

## Writing Scientific Reports

Adapted from Morgan, J.G. and M.E.B. Carter. Investigating Biology. 3<sup>rd</sup> Ed. Benjamin/Cummings. 1999 by Dr. R. Gerrits with further modified by Dr. C. S. Tritt.

For engineers, scientists or health care workers to be ultimately successful in their work, they must be able to communicate their results. When this is done in written format, it is called a scientific report. These reports are produced in a standard format and published in scientific or trade journals. These scientific reports generally include the following: Title page, Abstract, Materials and Methods, Results, Discussion and References Cited.

### Title Page

The title page is the first page of the paper and includes the title of your paper, your name, the course title, your lab time or section, your instructor's name, and the due date for the paper. The title should be *as short as possible and as long as necessary to communicate to the reader the questions being answered in the paper*. The title should be centered about 7 cm from the top of the page with the remaining information either centered or right justified toward the bottom of the page.

### Abstract

The abstract, when one is requested by the instructor, is placed at the beginning of the second page of the paper, after the title page. The abstract concisely summarizes the question being investigated in the paper, the methods used in the experiment, the results and the conclusions drawn. The reader should be able to determine the major topics of the paper without reading the entire paper. The abstract should be no more than 250 words, and fewer if possible. Compose the abstract after the paper is complete.

### Introduction

The introduction has two functions: 1) to provide the context of your investigation and 2) to state the hypothesis tested in the study.

1. Begin the introduction with at least one paragraph reviewing background information that will enable the reader to understand the objective of the study and the significance of the problem. If possible, relate the problem to the larger issues in the field. Include only information that directly prepares the reader to understand the question investigated. Most ideas of the introduction will come from outside sources, such as scientific journals or books dealing with the topic you are investigating. All sources of information must be referenced and included in the References section.

*References may be cited in more than one way, depending on the journal of publication. They may either be referenced with numbers (1) or the authors last name and year of publication (Gerrits, 1998). Either way, these must correspond to the Reference section. Most importantly stay consistent with your referencing.*

2. Make sure to clearly state your hypothesis or hypotheses (there may be several). It is sometimes helpful to precede the hypotheses with a question or two, but usually not necessary:

“The objective of the current research was to address the following specific hypotheses:”

or

“The questions to be addressed in this lab included: ..... From these questions the following hypotheses were developed:”

It is also important to not make your hypotheses overly broad or overly specific.

For example “The hypothesis is that drugs will affect heart rate” or “Epinephrine at a dose of 1 mg/kg will increase heart rate by 7 beats a minute” should be “It is hypothesized that as epinephrine dose increases, heart rate will increase”.

The hypotheses should be stated in such a way as to make the performance of statistical analysis straightforward (it should be clear from the hypotheses which values will need to be compared with statistical analyses).

Write the introduction in the past tense when referring to your experiment. Make sure to use third first person sentence structure. For example:

“The experiment we performed tested the hypothesis that pH would affect the rate of enzymatic reaction. To do this we tested the our reaction rate at a pH of 5 and a pH of 7.”

Should be: “The present experiment tested the effect of pH on the rate of enzymatic reaction. This was done by testing the specific hypothesis that decreasing pH by a factor of 2 would significantly slow the rate of starch breakdown into glucose.”

## **Materials and Methods**

The Materials and Methods section describes your experiment in such a way that it can be repeated exactly – including statistical methods. The majority of the information in this section comes from the Procedures section of the experiment, but in the paper, this information should be a narrative description, not a list of steps.

Write the Materials and Methods section in paragraph format in past tense. Do not list the materials (They will be covered in the narrative of the procedure). Be sure to include levels of treatment, numbers of replications, controls and statistical methods. Do not try to justify your procedures, report your results or discuss the results in this section.

The Materials and Methods section should be written in third person format. For example:

“We then added 3 drops of 1% starch solution to each beaker of salt mixture and then we measured the pH of this solution.”

Should be: Three drops of starch solution were added to each beaker of salt mixture, after which the pH of the solution was immediately measured”

Also, it is not necessary to explicitly list the independent, dependent and controlled variables as they will be obvious to the reader if this section is written correctly.

The Materials and Methods section is often the best place to begin writing your paper.

## **Results**

The results section consists of at least three components (1) one or two sentences reminding the reader about the nature of the research, (2) one or more paragraphs that describe the results, (3) figures (graphs, diagrams, pictures) and/or tables.

Tables and figures must be numbered consecutively throughout the paper. Refer to figures and tables within the paragraph as you describe your results, using the word Figure or Table, followed by its number. If possible, place each figure or table at the end of each paragraph in which it is cited.

If you have performed a statistical analysis on your data, include the results in this section (usually just the p values are needed, unless there is other statistical information that would be helpful to the reader).

Report your data as accurately as possible:

1. Do not report what you expected to happen in the experiment.
2. Do not discuss the meaning of your results in this section.
3. Do not critique the results.
4. Any data you plan to include in the Discussion section must be presented in your Results. Conversely, do not include data in your Results that you do not mention in your Discussion.
5. Finally, do not use extraneous figures and tables. Represent the data that is most pertinent to your hypotheses and represent the data so that it makes most sense in terms of your hypotheses.

For example, if your hypothesis is “Increasing the amount of substrate will increase the reaction rate”, should be plotted as reaction rate vs. substrate concentration and not substrate concentration vs. reaction rate.

It usually works best to write the Results section before attempting the Discussion section.

## Discussion

The Discussion section is where you will analyze and interpret the results of your experiment. You should state your conclusions in this section. Do not use the word “prove” in your conclusions. Your results will support, verify, or confirm your hypothesis, or they will negate, refute, or contradict your hypothesis.

Start your discussion by restating your hypothesis. Then try to answer your question or address your hypothesis with specific data, including referencing data from your results section. State whether your results support or negate your hypothesis. Also discuss if your results are the expected results and why or why not (this should be done in the context of referencing outside sources).

For example, if your hypothesis stated that “increasing enzyme concentration would decrease reaction time”, you need to discuss not only the results you obtained, but also published data regarding this hypothesis.

If the data is not as expected, discuss any weaknesses that you have identified in your experimental design that may have affected your results and/or list any problems that arose during the experiment that may have affected your results. Finally, clearly state your conclusions.

If you have more than one hypothesis, write a separate paragraph or section for each, restating the hypothesis and how your data support or negate it, and discussing it in the context of other published data.

Finally, discuss why the findings might be important.

Again, write in third person format.

## References

This section lists only those references cited in the paper. Proper formatting (style) is critical.

References should be in an acceptable style as described at:

**[www.msoe.edu/library/technical\\_style\\_guide.shtml](http://www.msoe.edu/library/technical_style_guide.shtml)**

*Carefully proofread your work. It is often helpful to have someone else read over your writings. Always spell check your work!!!*