GUIDELINES FOR WRITING LAB REPORTS
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Title

The title of a scientific paper is meant to inform the reader precisely about the contents of the article. It should state exactly what was studied and the outcome of the study. It may even include information about the technique that was used. Your title should not be broad.

Example of a bad title: “Photosynthesis”

Example of a good title: “Light intensity has a positive correlation with photosynthetic rate in Elodea”

Or

“Oxygen production as a measure of photosynthetic rate in Elodea: the positive effects of light intensity”

Abstract

An abstract is a very concise summary of the paper. You should include a sentence or two of introductory material, introducing the topic and stating the purpose of the study. This is followed by another brief sentence or two which mentions how the study was carried out (methods), very general to give the reader an idea of what types of methods were used. There is very little detail with regard to how these methods were carried out. Next is a very specific and precise description of the results. What was found? Lastly, write a conclusive statement that ties the results to some theoretical point and/or an overall conclusion (this is like a one or two sentence summary of your discussion section).

Introduction

The introduction provides the reader with the necessary background to understand the science and theoretical premise for the study. It should include discussions of basic mechanisms involved in the study and make mention of previous findings from other studies that are relevant to this research. This section includes many in-text references since you are primarily reporting on information that is not a result of your own research. Proper in-text referencing should follow this format:

Simians have larger brains than most other mammals, while humans have brains that are three times larger than the ‘typical’ simian brain (Martin, 1995).

Note: The in text reference has the author’s last name, the year of publication. The period follows the reference, outside the parentheses. If the article had two authors the reference would be as such: (Martin and Pryce, 2000). If the reference has more than
two authors it appears as such: (Martin et al., 2001). Note that et al. is italicized, because it is an abbreviation for et alia, which is Latin for ‘and others’. Whenever you write in another language other than the language used for the main text, you italicize it. Since et is a word, and al. is an abbreviation, the period only follows al. The comma must follow the period and then the year, as usual.

Another way to reference the same material in the text of your article is to include the author and year in the text itself, as follows:

As Martin (1995) states, simians have larger brains than most other mammals, while humans have brains that are three times larger than the ‘typical’ simian brain.

Of course, there are many ways to incorporate the reference in this style, depending on whether the statement is a conclusion: As Martin (1995) concludes,… or if you are discussing findings: The findings of Martin and Pryce (2000) support my hypothesis that….., etc.

Normally, an introduction ends with a statement regarding how what you’ve just discussed pertains to your research. For example, you may begin the last paragraph of the introduction with:

In this study, I hypothesize that…. or The purpose of this study was to …. 

**Methods**

If there is a detailed description of a technique, you can reference it. This is also where you can reference your handouts.

If you have devised the protocol yourself then the methods section is meant to give all the necessary information needed for the reader to reproduce the research. This does not mean that you describe in detail how you labeled your tubes, how many microliters of each chemical were added to each tube, or that you explain techniques that are explained elsewhere or are common knowledge. For example, if you used 10 ml of 10X TBE buffer to dilute 1 ml of extracted DNA solution, you would not explain that you measured out X g of each compound and added 1 liter of water to make the TBE Buffer and then put 1 ml of extraction into 10 ml of TBE. You would simply say “DNA extractions were diluted 1:10 in 10X TBE Buffer.” Anyone can look up how to make 10X TBE buffer (common knowledge), and they can make one liter of it or one milliliter, that is their problem. You only need to include the dilution factor for your extract, because another person may want to dilute their entire sample, another may want to save some and dilute only 1 microliter. For this reason, how they label their tubes is up to the researcher.

Methods do not mention in any way what you found; there are no results or background materials in here.
Results

The results should be entirely your own. Only you have collected this data, so you do not reference anyone in this section. This section will include a detailed description of exactly what you found. You will present the data in the most reader-friendly manner. So, if you are testing the effects of exercise on heart rate, you will be comparing heart rate for various individuals before and after exercising. It would not make sense to write a paragraph listing the results for each subject; you would want to make a figure that presents the data in a manner that makes it easy for the reader to see the differences that you found. You might make a table with the individual scores for each person with one column for before exercise, one column after exercise and leave it at that. The reader could see the overall trend by examining the data, or you might simply report the averages if they were significant. If you only have two measurements, it is easiest to state, “The average heart rate for all individuals before exercise was X, compared to Y after exercise.” Perhaps you have data from different age groups, and then you might present the averages in a bar graph format, showing the differences before and after exercise with the added benefit of showing age group differences in the same figure. You do not want to repeat any presentations of data. Choose one format to display.
Format all figures and tables consistently. All figures and tables are labeled underneath with a Figure/Table # and a descriptive title. See below:

<table>
<thead>
<tr>
<th>Age Category (years old)</th>
<th>Heart Rate (heart beats/minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Exercise</td>
</tr>
<tr>
<td>Under 20</td>
<td>65</td>
</tr>
<tr>
<td>20-40</td>
<td>70</td>
</tr>
<tr>
<td>40-60</td>
<td>85</td>
</tr>
<tr>
<td>Over 60</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 1: Average heart rate as a factor of age before and after exercise (N = 20 for age each category).

Figure 1: Heart Average heart rate as a factor of age before and after exercise (N = 20 for age each category).

Note: In graphs, the axes are always labeled, and units are included when necessary. Tables are numbered consecutively as are figures, despite each other. Use colors that are visible, and that photocopy well into black and white, you may just use a grey scale. Data in tables are centered. Overall, figures and tables need to be visually appealing and easy to read.
The results are interpreted for the reader, so you will write a brief explanation of what the results show.

Example: “While the average heart rate before exercise is positively correlated with age, the heart rate after exercise does not show the same pattern, and individuals over 60 years of age do not show the highest heart rate after exercise in our study (Fig. 1).”

You can see that this text describes what the reader should observe in the figure or table, but it offers no explanation as to why we see these patterns (that comes in the discussion). Make reference to the figure in which this data is presented. You might do it in another fashion:

“Figure 1 illustrates that the average heart rate before exercise is positively correlated with age, however, the heart rate after exercise does not show the same pattern, and individuals over 60 years of age do not show the highest heart rate after exercise in our study.”

By the way, “data” is plural for “datum”, so “The data are…” not “The data is…”

Discussion

The discussion is where you tie everything together. It should include any interpretation of your results. Here is where you might infer causation or relate your result to the finding found in other studies.

Example: “Our results showed that the elderly do not display the highest heart rates after exercise, unlike the patterns seen in resting heart rate. This may be due to an overall lower intensity of exercise that is common with old age as fatigue sets in earlier and reduced limberness results in lower exertion.”

This section often includes in text references to other works.

Example: “Our findings reflect those of Martin and Pierce (1998), in that…."

Overall, you want to relate the theoretical with the data here, and offer reflexive analysis of your results. This is really the most interesting part of a paper because this is where the author can interject new ideas based on the results and make inferences about future research possibilities. You should include future research ideas in your lab reports. Finally, this section is often ended with some form of conclusion, a sentence or two that tells the readers what it was all about, the punch line. “We conclude that….

Citations

The citations should follow a specific format and they should be consistent throughout. This list should include only the references that you cited in the text. You may have read much more than is listed, but if you do not use that information in the paper, then do not
reference it. Scientific journal articles, books, and chapters in books are referenced differently. You may use the format in your Fundamentals of Biology Lab Manual Appendix D. **Do not use web pages.** They are not primary sources, they are not peer reviewed, and so they can contain false information. This does not mean you cannot get information electronically as many scientific journals are now available online.

**Writing**

You will also be graded on your writing. Good scientific writing is never verbose and should be free of jargon. Think about every word, is it necessary? Can I remove this phrase without changing the meaning of the sentence? **Good writing is edited, many times.** Keep your sentences simple so that they read easily and organize what you will write before you begin. It is always a good idea to make an outline before you start. I recommend that you all read *How to Write and Publish a Scientific Paper* by Robert Day. This book has some chapters dedicated to cutting out jargon and wordiness in writing.

**Plagiarism (if I catch you, you will fail the assignment, and possibly the course)**

Not only is there no tolerance for plagiarism at Ramapo College as a policy, but it is also illegal to plagiarize a publication. If you use somebody else’s work to express an idea, you must give them credit for it. This does not mean that you have quoted them word for word. If I spent decades researching the mating patterns of sea slugs and you mention my findings in support of your work, then you must give me credit for my work (or risk getting caught and really angering the poor person who did all that work) in the form of an in text reference immediately following the phrase where you mention my results, even if it is in the middle of a sentence.

Example: “Sea slugs mate seasonally from March to June (Suarez, 2003), although this research has shown very high rates of mating through August.”