

Organization of Scientific Research Papers

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This paper greatly expands upon a handout originally prepared by an unknown author for distribution to students in introductory earth science courses at Dartmouth College. The work is presented here without copyright, although acknowledgement is (of course) appreciated. This document is available at <http://kilburn.keene.edu/Courses/Reference/Papers/Organization.html>

Introduction

A scientific paper, whether it is a class term-paper or the publishable results of an experiment or investigation, should reflect the application of the Scientific Method. Recall that the Scientific Method involves asking questions, based on some initial set of observations. The creative scientist then proposes one or more hypotheses or possible answers to the questions, and then proceeds to design and conduct experiments to test these hypotheses. These experiments yield new observations that might both help answer the previous questions as well as lead to new questions.

A scientific paper should be well organized, normally including the sections listed below, which are clearly delineated by appropriate headings and sub-headings. Your textbook and the journal articles you read in your research could serve as role models for how you might organize your paper. Note also that these books and journal articles usually contain lots of figures, charts, diagrams, tables, or other illustrations—often a scientist creates the figures she will use to illustrate her point and then writes the paper around those figures! Finally, be aware that science progresses only by building upon the work of others. In order for this system to work well, however, scientists must give proper credit to the others from whom they've obtained ideas, facts or data.

Components of a Scientific Paper

Introduction

The introduction should provide sufficient background information to allow the reader to understand and evaluate the paper better. A good introduction will state the topic of the paper, provide enough background information to orient the reader, review previous work on this problem, describe the methods used in the research and briefly state the principal results or conclusions. It is in the introduction that you should present the basic questions that you are asking, what the observations are that lead to those questions, and what the hypotheses were that you set out to test.

Body

The body of the paper should deal with the topic in a clear concise way. Use sub-sections with appropriate headings as needed. The ideas presented in the paper should be organized in a logical and consistent order, and the discussion should flow from thought to the next. Strive for correct grammar, spelling and a clear style. A writer never achieves this goal with just one draft.

It is in the body where you describe the observations and information, the data, you obtained from the experiments you conducted, as well as describing the experiments themselves. An experiment can include going to the library to look up information as well as going out into the field and making your own detailed observations of the environment around you. If you do conduct a controlled experiment in either a laboratory or field setting, you need to describe your procedures well enough that others could reproduce your experiment if they desired.

Figures

Figures—charts, tables, diagrams, photographs, or other illustrations—can be extremely helpful to a scientist who is trying to communicate his ideas, observations, or data to others. Many scientists outline their papers by deciding on what figures, graphs and tables they need in order to convey their story, and then fill in the text around these figures. The importance of figures in conveying scientific ideas cannot be overemphasized—just take a look at your text book or the journal article you are reading!

All figures should be neat and legible, should have a caption, and should be referenced from within the text of your paper (why include a picture if you don't discuss it in the body?). If the figure has been copied or adapted from another source, that source must be properly acknowledged in the caption and listed among your other references.

Conclusions

Discuss your findings in a way that leads logically to your conclusions. State the evidence for each conclusion as clearly and concisely as possible. Be sure to point out any exceptions to your general conclusions, discuss the assumptions you have made, and recognize any unresolved issues. It is in the conclusion that you discuss whether or not the observations and information you collected from your experiments validate the hypotheses you started with, answering your original questions.

References Cited

This is where all the references cited in the paper are fully listed. Often the list of references is the most important and useful section of a scientific paper. There are many different formats for reference citations, but perhaps the simplest is to indicate the author's last name and the year of publication, as outlined in Hansen (1991). A similar style, CBE scientific style, is promulgated by the Council of Science Editors (Council of Biology Editors, 1994). Additional details on citing references and formatting reference lists, and examples, are given in a separate document.

Title and Abstract

For papers that will be published for other scientists to refer to, the title and abstract are very important. Other scientists will first notice your paper in the table of contents of a journal, and will be deciding on the basis of the title alone whether to look further at your paper. "The title should be the fewest possible words that adequately describe the content of the paper" (Day, 1979, p. 8). In other words, it should be descriptive, and the key word here is adequate.

If other scientists do decide to read your paper further, their next step will likely be to read your abstract and look at your figures. The qualities of an abstract are best summarized by Landes (1951): “The abstract is of utmost importance, for it is read by 10 to 500 times more people than read the entire article. It should *not* be a mere recital of the subjects covered, replete with such expressions as ‘is discussed’ and ‘is described’. It should be a condensation and concentration of the essential qualities of the paper.” Although the abstract appears first in the report, it is usually written last.

Conclusion

The point in writing a scientific paper, or any paper for that matter, is to effectively communicate an idea or some information to your reader. A well-organized paper, with a logical flow to the discussion, an interdependent support between figures and text, and with appropriate acknowledgment of sources achieves this goal much more readily.

References Cited (in this paper)

Council of Biology Editors, 1994, *Scientific style and format : the CBE manual for authors, editors, and publishers*, 6th edition, Cambridge University Press, New York. 825 p.

Day, R. A., 1979, *How to write and publish a scientific paper*, ISI Press, Philadelphia, 45 p.

Hansen, W. R. (editor), 1991, *Suggestions to authors of the reports of the United States Geological Survey*, 7th edition, U. S. Government Printing Office, Washington, D. C., 311 p.

Landes, K. K., 1951, A scrutiny of the abstract, *Bulletin of the American Association of Petroleum Geologists*, v. 35.