

SCIENCE FAIR

WRITING A SCIENTIFIC RESEARCH PAPER FOR A SCIENCE PROJECT

Scientists, regardless of their level of achievement, are only as effective as their ability to communicate to others, in spoken or written word, the results of their endeavors. A scientific paper is, very simply, a clearly written, concise report of an experimental research project.

The Physical Arrangement of the Written Report

The following section establishes the basic written report requirements. Familiarity with the basic techniques and requirements will help you to read and understand scientific publications, give you an inside view of how scientists think, and help you to write your own scientific paper describing the results of your research experimentation. The main point to keep in mind is to think before you write, then rethink, revise, rewrite, reread again and again. Make it clear and concise.

The paper must include the following (in this order):

- A. **ABSTRACT** - In preparing your abstract, you must keep in mind that:
 1. The abstract is a concise summary of your work.
 2. As the first sheet of your research paper, it will help the reader form an opinion of your work.
 3. The physical form of the abstract is as follows:
 - a. Limit the abstract to 3 paragraphs
Purpose
Procedure
Conclusion
 - b. Type single-spaced
 - c. Limit the abstract to about 200 words or less.
- B. **SAFETY SHEET** - all safety hazards must be identified. If no safety hazards exist, a statement to that effect must be made.
- C. **ENDORSEMENTS** - when humans as test subjects or non-human vertebrates are used, endorsement sheets are required.
- D. **TITLE PAGE** - your title should be concise and clear.
- E. **TABLE OF CONTENTS** - include page numbers.
- F. **ACKNOWLEDGMENTS** should give credit to those who have helped you in your investigations; for guidance, materials and/or use of facilities.
- G. **PURPOSE AND HYPOTHESIS** - should state precisely the question you are attempting to investigate. Include your hypothesis or the expected outcome of your test.
- H. **REVIEW OF LITERATURE** is to report to the reader background information and/or work done in the past that pertains to your project. These references should be properly documented and listed in the section "Reference List". **Traditional footnotes are not to be used for citing references.**

- I. **MATERIALS AND METHODS OF PROCEDURE** should be a simple chronological account of what was done. The explanation of what was done must be clear and detailed enough so that the reader can duplicate the work. The apparatus and materials used should be listed - explain the workings of any apparatus you constructed or used. Drawings, diagrams that are clearly labeled, and photographs are appropriate if they enhance and clarify your explanation - do not use them as filler.
- J. **RESULTS** should be organized in tables and/or charts with graphic presentations, when applicable. Choosing the appropriate graph is important. The graphs should be presented so that they are easily read by someone not familiar with the work. If quantitative data are not involved, a day-by-day log may be used in place of the tables and charts. In either case, care should be taken to insure accuracy and clarity. A discussion section should follow the data section to include your evaluation and interpretation of the data and/or results of your investigation.
- K. **CONCLUSION** should be a concise evaluation and interpretation of the data and/or results. The conclusion should be limited to the results of the investigation and should refer to the stated purpose and hypothesis. Experimental error should be estimated and considered when drawing the conclusion.
- L. **REFERENCE LIST** is a list of published articles, books, and other communications actually cited in the paper. Sources should be current. The Reference List section is arranged alphabetically according to the author/editor's last name when it is known, or the first significant word in the title if the author/editor is not known. The correct style to use for citing references in the Reference List section is discussed in detail in the *Publication Manual of the American Psychological Association*, Fourth Edition or later.

TECHNICAL POINTS OF SCIENTIFIC WRITING

In preparing the paper the author should be concerned with the following mechanics:

- A. The paper must be typed, double spaced and have at least one-inch margins.
- B. Use only one side of the page.
- C. The font style and size (for example 10 or 12 pt Times New Roman) should be appropriate for a scientific paper.
- D. The paper must be neat and legible.
- E. There is no limit on the number of pages permitted in the project session portion of the exposition.
- F. The last name of the student listed on the first line of the abstract should appear at the top of each page.
- G. Tabular information should be kept to a minimum. Each table, chart, or drawing should not be more than one page in length and tabular data should not be duplicated in the text. Headings for tables and columns should be brief. Tables, charts, and drawings should be done on standard 8 1/2 x 11" paper.
- H. Graphs should be suitably titled and have both axes correctly labeled. Do not forget to include the correct units of measurement for any numbers.
- I. Photographs should be of good quality and contrast, and should have captions typed under them.

DESIRED QUALITIES OF SCIENTIFIC WRITING

The following points should help you to write your paper in an acceptable scientific style:

- A. When writing the first draft, do not start until you have clearly thought out your paper; the desired final result should be a clear and understandable paper.
- B. The tone of the paper should be established as one of calmness and objectivity.
- C. Learn to use the technical words that save space or that convey meaning better than common words; by all means avoid the use of vague terms.
- D. Sentences should be short and simple.
- E. The use of the 1st person "I" or "We" should be avoided whenever possible. Terms such as "The research experiment" or "The exhibitor" are examples of 3rd person usage. Third person is the preferred method for scientific writing. While scientific writing demands detachment and impartiality, do not be afraid to use "I", if the clarity and simplicity of the sentence are improved.
- F. After you have written your first draft, reread, revise, and rewrite it. Put yourself in someone else's mental shoes and read it slowly and thoughtfully. Have you omitted any steps? Are the steps in the proper order? Do your sentences say what you want them to say? If possible, have someone else read it; if not, put it away for a few days and then reread it yourself. Your paper must be an accurate report of what you have done - check and recheck your calculations, references, spelling, and grammar.

UNDESIRED QUALITIES OF SCIENTIFIC WRITING

Many of the faults in scientific papers can be traced to editing failures - objective reading of the many drafts of your paper will reveal fallacies and other faults that can and should be eliminated from your final draft. Errors to avoid may include:

- A. An illogical or unrelated grouping of facts.
- B. An unjustified switch in point of view as indicated by a change of subject or voice.
- C. The omission of vital facts or steps in procedures, interpretations, or conclusions.
- D. The needless repetition of facts.
- E. The imprecise use of words, the use of words in a manner peculiar only to the author or a small group, or the use of words only for the sake of the use of words.
- F. The inclusion of inaccurate or improper use of paraphrases or references.
- G. The exclusion of valuable data that are unfavorable to the conclusion.
- H. The drawing of conclusions not supported by the facts and data presented in the paper.
- I. Inaccuracy in calculations, spelling, grammar, and quotations.
- J. The lack of objectivity.
- K. Omitting literature citations in the text of the Review of Literature.

ORAL PRESENTATION

In presenting your project to the judges at a science exposition, the following approaches are proven successful

A. INTRODUCTION

- name(s), age, school.

B. ACKNOWLEDGMENTS

- give credit to those whom you have contacted and to those who have helped you.
- any work done in the past pertaining to your project.

C. PURPOSE AND HYPOTHESIS

- state exactly what the investigation is attempting to discover.
- make a prediction about the outcome.
- how did you get interested in this project? Reason for choosing it.

D. BACKGROUND INFORMATION

- background explanation for your project (to familiarize the judges), scope of your study, etc.

E. PROCEDURE

- be complete - do not leave out necessary details.
- proceed in a logical manner, telling what you did step by step.
- use visual aids: charts, pictures, graphs, etc. Point to your display, but stand aside when you do this
- explain how your apparatus was used. If you constructed it yourself, tell the judges you did, if not, give credit to those who helped you. Judges are more interested in your results and conclusions than in the apparatus.

F. RESULTS (DATA AND DISCUSSION)

- explain both your controls and your experimental variables.
- remember to use proper units of measure with your data.
- point to graphs, charts, etc., when you refer to them.

G. CONCLUSION

- state in a concise and logical order the conclusions you can validly draw from the experimentation you have done and the data and/or observations obtained.
- admit any deficiencies or limitations in this regard - judges can respect this.

H. FUTURE PLANS

- be sure to tell how you plan to continue your project.

I. ANY QUESTIONS

- when you have finished, ask the judges if there are any questions they would like to ask.
- when they ask you questions, think before you answer them. Answer slowly! If you don't know the answer say, "I'm not sure but I think..."
- if they ask you a question that is not related to your project and you don't know the answer, then say, "I really haven't been concerned with this in my project, but it will be interesting to look into."
- thank them for any suggestions they may have for bettering your research.

J. OTHER SUGGESTIONS

- speak slowly!
- be forward but polite, dynamic, and above all interested in what you are doing.
- remember that you are a salesperson and therefore your job is to sell your product to the judges. The judges are interested in your work - which is why they are judging you.
- your presentation should not exceed 10-15 minutes.