Steampunk Scientific Exposition:
A Turn of the Century Science Fair

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Background

The Great Exhibition of the Works of Industry of all Nations was organized by Prince Albert, Henry Cole, Francis Henry, George Wallis, Charles Dilke and other members of the Royal Society for the Encouragement of Arts, Manufactures and Commerce as a celebration of modern industrial technology and design. Held from May to October 1851 at the Crystal Palace in London, it is widely considered to be the first World's Fair.

In the spirit of this great historical event, Pop Goes the Classroom and the League of Extraordinary Academics has created the Steampunk Scientific Exposition: A Turn of the Century Science Fair. This community science fair will encourage focus on the scientific developments of the age of Steampunk, both real and imaginary.

This Handbook has been developed by the staff and volunteers at Pop Goes the Classroom and the League of Extraordinary Academics and is intended as a quick-reference guide for those who are planning to host or participate in the Steampunk Scientific Exposition: A Turn of the Century Science Fair.

A science fair is generally a competition where competitors create a project related to science, mathematics, engineering, or any topic to be studied using the SCIENTIFIC METHOD. This turn of the century science fair looks at the cutting edge science of the steampunk era which is based on a fantastical version of the Victorian/Edwardian Era. This is the inaugural year for the Steampunk Scientific Exposition.

There are two age categories for this year's event:

Family (for children through age 15), Adult (for ages 15 through Reanimation)

PLEASE NOTE: While this is a 10 page document it is not meant to overwhelm but only to offer example and answer questions. It really all boils down to taking your passion and supporting it with scientific method. Even if that science is suspect by modern terms, if it fits within the genre that's exactly what we're looking for.

If you have ANY questions please send them to: spsf@phoenixcomicon.com

Rules, Regulations, and Hints

The Victorian concept of fair play is at the foundation of the rules and regulations for the Steampunk Scientific Exposition.

General Guidelines.

- The project must be the work of those registered for the Science Fair. All participants must be credited for their participation.
- Before the project is started, each student /team/group should develop a PROJECT PLAN. This plan will be very helpful as you carry out your project. With the SCIENTIFIC METHOD as your guide, plan out:
  - What your question is
  - How/Where you're going to research your question
  - What experiments will you do to answer your question
  - What materials you will need for the experiments
  - How long will the experiment take
  - How will you record your results/measurements
- A Project Journal is required for each project. This journal is a diary like HISTORY and detailed RECORD of the project as you are doing the work. The journal WILL be judged as part of your submission to the Exposition and its absence will result in lower scores.
  - See section 8.0 for more details on the use and content on the Project Journal
- All projects must use the standard display board (see Section 9.0 for an example)
- The display board layout should follow the SCIENTIFIC METHOD
- The size of the exhibit must not occupy a space in excess of 30 inches deep- front to back: 36 inches wide –side-to-side; and 108 inches high – bottom to top. ***If you need an exception, please contact us: spsf@phoenixcomicon.com***
- The entrants' names or other identifying information including photographs may NOT appear on the front of the project.
- Relevant written materials should be displayed with the Project Journal.
- Entrants must demonstrate through written reports, pictures, charts, graphs, diagrams, and tables that research was accomplished. The section in the Project Journal on research should show where the research was done and what was derived from each source.
- All exhibits should have a freestanding backdrop. No commercial models or kits should be allowed as exhibits.

- No ACTUAL live animals, preserved animal, dangerous chemicals, dangerous equipment, cell cultures, bacteria, molds, microorganisms, soil, mud, liquids (including water), and solvents may be exhibited at the exposition.
- Only plants and/or animals that do not present any danger or possibility of harm to exposition participants or the general public may be used in displays. It must be understood that plants and or animals must be able to thrive with minimal care for 4 days. It must also be understood that there will be no possibility of harm or discomfort to any plant or animal involved in a display.

Prizes and Awards

- A personalized Certificate of Participation will be presented to all participants of the Exposition.
- Honorable Mention Medals will be awarded to a number of projects in each group, as determined by the Judging Committee.

Tips for Participants

In supporting your Science Fair efforts, the following should be useful:

- The Scientific Exposition is designed to help you strengthen your ability as a citizen scientist.
- The Scientific Exposition is a method to teach the concepts of Scientific Method to solve problems.

The SCIENTIFIC METHOD is not just use to solve scientific problems but can be used to solve all types of problems and make most major decisions in their lives.

- the Scientific Exposition is not a high stakes competition and should be approached as a fun way to share interests with your friends and family.
- Design a project that is safe.
- Feel a sense of pride and accomplishment when the Scientific Exhibition is over. You and you have earned it

The Scientific Method

The Scientific Method is an approach frequently used by scientist and engineers, both young and old, to study and analyze what they see in the world. It is most important that students realize that the scientific method is a form of critical thinking. The scientific method, as it could be applied to a science fair project, should include the following phases:

1. Form question
2. Research (planning, bounding the question, evaluating current evidence)
3. Forming a hypothesis
4. Experimentation (testing the hypothesis)
5. Analysis and evaluation
6. Conclusions

Work done in each of these steps should be recorded as they are being done in your Project Journal.

1. Form Question

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. Be as specific as you can when first writing a description of the problem. This will help focus your efforts in the following phases.

Your subsequent research may lead to a better description of the problem.

A simple example of a topic/problem might be “How can the findings of Tesla be harness into a personal device?” or “What allows a fairy to fly?”

2. Research.

The research phase of you project includes many activities. Some of the things you will want to do during the research phase include:

- To learn more about the problem you have selected
- To understand the variables associated with your problem
- To understand your problem well enough to develop a hypothesis
- Show a direct connection between the Question and the Hypothesis
- Develop a time line to manage your time efficiently
- More detail about each of these areas is provided below.
- To learn more about the problem you have selected
- Organize everything you have learned about your topic. At this point, you should narrow your thinking by focusing on a particular idea.

- Review published materials related to your problem or question. This is called background information
- Go to the library or internet to learn more about your topic.
- Always ask ‘Why or What if’. Look for unexplained or unexpected results.
- Talk to professionals in the field.
- To understand the variables associated with your problem
- Independent (manipulated) variables – those variables you will change when conducting experiments
- Dependent (responding) variables – those variables to be measured as you change the values of the independent variables
- Controlled variables – those variables being kept constant throughout the experiment
- To understand your problem well enough to develop a hypothesis.
- It is important that your hypothesis is testable in the amount of time you will have to spend on the project and with the resources available to you.
- Read the following section before starting your research to help focus some of you research efforts on getting the information you need to form a hypothesis.
- Develop a time line to manage your time efficiently.
- Develop a time line to research, experiment, collect date and record information in your Project Journal
- You may end up wanting to repeat some experiments if you are not satisfied with the results on your first try
- You will also need time to write a report and put together a display or board

It is important to keep extensive notes in your Project Journal throughout the Research phase. You will be doing a lot of reading, talking to professionals and other ways of collecting information. There is no way you can remember everything you learn in the research phase. Write down what you learn for later reference.

3. Hypothesis

To answer your question a hypothesis will be formed. This is an educated guess regarding the question’s answer. Educated is highlighted because no good hypothesis can be developed without research into the problem.

A scientific hypothesis has to be testable. Your testing must be able to determine if your hypothesis is true or false. All hypotheses will not, and do not need to, turn out to be true. A good form in which to write the hypothesis is

If _________________ is changed, the ________________ will change in the following way

(independent variable)   (dependent variable)

Not that the manner in which the dependent variable changes is called out. Do not just say that the dependent variable will change when the independent variable changes.

Examples of controlled variables in this example are:

- the oven used
- the recipe used
- the pan/dish used
- the temperature of the cake mixture at the start of baking

4. Experimentation

Once the hypothesis has been established, it is time to test it. An experiment is designed to prove or disprove the hypothesis. In designing the experiment and identifying the appropriate procedures it is critical that only one variable – a condition that may affect the results of the experiment – is changed at a time. This makes the experiment a “controlled” experiment. Testing and experimenting can occur in the classroom, in the field, on the blackboard or the computer. Results of testing must be reproducible and verifiable. In many instances, it is best to repeat the experiment more than once to see how the results change.

Make an initial determination of independent variable values for which you wish to run your experiment.

As you run your initial experiments and collect the dependent variable results, you may determine that additional values of the independent variable need to be tested. That frequently happens when conducting experiments. Here, the experimentation and the data analysis over lap and can be iterative.

That is, you conduct some experiments; you analyze the data and determine what additional experiments need to be conducted. Be sure to allow for such additional testing when you develop your time line.

During experimentation, keep detailed notes of each and every experiment, measurement and observation in a Project Journal. Do not rely on memory. Besides, judges love Project Journals. Use data tables or charts to record your quantitative data. Give some thought as to how you want to organize the collected data. Allow for plenty of room to record your results. Remember, you do not know exactly how your experimentation is going to go. If you did, you would not need to do it.

5. Analysis and Evaluation

When you complete your experiments, examine and organize your findings. Use appropriate graphs to make “pictures” of your data. Graphs very often provide a view of the data that will not be seen when the same data is in a table. 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? Did you repeat the experiment enough times to show that the results are repeatable? 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, analyze your data using the data that you can understand and explain their meaning.

What patterns do you see from your graph analysis that exists 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 my 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

6. Conclusions

The focus here is on describing why the hypothesis is correct, mostly correct, partially correct, or false (any of these is OK). Other important parts to this section include the changes you would make were you to do the project again, further experimentation needed, and additional research that would extend your understanding of your problem

The Project Journal

An essential part of experimental science is a well maintained Project Journal which records all your work.

It is a place for you to record your data and the procedure you undertook. It is the place to write down all your ideas: from the scientific background for carrying out the work to the analysis and interpretation of the data. It is the place where you can make notes and attach documents about your findings, even if, at the time, you think they are unimportant. In essence it contains all the evidence for your findings and your logical deductions.

A Project Journal should be thought of as a diary of activities done during the project that are described in sufficient detail to allow another student to replicate the steps. The level of detail of the entries should be grade appropriate.

Guidelines for project journals vary widely. However, some fairly common guidelines include:

- the project journal is typically permanently bound (a spiral ring notebook works well)
- pages are numbered
- entries should be made as the project progresses – this is really important
- the date when the entry is made should be provided
- the name of the person making the entry should be provided
- entries are typically made with a permanent marker, e.g. a ballpoint pen
- if an entry made earlier is found to be incorrect, do not remove the entry, make another entry correcting the earlier incorrect entry.

Included in a Project Journal, but not limited to, is a written record of

- a plan, with a time line, for conducting the project
- references
- all the work done on the project
- how the question the project is attempting to answer was derived
- the research conducted
- the hypothesis with a discussion showing that the hypothesis is testable
- a description of the experiment designed to test the hypothesis
- a list of materials and equipment used
- the data collected while conducting the experiment (both good and bad data) with dates
- the ideas generated
- observations and insights
- the analysis of the data collected (both good data and bad data)
- the conclusions derived on a project
- thoughts on future research and experiments

While it may be a bit advanced, particularly for some of the younger participants, an excellent reference on Project Journals, also called Lab Notebooks, is found at http://level1.physics.dur.ac.uk/skills/labbook.php.

Middle school students should find the following useful when planning a Project Journal

www.science-house.org/middleschool/essays/labbook.html

And, for the elementary students the following should be useful

www.iwacc.org/temporaryfiles/sciencefairlogbook5thgrade.pdf

Project Display

One cannot overemphasize the importance of properly displaying the results of your projects. The ONLY visibility the judges, your teacher, your friends, or anyone else has to what you did for your project is through the display board you prepare. It is very important that you cover your problem on you display board and report. The judges will read your ProjectJournal to help them understand your project. Included in what you might want to present are:

- present the important phases of the project in an orderly manner?
- the six phases of the Scientific Method presented above are to be used on the display board (see next page for example project board)
- clearly present the data and the results
- show that conclusions based on replicated experiments were appropriate
- material that shows you understand the research
- cite scientific literature, popular literature (local newspaper, Reader's Digest), rather than citing only internet literature (web sites, search engines)
- indicate what further research is warranted

English is the language to be used on the display board and in the Project Journal

Dates and Deadlines

Setup and check in is scheduled for Friday, May 24, from 10:30AM to 2:00PM in West 105C at the Phoenix Convention Center.

The exhibition will be open to the public through Sunday, May 26th. Please plan on picking up your project at 5PM.