Writing a Scientific Paper

When you write about scientific topics to specialists in a particular scientific field, we call that scientific writing. (When you write to non-specialists about scientific topics, we call that science writing.)

The scientific paper has developed over the past three centuries into a tool to communicate the results of scientific inquiry. The main audience for scientific papers is extremely specialized. The purpose of these papers is twofold: to present information so that it is easy to retrieve, and to present enough information that the reader can duplicate the scientific study. A standard format with six main parts helps readers to find expected information and analysis:

- Title--subject and what aspect of the subject was studied.
- Abstract--summary of paper: The main reason for the study, the primary results, the main conclusions
- Introduction--*why* the study was undertaken
- Methods and Materials--*how* the study was undertaken
- Results--*what* was found
- Discussion--*why* these results could be significant (what the reasons might be for the patterns found or not found)
- Conclusion:
- Reference list:

Title

The title should be very limited and specific. Really, it should be a pithy summary of the article's main focus.

- "Renal disease susceptibility and hypertension are under independent genetic control in the fawn hooded rat"
- "Replacement of deciduous first premolars and dental eruption in archaeocete whales"
- "The Radio-Frequency Single-Electron Transistor (RF-SET): A Fast and Ultrasensitive Electrometer"

Abstract

This is a summary of your article. Generally between 50-100 words, it should state the goals, results, and the main conclusions of your study. You should list the parameters of your study (when and where was it conducted, if applicable; your sample size; the specific species, proteins, genes, etc., studied). Think of the process of writing the abstract as taking one or two sentences from each of your sections (an introductory sentence, a sentence stating the specific question addressed, a sentence listing your main techniques or procedures, two or three sentences describing your results, and one sentence describing your main conclusion).

Introduction

The introduction is where you sketch out the background of your study, including why you have investigated the question that you have and how it relates to earlier research that has been done in the field. It may help to think of an introduction as a telescoping focus, where you begin with the broader context and gradually narrow to the specific problem addressed by the report. A typical (and very useful) construction of an introduction proceeds as follows:

1. Open with two or three sentences placing your study subject in context.
2. Follow with a description of the problem and its history, including previous research.
3. Describe how your work addresses a gap in existing knowledge or ability (here's where you'll state why you've undertaken this study).
4. State what information your article will address.

Methods and Materials

In this section you describe how you performed your study. You need to provide enough information here for the reader to duplicate your experiment. However, be reasonable about who the reader is. Assume that he or she is someone familiar with the basic practices of your field.

It's helpful to both writer and reader to organize this section chronologically: that is, describe each procedure in the order it was performed. For example, DNA-extraction, purification, amplification, assay, detection. Or, study area, study population, sampling technique, variables studied, analysis method.

Include in this section:

- study design: procedures should be listed and described, or the reader should be referred to papers that have already described the used procedure
- particular techniques used and why, if relevant
- modifications of any techniques; be sure to describe the modification
- specialized equipment, including brand-names
- temporal, spatial, and historical description of study area and studied population
- assumptions underlying the study
- statistical methods, including software programs

Results

This section presents the facts--what was found in the course of this investigation. Detailed data--measurements, counts, percentages, patterns--usually appear in tables, figures, and graphs, and the text of the section draws attention to the key data and relationships among data. Three rules of thumb will help you with this section:

- present results clearly and logically
- avoid excess verbiage

- consider providing a one-sentence summary at the beginning of each paragraph if you think it will help your reader understand your data

Remember to use table and figures effectively. But don't expect these to stand alone.

Notice how the second sample points out what is important in the accompanying figure. It makes us aware of relationships that we may not have noticed quickly otherwise and that will be important to the discussion.

Related Information: Use Tables and Figures Effectively

Do not repeat all of the information in the text that appears in a table, but do summarize it. For example, if you present a table of temperature measurements taken at various times, describe the general pattern of temperature change and refer to the table.

Remember that readers have all that data in the accompanying tables and figures, so your task in this section is to highlight key data, changes, or relationships.

Discussion

In this section you discuss your results. What aspect you choose to focus on depends on your results and on the main questions addressed by them. For example, if you were testing a new technique, you will want to discuss how useful this technique is: how well did it work, what are the benefits and drawbacks, etc. If you are presenting data that appear to refute or support earlier research, you will want to analyze both your own data and the earlier data--what conditions are different? how much difference is due to a change in the study design, and how much to a new property in the study subject? You may discuss the implication of your research--particularly if it has a direct bearing on a practical issue, such as conservation or public health.

Bibliography

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