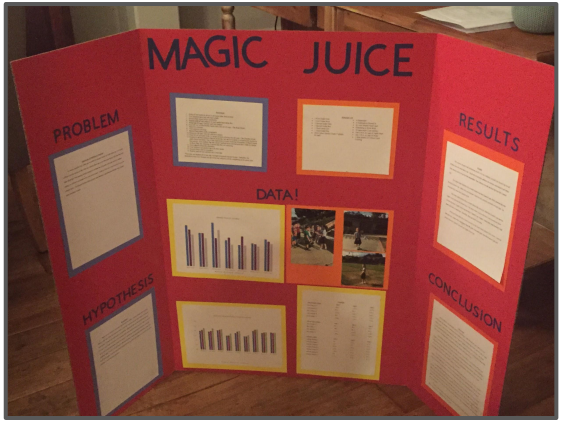
- Everything must fit within the space on the table – 4 feet across. If your project requires floor space rather than a table, send an email with your request (provide all pertinent details about you and your project) within 2 days of submitting your application and fees.

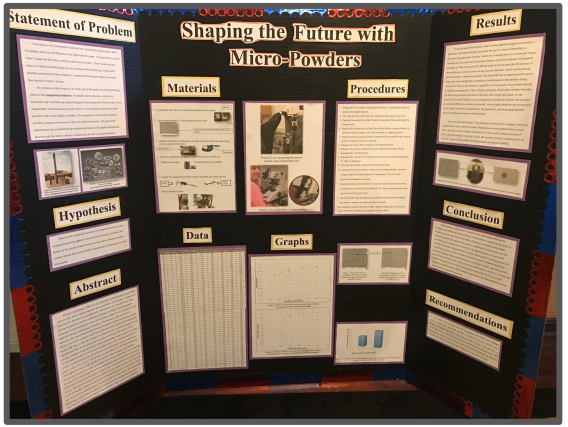
❖ **Displays and materials must pass the Size and Safety Check on check-in day .**

Creating Your Project Display:
Instructions – Do's

- Use appropriate colors to make content readable and presentable - keep it easy on the eye
- All text, graphs, diagrams should be clear to see and easy for you to refer to during judging
- Type everything using easy to read fonts
- Check for spelling, grammar, capitalization and punctuation
- Balance the spacing on the board – don't make it too crowded or have too much blank space.
- Cite source and label photos, graphics, pictures (even if you created them)

❖ Judges want to see the science/engineering aspects in the form of photos and data rather than any decorations that may distract attention from the student's research.





Creating Your Project Display:
Instructions – Don’ts

See the **Project Display Requirements** page for complete and specific information – https://www.gsdsef.org/projectdisplayrequirements

- No grade level or age listed on the board (only name and school)
- No personalized graphics, logos, website urls, emails, social media addresses, QR codes, etc. that can indicate a commercial purpose or self-promotion
- No reference to a mentor or an institution on the display
- No reference to a patent status related to the project or student exhibitor(s)
- No items for distribution (business cards, brochures, booklets, etc.)
- No awards or medals from previous fairs

Creating Your Project Display:
Instructions – Don'ts

Refer to the Project Display Requirements page for the complete list and description –
https://www.gsdsef.org/projectdisplayrequirements

- No Human Participant forms, surveys, etc. or participants names on the board or in notebook
- No living or preserved organisms, including plants even if in sealed containers
- No soil, dirt, sand, cement, waste samples – even if encased or in sealed containers
- No water or liquids even in sealed containers
- No glass objects (except for computer-type devices)
- No sharp items or items that can be considered potentially harmful or dangerous
- No flammable materials or heating elements
- No glitter or other items that can make a mess on the judging hall floor
- No items that can be easily removed (cotton balls, flowers, small electronic pieces)

GSDSEF - Sample Science Fair Project Display

This is one suggested layout for your science fair project display board. Your board should include the scientific method and should have a similar layout, however it may be modified to fit your project.

36" to 77" high from tabletop/108" from floor

Problem/Question

State your problem/question clearly and concisely in way that is answerable by a scientific method.

Background Research

Summarize or make a bulleted list of information from resources that helped you make a hypothesis.
(optional item on display. Include in notebook))

Hypothesis

State your prediction based on your research. This is an educated guess to the answer to your problem. Use the background information to justify your guess.

Variables

Identify the Independent Variables (IV), Dependent Variables (DV), and the Constant Variables
(optional item on display)

Project Title

(10 words or fewer)

The use of photographs is recommended. Photographs should NOT include direct face shots. Photos of students conducting their investigations and of materials or devices/apparatuses may be used, but not show entire face. Photos should be placed on the board in a logical order and should include captions explaining their purpose.

Materials

Provide a detailed list of materials you used during your investigation. Use a bulleted list and specify amounts and/or types.

Procedures

Provide a detailed, step-by-step list of the process you followed during your investigation so someone else is able to duplicate your investigation and get the same or similar results. Use flaps if more room is needed.

Results

Data Table(s)

Include data collected here. Data can be collected in tables, calendars, timelines, observations, etc. All data should be labeled appropriately, with SI units (International System of Units) of measurement and/or detailed descriptions of what it represents. Add flaps for data tables as needed. Keep raw data in your notebook.

Graph(s)

Include graphs/charts with a descriptive title. Choose graphs that is appropriate for your data. Put IV on x-axis and DV on y-axis and each axis is labeled correctly. Data points need to be clearly and correctly plotted. Make sure units of measure are noted on each axis. Include a brief statement of what each graph shows. Use flaps if more room is needed.

Results/Data Analysis

Provide an ***objective*** summary of your data analysis/results here. Include specific data points you consider significant. Identify and discuss trends you observed in your graphs. Use the data from the results in your statements. However, DO NOT explain why you think the results happened that way.

Conclusion

Provide your conclusion here. Include whether your results and analysis agreed or disagreed with your hypothesis and explain why. Your conclusion should be based upon the data – specific examples or trends. Include any changes you would make to your experimentation or extensions you could try.

Significance

Explain why your project is important or significant. Include any real world application for your project.

48 inches wide

Do not display your name, school, logos, or acknowledgements of any lab, mentor, etc. on the board. Put name and school on back.

Project Notebook

Model/Apparatus*

*NOTE: Certain items are not allowed with display. Refer to "Items Not Allowed On or With Display" list. Displays and models/apparatuses are inspected for size and safety before entry into the Exhibitors/Judging Hall.

GSDSEF – Sample Engineering Project Display

This is a suggested layout. Your board should flow in a similar fashion and include engineering design principles, but may be modified to fit your project.

36" to 77" high from tabletop/108" from floor

Problem/Need

Describe the problem or need for your design solution in this section.

Background Research

Summarize or make a bulleted list of information from resources.
(OPTIONAL item on display. Include in notebook)

Criteria/Constraints

Explain what your prototype will do (Criteria) and what variable you will test to determine if it meets your criteria. Explain any limitations you expect (Constraints).

Materials

Include a detailed list of materials used during your investigation. Use a bulleted list and specify amounts or types.

Project Title
(10 words or fewer)

The use of photographs is recommended. Photographs should NOT include direct face shots. Photos of students conducting their investigations and of materials or devices/apparatuses may be used, but not show entire face. Photos should be placed on the board in a logical order and should include captions explaining their purpose.

Design Execution

Include a detailed, step-by-step list of the process you followed to construct, set up and test during your investigation. Include diagrams/photos as appropriate. Add flaps if more room is needed. Identify the IV, DV, and CV's for testing.

Prototypes

Show/describe each prototype in this section. Use labeled diagrams and/or photos with captions. Add comments or evaluation of successes and failures. Use flaps if more room is needed.

Results

Data Table(s)

Include data collected here. Data can be collected in tables, calendars, timelines, observations, photos, or drawings. Add flaps as needed. All data should be labeled appropriately, with SI units (International System of Units) of measurement.

Graph(s)

Include graphs/charts. Be sure they are labeled appropriately on each axis and have a descriptive title. Note each units of measure are on each axis. Include a brief statement of what each graph shows.

Results

Provide an objective summary of your data/results here. Include specific data points you consider significant. Discuss trends you noticed in your data. However, DO NOT explain why you think it happened that way.

Conclusion

Provide your conclusion here. Include a brief overview or summary of your engineering design investigation, and analysis of your results, the problems you encountered, extensions you could try, and real world applications.

References/Resources

Use MLA format or APA format to list resources/bibliography.
(OPTIONAL item on display. Include in notebook)

48 inches wide

Do not display your name, school, logos, or acknowledgements of any lab, mentor, etc. on the board. Put name and school on back.

Project Notebook

Model/Apparatus*

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FOLLOW US!!!

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Last workshop!!

February 29, 2020
9-11am
Annex C, SDCOE

All about judging - what to expect at the fair. Bring your displays and practice your presentations!

Peer Mentoring Time