Getting Started with your Research

1. Pick your topic: This is perhaps the most difficult part. Get an idea of what you want to study or learn about. Ideas should come from things in your area of interest. A hobby might lead you to a good topic. What is going on in the world that you would like to know more about? Most importantly, pick a question or problem that is not too broad and that can be answered through scientific investigation.
2. Research your topic: Go to the library or internet to learn more about your topic. Always ask Why or What if.. Look for unexplained or unexpected results. Also, talk to professionals in the field.
3. Organize: Organize everything you have learned about your topic. At this point, you should narrow your thinking by focusing on a particular idea.
4. Make a time table: Choose a topic that not only interests you, but can be done in the amount of time you have. Identify your 'testable question'. Develop a time line to manage your time efficiently. You will need time to fill out the necessary forms and to review the Research Plan with your sponsor. Certain projects will require more time because they need prior Scientific Review Committee (SRC) or Institutional Review Board (IRB) approval. Allow plenty of time to experiment and collect data. You will also need time to write a paper and put together a display or 'board'.
5. Plan Your Experiment: Give careful thought to experimental design. Once you have a feasible project idea, write a research plan. This plan should explain how you will do your experiments and exactly what will be involved. Remember you must design your experiment so that it is a 'controlled' experiment. This is one in which only one variable is changed at a time. The results are then compared to the 'standard' data you take originally before you change that one variable. Thus, you have designed an investigation with adequate control and limited variables to investigate a question. Also, in your experimental design, make sure you include sufficient numbers in both control (if applicable) and experimental groups to be statistically valid. The experimental design should also include a list of materials. Once finished with the experimental design (called 'procedure') all students are required to fill out the appropriate forms.
6. Consult with Your Adult Sponsor and get Approvals: You are required to discuss your research plan with an Adult Sponsor and

obtain a signature of approval. In reviewing your research plan, you should determine if additional forms and prior approval are needed.

7. Conduct your experiment: During experimentation, keep detailed notes of each and every experiment, measurement and observation in a log book. Do not rely on memory. Besides, judges love logbooks! Use data tables or charts to record your quantitative data.
8. Analyze Your Results: When you complete your experiments, examine and organize your findings. Use appropriate graphs to make 'pictures' of your data. Identify patterns from the graphs. This will help you answer your testable question. Did your experiments give you the expected results? Why or why not? Was your experiment preformed with the exact same steps each time? Are there other explanations that you had not considered or observed? Were there experimental errors in your data taking, experimental design or observations? Remember, that understanding errors is a key skill scientists must develop. In addition, reporting that a suspected variable did not change the results can be valuable information. That is just as much a 'discovery' as if there was some change due to the variable. In addition, statistically analyze your data using the statistics that you can understand and explain their meaning.
9. Draw Conclusions: Did the variable(s) tested cause a change when compared to the standard you are using? What patterns do you see from your graph analysis that exist between your variables? Which variables are important? Did you collect enough data? Do you need to conduct more experimentation? Keep an open mind - never alter results to fit a theory. If your results do not support your hypothesis, that's ok and in some cases good! Try to explain why you obtained different results than your literature research predicted for you. Were there sources of error that may have caused these differences? If so, identify them. Even if the results do differ, you still have accomplished successful scientific research because you have taken a question and attempted to discover the answer through quantitative testing. This is the way knowledge is obtained in the world of science. Think of practical applications that can be made from this research. How could this project be used in the real world? Finally, explain how you would improve the experiment and what would you do differently.

ELEMENTS OF A SUCCESSFUL PROJECT

1) Project Data Book:
A project data book is your most treasured piece of work. Accurate and detailed notes make a logical and winning project. 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 that units are included in the data tables. Make sure you date each entry.

2) Research Paper:
A research paper should be prepared and available along with the project data book and any necessary forms or relevant written materials. A research paper helps organize data as well as thoughts. A good paper includes the following sections.

a. Title Page and Table of Contents: The title page and table of contents allows the reader to follow the organization of the paper quickly.
b. Introduction: 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.
c. Materials and Methods: Describe in detail the methodology you used to collect data, make observations, design apparatus, etc. Your report should be detailed enough so that someone would be able to repeat the experiment from the information in you paper. Include detailed photographs or drawings of self-designed equipment. *Only include this year's work*.
d. Results: The results include data and analysis. This should include statistics, graphs, pages with your raw collected data, etc.
e. Discussion: This is the essence of your paper. Compare your results with theoretical values, published data, commonly held beliefs, and/or expected results. Include a discussion of possible errors. How did the data vary between repeated observations of similar events? How were your results affected by uncontrolled events? What would you do differently if you repeated this project? What other experiments should be conducted?
f. Conclusions: Briefly summarize your results. State your findings in relationships of one variable with the other. Support those statements with empirical data. (one average compared to the other average, for example). Be specific, do not generalize. Never introduce anything in the conclusion that has not already been discussed. Also mention practical applications.

g. **Acknowledgments:** You should always credit those who have assisted you, including individuals, businesses and educational or research institutions.
h. **References/Bibliography:** Your reference list should include any documentation that is not your own (i.e. books, journal articles, websites, etc.). See an appropriate reference in your discipline for format or refer to the Instructions to Authors of the appropriate publication.

   Three common reference styles are:
   APA (American Psychological Association) **Style**:

   http://apastyle.apa.org/
   http://owl.english.purdue.edu/owl/resource/560/01/
   This resource, revised according to the 5th edition of the APA manual, offers examples for the general format of APA research papers, in-text citations, endnotes/footnotes, and the reference page.