Esquimalt High School Student Science Fair Step by Step Guide to Success

1. **Pick your topic:**
   Research suggests this may be the most difficult part.
   Get an idea of what you want to study or learn about. Think about what you are interested in. 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.

Discuss the topic with Mr. Orme or a science fair mentor he refers you to.

Topic Review: Approved:_____ Needs Revision: _____ Date: _____

2. **Research your topic:**
   Go to the library, find and talk to experts and search the internet to learn more about your topic.
   Check with Mr. Orme, Esquimalt High School's teacher-librarian for sources of information on the topic area you are interested in. The school library website (www.esquimalt.sd61.bc.ca - click on "Library") provides access to lots of online services that can only be accessed for a fee. The school has already paid for your access to these services.
   Always ask "Why?" or "What if..?" Look for unexplained or unexpected results.
   Keep track of the information you collect. Record your sources (websites, magazines, people etc) as you collect information to prove that your work is your own and save yourself time later.

Discuss the sources you have used and the information you have collected with Mr. Orme.

Research Reviewed: Approved:_____ Needs Revision: _____ Date: _____

3. **Organize your information:**
   Organize everything you have learned about your topic. Narrow your thinking by focusing on a particular idea.

4. **Plan your time:**
   Choose a topic that not only interests you, but can be done in the amount of time you have.
   1. Identify your 'testable question'.
   2. Develop a time line to manage your time efficiently. You will need time to review your Research Plan with Mr. Orme. Some projects take longer because they need approval.
   3. **Allow plenty of time to experiment and collect data.**
   4. Allow time to write a paper and put together a display.

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 exactly you will do your experiments.
   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. You compare these results to the 'standard' data you recorded before you changed that one variable. Make sure your experimental design includes sufficient numbers in both control and experimental groups to be statistically valid.
   The experimental design should also include a list of materials.

Discuss your Research Plan with Mr. Orme or your science fair mentor.

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6. **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. Use tables or charts to record your data.

7. **Analyze Your Results:**
   1. 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.
   2. Did your experiments give you the expected results? Why or why not?
   3. Was your experiment preformed with the exact same steps each time?
   4. Are there other explanations that you had not considered or observed?

5. 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.
6. Statistically analyze your data using the statistics that you can understand and explain their meaning.

8. **Draw Conclusions:**
    1. Did the variable(s) tested cause a change when compared to the standard you are using?
    2. What patterns do you see from your graph analysis that exist between your variables?
    3. Which variables are important?
    4. Did you collect enough data?
    5. Do you need to conduct more experimentation?
    6. 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.
    7. 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.
    8. Think of practical applications that can be made from this research. How could this project be used in the real world?
    9. Finally, explain how you would improve the experiment and what would you do differently.

SUCCESSFUL PROJECTS INCLUDE:

1) Project Data Book:
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 data 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 and includes:

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, 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.
d. **Results:**
   The results include data and analysis. This should include statistics, graphs, pages with your raw 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 institutions.
h. **Reference List/Bibliography:**
   Your reference list should include all sources that are not your own (i.e. books, journal articles, websites, etc.). Go to the school website www.esquimalt.sd61.bc.ca and click on Library>>Cite it Right.
   For more information go to http://web.uvic.ca/~virsf/ or http://www.sciserv.org/isef/primer/index.asp