Science Fair Project Development Guidelines

Mohammad Haidar, Ph.D. Spring Branch Academic Institute

This Science Fair project development guidelines will provide students with an strategy to develop successful Science Fair projects for local, regional and national level competitions. The key to a successful Science Fair project is to understand that many major discoveries came from simple observations or asking a simple question. The discovery of gravitational force by Sir Isaac Newton began by asking a simple question "Why did the apple fall from the tree?" The discovery of penicillin by Alexander Fleming came from the simple observation of inhibition of bacterial growth around a mold colony in a culture plate. This was the greatest discovery in the field of medicine for treating bacterial diseases. Alexander Fleming received the Nobel Prize in 1945 for his discovery of Penicillin. Alexander Fleming described his discovery by saying *"*When I woke up just after dawn on September 28, 1928, I certainly didn't plan to revolutionize all medicine by discovering the world's first antibiotic, or bacteria killer. But I suppose that was exactly what I did*"*. So, if you can ask a question or make an observation in nature, you can make a great discovery. Let's begin your journey…….....

Steps of doing a successful Science Fair project: All scientist follow a standard stepwise method called "Scientific Method" to perform a scientific investigation.

1. **Problem/Question:** The first and most important step is to make careful observation in nature and ask a question or identify a problem that you like to solve. Once you found your Problem/Question, submit preliminary proposal for approval to your teacher. After your project is approved enter project information in Scienteer (Science Fair project management system). At the beginning Scienteer will ask you lot of questions about your project, you must answer them correctly. Depending upon your answer, Scienteer will populate relevant Forms for you, your parent, and outside supervisor to fill out.

2. **Background Research:** Do through research on your topic. Go to the school, local and county libraries, read Science Magazine and Journals, and search public database on Science, Engineering and Technology online. Remember you must be knowledgeable abound recent advancement and discoveries in the field of your interest to do a good Science Fair project. This will provide you with the background information need to put forward your hypothesis and help plan and design your experimental procedure.

3. **Formulate a Hypothesis:** Hypothesis is your educated answer / solution to your question or problem. Your hypothesis must be testable using scientific procedure. A typical

hypothesis is often presented in the form of a "IF……,THEN……."statement.

4. **Designing your experiment:** You must describe your experimental strategy in detail as follows:
   a) Materials, Instrument, Safety, and Location of Research:
      - Describe the location and facility where you will conduct the investigation.
      - Designate an adult supervisor during your experiment.
      - Describe the safety procedure you will implement during investigation. Also describe steps you will take in the case of accidental spill of any chemical, breaking of glass apparatus, etc. Remember the Rule**: SAFETY FIRST**.
      - List all materials needed. Where do you get those materials? Read the SDS (Safety Data Sheet) for each chemical. How to store, how to transport, how to handle, and what to do in case of accidental spill.
      - List and describe the Instruments you will need to complete the research project.
      - Investigation involving living animal or organism. All students should review the SEFH web site http://www.sefhouston.org/ or the International Science Engineering Fair web site http://www.societyforscience.org/ISEF/ for exact rules concerning both experimentation and project display
      - Experiment involving Vertebrate Animals. SEFH recommend use of invertebrates over vertebrate animals. Studies involving behavioral studies are encouraged over physiological and interventional studies. Animals may not be expose to any chemicals or conditions that may be harmful, including dissection, surgical intervention. Experiments involving animal sacrifice is not allowed. Teacher and SRC approval needed for animal experimentation.
      - Experiment involving Human Subjects. All rules for use of vertebrate animals also apply for experiments involving human subjects. Teachers, IRB, and SRC approval needed for human subject experiments.
      - Working with Bacteria/Fungi and Other Microorganisms. Experiments involving microorganisms or fungi must be performed under professional supervision and should not be done at home**.** SRC approval is required for experimenting with Bacteria and Fungi.
      - Define your independent and dependent variables. Independent variable is that you change in an experiment. You should change only one independent variable at a time. The Dependent variable is that you measure in an experiment and is dependent on independent variable.
      - Design a controlled experiment. Your experiment must contain a control group (without independent variable) and an experimental group (with independent variable). You will compare the experimental group with control group to evaluate the effect of independent variable. For example if you are doing an experiment to evaluate the effect of caffeine on heart rate. The control group

will drink water and experimental groups will drink water containing different amounts of caffeine. Caffeine in this experiment will be independent variable, and heart rate will be dependent variable.

- Project Log Book. You must record all experiments in a composition book. All pages in the not book should be numbered. Keep first two pages empty for making table of contents after all the experiments are completed. Record all experiment with date and time. Collect data and record in data table. You must record everything in ink and it should be legible. Remember this Log Book must be presented to the Science Fair judges. This Log Book will demonstrate how meticulous, sincere and through you are in designing and executing your experiment. This log book is most valuable evidence of your experimental performances. A well written Log Book will impress the judges, and also may receive an award for writing Best Log book. Good notes show consistency and thoroughness to the judges and will help you when writing your research paper.

5. **Collecting and Analyzing Data:**
    - Collecting Data. Make a data table and collect both quantitative and qualitative data of your experiments. Quantitative data are measurable, while qualitative data is your observation through your sens. For example if you are doing an experiment on effect of fertilizer on plant growth. The growth measured using a ruler will be quantitative data but your observation of the plant state of health through your senses would be qualitative data. Take picture of experimental setup, control and experimental groups.
    - Analyzing Data. After your data collection is complete, it is time for data analysis and making sense of your data. Organize the data and perform statistical analysis. Plot X-Y graphs with independent variable in the X-axis and dependent make variable in the Y-axis. Play with the data and plot different graphs to best visualize your result. Examine the data tables and graphs to see any pattern that comes out of your data.

6. **Conclusion:** Make a conclusion after critical analysis of your data. Does the independent variable caused a change in the dependent variable? Is your data statistically significant? Does the data support your hypothesis? If it does, that is fantastic! If not, you need to dig through the data and look for experimental errors that might have caused this different outcome. Did you followed the experiment exactly the same way every time? As long as you follow the experimental procedure, and completed the investigation following Scientific Method and drawn your conclusion, even though your data did not support you hypothesis, you accomplished your Science Fair objective. Scientists often found results that are not expected. Some of these results found to be more interesting and ground breaking than would be expected result. For example, Frederick Griffith in

1928 discovered transformation principal, which eventually led to the discovery of DNA as the genetic material, while he was working on developing vaccine against Pneumonia during post world war Spanish Influenza pandemic. If your results do not support your hypothesis, that is O.K. Accept the result, try to explain why you obtained different results than what you predicted.

7. **Communication / Publication**: Publication or preparing for presentation for the Science Fair is the final and most important step of your Science Fair investigation. You worked hard on your Science Fair proposal writing, designing and executing the experiment. Now is the time to sale your product. Remember you have approximately 6-8 minutes to present your project to the judges. Write abstract eloquently to communicate your result, your data table, graphs, and illustrations, pictures should be clear, colorful and self-explanatory. SBAI Science Fair will follow District and SEFH presentation guidelines. Some general rules for presentation and poster display are listed below.
   a) All projects must follow rules and guidelines of Science Engineering Fair of Houston. http://www.sefhouston.org/
   b) The display of anything that could be hazardous to the public or facility is prohibited. This includes, but is not limited to, the following:
      - Living organisms, including plants and animals
      - No chemical substances may be displayed
      - No liquids, **including water**, may be displayed
      - Any containers of commercial products displayed should be empty. This includes food products, cleaning products, etc.
      - No open flames permitted.
      - No cultures of mold or bacteria may be exhibited
      - No food may be displayed
   c) Restriction on photograph display. The SEFH web site should be checked for specific restrictions. Photographs showing the student doing the research are allowed. Appropriate credit should be provided for photographs use.

Science Fair time lines: Create a detailed time line of completing the projects

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Preliminary Science Fair Research Proposal

Project Title : _____

Name: _____ Grade _____

Team Member: _____ _____

Problem / Question:	Write couple of sentences stating the problem or question
Hypothesis:	Write your hypothesis in 1-2 sentences.
Experimental Design:	Write your research plan and procedures:
Independent Variable	Identify your independent variable:
Dependent variable	Identify your dependent variable:
Importance/ significance:	Write 3-4 sentences describing the relevance or importance of your project:

Project approved: yes / no Revisions needed: yes / no

Date approved: _____ Teacher Signature: _____

Science Fair Research Progress Checkpoints

Date	Science Fair Research Progress Report	Parent Signature*

*Parent signature is required for students to receive weekly grades for working on the Science Fair Project at home.

Links to important resources:

Scienteer Student Guide: https://www.scienteer.com/downloads/student_guide.pdf

ISEF Rules: https://www.scienteer.com/downloads/isef/isef_rules.pdf

SEFH web site: http://www.sefhouston.org/

International Science Engineering Fair web site: http://www.societyforscience.org/ISEF/

PubMed: https://pubmed.ncbi.nlm.nih.gov/