How to Do a Science Project

The scientific method is a pattern of inquiry that forms a structure for advancing scientific understanding. By identifying a problem, forming a hypothesis, designing and conducting an experiment, taking data, and analyzing the results, scientists have answered questions ranging from the simplest to the most complex. Yet the process can be broken down into several distinct steps.

We've tried to be quite explicit in outlining the steps of the process. And we believe doing all the steps is appropriate for a student doing an individual project either as a classroom project or for a competitive fair. On the other hand, teachers doing projects in the classroom might choose to skip

some of the steps, depending on the level of the students and the time available.

1. Identify an area of interest

· Decide what area of science is of interest, for example physics, biology, chemistry, or engineering.

· Narrow the area of interest so that it is more specific, for example, solar energy, plants, or structures.

2. Gather information

Our knowledge of the world comes from ideas and observations made

by ourselves and others. Many of these observations are recorded in

scientific literature such as scientific journals, government documents, periodicals, websites, and books.

Search for information in the area of interest in the library and on the Internet.

· Begin in an organized manner by using reference material such as the Reader's Guide or the card catalog.

· Keep in mind that most scientific journals publish information pertaining to a single field of science. For example, the American Journal of Physics and the American Journal of Botany relate to specific topics. On the other hand, some periodicals, such as Scientific American and Science, cover a range of scientific issues.

· Make sure to record the author(s), the title of the articles and the journal, the page numbers, the website addresses, and any pertinent publishing information for every reference used.

3. Select a specific problem within the area of interest

It is important to narrow the research area to a specific problem. One common error is to try to do too much. This process should be repeated as more information is gathered.

4. Gather more information

It may be necessary to return to the library and look for information

that deals **directly** with the specific topic. Look for ideas that may help in the experimental design or for ideas that complement the topic.

5. Plan an investigation or an experiment

Keep these things in mind when designing the experiment:

· What are the variables?

· Are the variables appropriate?

· Are the variables independent?

· Are the variables measurable?

· What kind of controls will be included?

· What data will be collected?

· Is the experiment designed appropriately if the results are to be analysed statistically?

· Are the materials and equipment available?

· Are there any special safety or environmental concerns?

If the project uses mathematical or computer modelling instead of experimentation, how will the results be validated? Is there a way to test the model?

When the approach to the experiment is clear, it's time to write a proposal. The proposal should describe the experiment in detail, including the required

materials and equipment, any safety concerns, and the expected results. It will allow the teacher or the science fair review committee to evaluate the appropriateness of the project. Include the following in the proposal:

· Background information: A review of the literature summarizing information related to the project. Be sure to cite all references.

· Purpose and hypothesis: A brief description of the purpose of the project and a statement of the hypothesis.

· Experimental design: A detailed explanation of the research plan and the materials needed is included in this section. The methods and materials should be described in a way that anyone could duplicate the experiment(s).

· Literature cited and references: Include a list of all authors and websites cited and list of supplemental references.

6. Obtain approval of the proposal from the teacher or science fair review committee

7. Conduct the experiment(s) and collect data

· Record the data in a notebook. Record the data immediately, completely, and accurately. (It is better to record too much data then not enough.)

· Record other observations about the progress, take pictures, and make sketches. Are some things not going according to plan? Are there any surprises? These observations may be important later.

8. Organize and report the results

Most data involve numbers and can be quantified. Therefore, using statistics, graphs, tables, and charts is appropriate. Remember, this is the portion of the research on which conclusions are based. The better this portion is presented, the easier it is to formulate conclusions. Data should be presented:

· In written or word processed form with graphs, table and charts

· Without conclusions or value judgments.

9. Analyze and discuss the results

Think about the results. What do they mean? How should they be

interpreted? Discussing the various aspects of the experiment and observations provides additional context for the results shown by the data. Look for patterns, relationships, and correlations.

10. Formulate conclusions

Was the hypothesis supported or disproved? This is an important step and the student must emphasize what has been learned from doing the project. Conclusion statements must be supported by data collected and related directly to the purpose and hypothesis.

11. Assess the project

Did the experiment go as planned? If so, were there other interesting

aspects that deserve follow-up research? If the experiment did not go as planned, why not? Was the hypothesis too broad? Was the experimental design inappropriate? If the hypothesis was not confirmed, what was learned?

Answers to all these questions can help form recommendations for further research.

12. Write the final report

The final report, whether it is to be presented orally or in written form, should include the following:

· Title

- This should be self-explanatory, i.e., the reader should be able to tell what the research is about without reading the paper. Avoid technical jargon in the title.

· Abstract

- This should be a brief condensation of the entire report, 150 to 250 words for advanced students; shorter for students in lower grade levels. This should be written last.

- This should include the purpose, a very brief explanation of the methods, and the conclusions.

· Introduction

- This should contain the background information, along with cited references and a statement of the problem or purpose.

· Methods and Materials

- This should contain an explanation of how the work was done (the experimental design).

- It should describe materials.

What was used and how?

This should be stated briefly and clearly so that others can repeat the experiments.

· Results

- This should include a written explanation of the data in a straightforward manner, with no conclusions or judgmental statements.

- It should use tables, graphs, pictures, and other types of data where appropriate.

· Discussion

- This should explain what the results mean.

- It should describe any patterns, relationships, and correlations.

· Conclusions

- This should present the important conclusions that the reader needs to know.

- It should include a discussion of the problems encountered and any recommendations for further research.

· Literature Cited

- This should list all published information referred to in the text of the paper alphabetically by author. Other references can be used and referred to in a bibliography.

· Acknowledgements

- This should list and give credit to the people who were helpful in providing materials and equipment or ideas.

13. Present the results orally

If this is a project for the classroom, make an oral presentation about the work to the class. If the project is for a science fair, prepare a display (see

science fair officials for details) and prepare to discuss the project with the judges. In either case, be prepared by:

- becoming knowledgeable about the project
- practicing the presentation before others
- talking clearly
- acting interested
- dressing neatly