Guidelines for Writing a Scientific Paper

Scientific papers are the vehicle through which scientists report their work to the world. Their professional reputation is built on how these papers are received by the scientific community. No matter how good the actual experiment, a poorly written paper may negatively affect one’s professional reputation, or worse, prevent the paper from being published at all (thereby keeping the scientist completely unknown). Therefore, it is extremely important to learn to properly write a scientific paper.

A scientific paper consists of the following parts: Title, Abstract, Introduction, Materials and Methods, Results, Tables and Figures, Discussion, and Literature Cited.

The following guidelines should be observed throughout the entire paper:

- Paper MUST be typed and double-spaced
- Use a professional font (e.g. Times New Roman, 12 pt)
- Use only black ink
- Include section headings
- Do NOT begin each section on a new page – if a section ends part way down one page, start the next section immediately following it on the same page
- Write clearly – proofread to correct spelling and grammar
- Use past tense when referring to events of your experiment
- Keep writing scientific – no flowery language
- Be as concise and complete as possible
- Paraphrase or re-state source information in your own words. Do not quote.

Title

The title of a paper is what often determines whether a potential reader will actually read your paper. It should be as specific as possible without being too long.

- Title should accurately reflect the purpose of the experiment
- Keep length to 10 words or less
- Avoid using jargon

Abstract

The abstract is a short summary of the entire paper that should “stand alone.” In other words, the reader should be able to get a complete idea of what was done and what was concluded from reading just the abstract.

- Summarize entire paper – include Introduction, Materials and Methods, Results, and Discussion
- Be concise – keep it to around 250 words or less. A good goal is one to two sentences to summarize each section of the paper
- Do not include references
- This section is best if written last
**Introduction**
The purpose of the introduction is to introduce the reader to your experiment. This is done by giving some background on the subject in general and explaining why your particular experiment was performed (what will examining the questions that you examined add to our body of knowledge on the subject?).

- Start broad by introducing background on the general question/problem at hand and end narrow with the objectives (purpose) and hypotheses of your particular study.
- Write in paragraph form. This section should have multiple paragraphs.
- Background information should include references.
- State purpose of experiment and hypotheses clearly

**Materials and Methods**
This section describes to your reader exactly what you did and how you did it. The key to writing this section is to include enough detail in your description to allow another scientist to reproduce the experiment simply by reading this section of your paper.

- Written in paragraph form
- Do not include a list of materials required – the reader should be able to figure out what is needed based on the description of the method.
- Write in past tense
- Include appropriate reference if required

**Results**
This section summarizes the results of your study in written form. It should contain only results. All interpretations and explanations of the results belong in the Discussion and all methods belong in Materials and Methods. Often tables and figures are useful in presenting results.

- Keep it simple and concise – especially if tables and figures are used, this section should not be very long.
- There must be some written description of results. Simply referring to tables and figures is not sufficient.
- If any tables or figures are used, they must be referred to AND briefly explained in the text.
- **Appropriate** way to reference a table or figure: “The temperature of the water was found to increase with time as demonstrated in Figure 1.” OR “Table 2 lists absorbance values of the chlorophyll solutions and shows that the most concentrated chlorophyll solutions had the highest absorbance values.”
- **Inappropriate** way to reference a table or figure: “Results are in tables 1,2 and figure 1.”
Tables and Figures
Tables and figures can be very helpful in presenting information to the reader. They may be included in the body of the paper, but this is not necessary. It is perfectly acceptable (and easier) to assign one page per table/figure and include these in the back of your paper.

- All non-table materials are referred to as figures – this includes graphs, maps, pictures, diagrams, etc.
- All tables and figures should have a number, title, and short description.
- Number tables and figures independently of each other – e.g. Table 1, Table 2, Figure 1, Figure 2, etc.
- Number tables and figures according to the order in which they are first mentioned in the text.
- Tables are labeled at the top; figures are labeled at the bottom.
- Titles and descriptions must be self-explanatory – reader should be able to understand what a table/figure is showing without having to read the text of the paper.
- Tables and figures should be neat, easily understood, and correctly summarized the data.
- DO NOT present the same results several times over: if a graph summarizes the trends observed, do not also include the table of data used to create the graph.

Discussion
This is the section where you pull everything in the paper together and explain what your results mean and why they matter. Interpret your results within the context of the background information that you provided in the Introduction. This section will conclude your paper and thus will be responsible for your final impression on the reader. Therefore, this section requires a lot of thought and attention.

- Organize this section opposite to the Introduction. Begin narrow by discussing your specific experiment and end broad by placing your experiment within the larger context of the general field.
- Write in paragraph form. This section should contain multiple paragraphs.
- Point out unexpected results and when doing so, be sure to discuss possible sources of error.
- Be specific about sources of error and how exactly a particular error would influence your results. DO NOT attribute such results to simply “human error.”
- Compare your results to existing literature.
- Clearly state your conclusions and whether the results support or reject the hypotheses (in doing so, re-state your hypotheses).
- Make sure the paper ends appropriately.

Literature Cited
All references MUST be properly cited both within the text and the literature cited section. To properly cite your materials, follow the guidelines set forth for you in the “Citing References” handout you received at the beginning of the semester.
Citing References

In-text Citations

Whenever a researcher mentions information that they did not personally obtain through experimentation or observation, the MUST include a reference indicating the source of information i.e. they must cite the reference. When citing a reference within the text of a report, it is sufficient to list only the author and year of publication. The complete reference is then found in “Literature Cited.”

Reference cited before or after information:

Smith and Dirt (2000) found that sea otters preyed on abalone and clams.

Sea otters prey on abalone and clams (Smith and Dirt, 2000).

Single reference for multiple pieces of related information (listed one after another in same paragraph):

Black bears in Alaska were found to hibernate from November to April. Males lost an average of 37 kg, while females lost an average of 42 kg. This difference in weight loss was attributed to the fact that females gave birth prior to hibernation, and suckled cubs during the winter months (Rhodes, 1997).

Multiple references for multiple bits of information (within the same sentence) or multiple references for the same bit of information.

It has been found that weiner dogs (Jordan, 1965), small kick dogs (Sam and Flueglehorn, 1981; Joshi and Jhii, 1989; Thompson, 1995)* and spotted dogs (Bertrand, 1999) prefer tofu to steak.

*Note: list multiple references in date order within each set of parentheses.

Reference with 3+ authors:

Albatross suffering from droop-wing were found to have ingested paint chips containing lead (Pink et al., 1998)*

Note: “et al.” is in italics. Complete reference listing all authors found in Literature Cited.

(“et alli” is Latin for “and others”)

Personal Communication:

Smith (personal communication) has shown that manatees do not react to bright light.

Note: Personal communications are not listed in Literature Cited.
**Literature Cited**

All references cited within the text of a paper/report must be listed in the “Literature Cited” section. References should be listed in alphabetical order by first author. Within a reference, the order of authors should remain the same as the order they are listed on the publication.

**Book/text:**


**Chapter from a book, where a different author writes each chapter:**


**Article from a published journal:**


**More than one reference by the same author:**


Note: multiple references by the same author are list in order of year.