Report Writing Guidelines for the School of Biological Sciences

The staff of the School of Biological Sciences hope that your Monash education provides you with an understanding of the theoretical concepts and applied skills needed by biologists, encourages you to think independently, and helps you to communicate with precision, clarity and economy in both speech and writing. Perfecting your writing is an essential part of your university education. As a student in an Australian university, we expect you to write reports in clear, grammatically correct, and correctly spelt English. The guidelines below will help you achieve this.

Research reports are the fundamental form of communication in science. A conventional format for research reports has evolved among scientists, and you are expected to follow this format in your assignments. Please consult with your unit coordinator to find if there are any modifications to these guidelines or additional requirements you should meet.

General Information

- Use the ‘Assignment Cover Sheet’ available for downloading from the ‘Blackboard’ Web pages of your unit (under the Guidelines, Policies & Forms link) and from http://monash.edu/science/about/schools/biological-sciences/undergrad/. Your name and student ID number should be written on this cover sheet. Do not place either your name on any other page of your report. Ensure that the cover sheet is firmly fixed to the main body of the report with a staple when you submit the report.
- Reports submitted to the School of Biological Sciences should be double-spaced throughout for ease of reading and to allow room for corrections and comments. Double spacing is especially important in handwritten reports. Single spaced assignments may be returned for reprinting or rewriting.
- Use A4 paper, 3 cm margins, and 12 point font.
- Pages should be numbered sequentially starting with page 2 (either centred at the bottom or placed in the upper right-hand corner of the page).
- Each paragraph should be indented. Indents draw the eye to the beginning of a paragraph and facilitate reading, an important consideration for anyone who must read many paragraphs. The inclusion of blank lines between paragraphs is unnecessary and is discouraged.
- Consult an Australian dictionary (e.g., The Macquarie Dictionary) if you are unsure of the spelling or meaning of a word, and use the spell checker on your word processor.

In most cases, your report should follow the format of a scientific journal. The format recommended below is similar to that required for most peer-reviewed journals in the biological sciences. If any of the following instructions are not clear, then consult:

*Style Manual for Authors, Editors and Printers.* Australian Government Publishing Service, Canberra, 1994;
Format

Scientific papers and reports conventionally have the following headings and sections:

Title
Abstract
Introduction
Materials and Methods
Results
Discussion
Acknowledgments
References
Tables
Figures

Notes:
1. Always check with the appropriate staff member responsible for your report to see if they wish to modify or delete any of the sections above, depending on the nature of the research and requirements of the write-up. For example, a 'Literature review' section may replace the 'Materials and methods' and 'Results' sections in a non-experimental report.
2. Group the tables and figures at the end of the text, unless you are 'typesetting' your report.

1. Title

Make the title a succinct statement of what is in the report. Try to include significant key words that alert a reader to the content. Practical reports are often submitted without any title at all—don't forget!

Poor: Practical 3—Aquatic Ecology
Good: Differences in the invertebrate fauna of two freshwater ponds on the Monash University campus

2. Abstract

An abstract presents a "skeleton" of the entire paper—the purpose, the experiment or observations made, the results and conclusions, are all presented in extremely concise form. The abstract indicates what the paper contains, in a form longer than the title, but much shorter than the paper as a whole. It is not easy to put so much into just a few sentences, so Abstracts are typically difficult to write. You should generally write the Abstract last: it is easier to extract the essence of the report after you know what the rest of the report says. Abstracts do not generally include statistical results.

Look at some papers in nearly any scientific journal in the Hargrave-Andrew Library to get a feel for the style and contents of an abstract. Most published research papers contain an abstract, but not always (different journals have different practices). The requirements in different subjects within Biological Sciences may vary. Consult with the instructor about whether an Abstract is required for any particular report.
3. Introduction

This section provides background to the issues involved, and states the purpose or goal of the study. **Why** was the study done? Often one cites references to previous work on the topic (see the References section below for details about how to cite published material in the main text). Usually the organism(s) studied will be mentioned (they may have been mentioned in the title already, but the introduction gives more information or context). These elements are contained in the following example:

A longstanding issue in ecology concerns the relative importance of physical factors, biotic factors, and random historical factors in shaping the composition of a community (Weir 1897; Marshall 1926). If physical factors predominate, then physically similar habitats should contain similar communities. To test this prediction we measured several features of the physical structure and water chemistry of two freshwater ponds, and then examined the macroscopic invertebrate fauna of each.

4. Materials and Methods

Explain **where** and **when** you did the work, and **how** it was carried out. A practising researcher in the discipline should be able to repeat the study from the information in this section. Describe fully (including Latin names) the organisms you studied, indicating details about the sex, age, size, and number used, where relevant. Indicate what equipment was used. It is often helpful, especially if the apparatus is unusual or specialised, to state in general terms what it does (for example: The digested DNA samples were examined using gel electrophoresis, which separates DNA fragments based on their size and mobility in an electric field.). Note that what is considered unusual or specialised will vary according to the sub-discipline. Although it is important to include the details of experimental procedure, a poor way of describing those details is simply to list the steps you followed in chronological order, like the instructions in a cooking recipe. A step-by-step list fails to indicate the overall structure of the experimental procedure, and does not distinguish between essential and peripheral aspects of the methods.

A poor version:

In the first week a *Drosophila* fly population was 'knocked out' with CO$_2$ and examined under a dissecting microscope that had a graduated scale in one ocular. Thirty flies were collected and their wing length was measured using the ocular scale. From these flies, we took five males and five virgin females with the longest wing lengths. These were placed in a bottle with food in the bottom and allowed to mate. The bottles were incubated at 25 °C for two weeks until the offspring emerged. We then took 30 flies from the offspring generation measured their wing lengths. We determined the mean value for the offspring, and compared it to the mean for the starting population. The data from the first week and the fourth week were entered in the computer program "Microsoft Excel", and a *t*-test was performed to compare the two sets of data.

This has all the details, but it's hard to grasp the "big picture" of what was done—it doesn't tell why you did it that way. Here's a better version that does not follow a step-by-step description, but is more informative:

We conducted an artificial selection experiment to determine if mean wing length in a population of the fruit fly *Drosophila melanogaster* could be increased in one generation of
selection. Mean wing length in the starting population was estimated from measurements of a sample of 30 individuals. Selection was then imposed by allowing only the five males and five virgin females with the longest wing lengths in this sample to mate and produce the post-selection generation. Wing length was measured in 30 individuals from this offspring generation. We then compared the means wing lengths of the pre- and post-selection generations to determine if they were significantly different.

Flies were anaesthetised with C02 to allow handling and measurement. Wing length measurements were made under a dissecting microscope with an ocular scale at a magnification of 40x, and converted to millimetres following a calibration made earlier. Both the starting population and the offspring generation were cultured in a 25 °C constant-temperature room at the Monash University School of Biological Sciences, using glass bottles containing a standard laboratory yeast-based medium to feed the larvae. Thus, environmental conditions were uniform for both generations in the experiment. To compare the mean wing lengths in the generations before and after artificial selection, we performed a $t$-test using the computer software "Microsoft Excel".

What makes this second version better? It is more precise (e.g., "a standard laboratory yeast-based medium" rather than "food in the bottom"), but the real improvement is that it presents the entire outline of the experiment (something the first version fails to do) and indicates the reasons for the procedures.

5. Results

Describe what you found in your experiment. Give the various parts of your experiment meaningful names, and use those names precisely and consistently (e.g., "replicate 1", "F1 generation", "starch concentration assay", "the EcoRI digestion"). Present your numerical results (using SI units), but note that raw data are seldom reported in the Results section. Instead they should be analysed and summarised in meaningful ways (for example, by presenting means and standard deviations of several replicates). Do not just "spill out" the raw results you recorded in the experiment, and leave the reader to interpret how it pertains to your objectives.

Tables and graphs are good ways to present data. Each table or graph should (1) be numbered (Figure 1, Table 4, and so on); (2) have a title that clearly indicates the content of the figure or table; (3) have a legend that explains all symbols and abbreviations, source of the data, and other pertinent information.

Explain how to interpret each figure or table in the text of the Results section. NEVER present "naked" table and figures (meaning without any legend and explanation in the text). Tables and graphs are never self-explanatory — you must explain what part of the experiment they address, what the numbers or lines mean, how to interpret them, and so on.

If you have used statistical tests to analyse your data the results should be presented here. Statistical results should be included in a sentence explaining the significance of the results. For example:

"There were significantly more invertebrates found in the shaded ponds compared to the exposed ponds (Fig. 1. $t = 3.2$, d.f. = 4, $P<0.05$)."

This sentence not only tells the readers what the direction of the difference was, it refers them to the appropriate figure (Fig 1), shows them the result of the statistical test (in this case a $t$-test with 4 degrees of freedom) and also whether or not this was significant ($P<0.05$).
6. Discussion

In the Discussion, state the conclusions that can be deduced from the results. Normally, your results are related to published work on the topic (citing appropriate references), and some comment is made about the wider biological significance of what you found. Identify the most central, interesting, or important result of your work, and discuss that first. More peripheral issues or "biological trivia" should be left until after the main findings have been discussed.

Experiments often do not "work" and you may wish to indicate possible reasons why an expected result was not obtained. But be careful in doing this: student reports often degenerate into long lists of hypothetical problems (often as a string of apologies), rather than really grappling with the information that can be gained from the experiment, even if it did not produce what was expected. If the only valid results were what we expected in the first place, how would discoveries be made?

7. References

The References section lists the scientific literature you cited in the main text of your report. When should you cite a reference in your report?

- When you quote directly from the source, or closely paraphrase the source.
- Whenever ideas, facts, or data mentioned in your report are taken from another source.
- Whenever you make a statement of fact or opinion that is not common knowledge, and is not supported by your own data and arguments.

Read carefully the section on plagiarism at the end of this guide in relation to these three points.

Generally you should cite primary literature (that is, journal articles or academic books that have been subject to 'peer review' by other scientists). You generally should not cite encyclopaedias, magazine articles, or other non-scientific sources. Citing references serves two purposes: it protects you from a charge of plagiarism and it allows your readers to verify your statements and learn more about the background to your work.

There are two formats for citations: a short format for citations made in the main body of the text (the Introduction, Methods, Results and Discussion), and a full format for listing the publication details in the References section at the end.

a) Citing a reference in the body of the text.

Numbered footnotes are common in some disciplines, but not in science. Instead, a source is cited by the **author's surname and date of publication**.

- If you refer directly to the source, use the surname and place the date in brackets:
  
  Fisher (1930) was the first to propose a theory for the evolution of sex ratios.

- If you refer to the publication indirectly, both author and date go in brackets:
  
  Half a century after Darwin, a theory of sex ratio evolution was proposed (Fisher 1930).

- For a source with two authors, indicate the surnames of both along with the date:
  
  DNA takes the form of a double helix (Watson and Crick 1954).

- For a source with three or more authors, cite the surname of the first author, and add "et al." (an abbreviation of the Latin *et alia*, meaning "and others") to represent the other authors.
Note that "et" is a whole word and receives no punctuation, while "al." is an abbreviation and is punctuated. Thus, "et al" and "et. al." are not correct.

Plants of different ecotypes retained different growth forms when cultivated in a common environment (Clausen et al. 1943). [The reference is to a famous paper by Jens Clausen, David Keck, and William Hiesey.]

- You may cite more than one paper in support of a point. Within brackets, separate the citations by a semicolon. Usually, multiple citations are ordered by date of publication.
  DNA sequence data of the Adh locus in Drosophila melanogaster shows variation among populations due to selection pressure (Hudson et al. 1987; Golding 1994).
- You may cite more than one paper published by the same authors. If the year of publication differs, there is no ambiguity: give the surname once and the several dates. If the publication date is the same for more than one paper, the letters a, b, c ... are added after the year to distinguish them.
  Studies of plant reproduction have yielded many insights about evolution (Darwin 1876, 1880).
  Studies of mate searching behaviour (Parker 1974a) and post-mating defence of females (Parker 1974b) in the fly species Scatophaga stercoraria show how time investments affect male reproductive behaviour.
- A citation is part of the sentence it refers to. A full stop goes after the citation, not before.
  Wrong: DNA takes the form of a double helix. (Watson and Crick 1954)
  Right: DNA takes the form of a double helix (Watson and Crick 1954).
- Student reports often contain "second-hand" references, like the following:
  Biochemical reactions mediated by calcium influxes may form part of the molecular basis of memory in neurons (Lisman 1994 in Gerhart and Kirschner 1997).
  This "X in Y" manner of citing something is seldom used in scientific writing, and you should avoid it. It is justified if X is written in a foreign language, or is in an obscure and hard to obtain source, and is described by Y in a more accessible source. But this is a rare circumstance. Usually, a citation like that above means that you read a reference to Lisman's paper in Gerhart and Kirschner, but didn't go read Lisman's paper itself. So you don't really know what Lisman wrote, only what others claim about what he wrote. Go read the original source and cite that. Otherwise, cite what you really read:
  Research discussed by Gerhart and Kirschner (1997) suggests that biochemical reactions triggered by calcium influxes may form part of the molecular basis of memory in neurons.

b) Listing references in the References section.

In this section, list all the sources you have cited in the main text with full publication details. List in alphabetical order according to the surname of the first author. Any source cited in the text should be included in the reference list. Nothing should be included in the reference list that is not cited in the text of your report.
There are slight differences in the format for a paper in a scientific journal, a book, or a chapter from an edited book. The common formats (e.g. used in publications of the CSIRO) are explained below.

- **Journal article:**
  

  All authors are listed ("et al." is not used in the References list), and initials of their given names are included. If you used, say, "1993a" and "1993b" in the main text to distinguish two papers by the same authors in the same year, continue that practice when you list them in the References section. Give the title of the article, and place a full stop at the end. The journal name should be spelled completely, not abbreviated. (Some journals do abbreviate journal names, but we will not follow that practice). The notation "171:737-738" means volume 171, pages 737-738. There are sometimes slight variations to the format, such as '171, 737-738". We never use "vol. 171, pp. 737-738" because it is cumbersome.

- **Book:**
  

- **Chapter from an edited volume:**
  

8. **Tables**

   Each table should be numbered consecutively with an arabic numeral, according to the order in which they are mentioned in the main text. A table should have a title followed by any explanatory legend containing all of the information needed to understand the material presented in the table.

9. **Figures**

   Like tables, each figure should be numbered consecutively with an arabic numeral, according to the order in which they are mentioned in the text. Figures also have a title followed by an explanatory legend, but these should be placed below the figure itself. If you are adept with word processing software, you may embed tables and figures on the same pages as the text. A simpler and allowable format is to put each figure or table on a separate page and include these pages at the end of the report.
Some hints on writing a good report

1. Write for an uninformed and anonymous reader. THIS IS VERY IMPORTANT. Students often implicitly address their writing only to the instructor who was there during the prac, and make the assumption that the reader already knows what was done. You must write as if the report will have many anonymous readers.

   Poor style: We selected female flies and put them in the bottles with the males for mating, following the instructions in the practical handout.

   What flies? What bottles? What handout? Yes, your instructor knows, but no one else would.

   Proper style: We selected five virgin female *Drosophila melanogaster* flies that had been isolated shortly after eclosion, and placed them with five wild type males in 150 ml bottles containing a yeast-based culture medium.

2. Don't staple the practical handout to the back of your report as an appendix, and then write "see the Appendix" as a way to avoid describing in your own words what you did.

3. In general, use the past tense—the study has been done.

4. Be aware of the distinction between the first-person, active voice and the third-person, passive voice.

   Active: I used spectrophotometry to determine the concentration of sucrose in the solution.

   Passive: Spectrophotometry was used to determine the concentration of sucrose.

   Check with your subject coordinator to determine standards for active and passive voice. Despite what you may have been taught in high school, first person, active voice is commonly used in scientific writing.

5. Read widely and do not base an essay or report on one or two references. It usually shows.

6. **Write at least one rough draft** that you re-read and correct before producing the final copy. Check your spelling. Most word processors have spell-check features, so you can get electronic help with this task. Spell-checkers pick up incorrectly spelt words, not words that are simply inappropriate (e.g. there and their) so you should carefully read your work and revise it when the writing isn't good enough. It is your choice if you don't want to bother revising, but no one writes well on the first pass, so expect a poor mark.

7. Avoid using footnotes. If it can go in a footnote, it can go in the text.

8. Make sure that your bibliography has only the references cited in the text, and that it contains all of the references cited.

9. If you don’t have access to a word processor (available to all students in the university computer labs), then write legibly.
Special elements of technical writing in the biological sciences

Scientific Names

Latin binomials (e.g., *Homo sapiens*) are always treated as foreign words, and therefore are underlined or italicised. You must use either underlining or italics for Latin binomials (and other foreign words) in your papers. When a foreign word has become part of common English usage, then it is no longer considered foreign and is no longer italicised, e.g., 'kangaroo', 'mosquito', 'junta', 'rhinoceros', and 'gorilla'. However, you should clearly distinguish between 'gorilla' as a common name and 'Gorilla' as the name of a genus.

The first time you use a Latin binomial name of a microbe, plant, or animal in the body of a paper, you should spell the generic name in full. Subsequent to its first use, abbreviate the genus name using its first letter followed by a full stop, and then followed by the species epithet. For example, write *Homo sapiens* for the first mention of this taxon, and *H. sapiens* subsequently (unless a sentence begins with the Latin name, in which case the genus name should again be spelt in full).

Names of taxonomic phyla, orders and families begin with a capital letter and are not italicised or underlined, e.g., 'Lepidoptera' or 'Santalales'. Ordinal names are often converted from proper to common nouns by adding an 'n' to the end of the word and using a lower case first letter, e.g., 'lepidopteran' (N.B. - this is a similar usage to 'Australian', etc.). Modified taxonomic names can also function as adjectives, e.g., 'orthopteran egg case', or the final letter can be dropped and 'ous' added, e.g., 'lepidopterous'.

Abbreviations

Several frequently used phrases, usually derived from Latin, are now abbreviated. In general, these abbreviations are in common usage, so the rule about italicising or underlining is relaxed. However, because they are abbreviations you must use periods where appropriate, for example 'e.g.', 'i.e.', 'etc.', 'Ph.D.', 'et al.' (N.B. 'et' is a complete word and is not followed by a period, and also note that most journals still treat *et al.* as a foreign phrase). Certain abbreviations relating to measurements are no longer followed by periods, e.g., 'g', 'm', 'um', 'L'. When indicating a rate or density, use the reciprocal. For example, use 'g⁻¹' for 'per gram' or 'm⁻²' for 'per m²'. Always use a space between a number and an abbreviation (e.g., '10 m' not '10m').

Numbers and dates

Use arabic numerals when a measurement is followed by its units, e.g., '1 m', '10 g', '100°C'. Otherwise, spell out the numbers one through nine, but use arabic numerals for 10 and above unless they come at the beginning of a sentence.

Statistical analyses

You should include a complete but concise description of the statistical methods used in the 'Materials and methods' section along with citations to appropriate texts. If a statistician helped with the analysis, then this should be noted in the 'Acknowledgements' section. Means ± standard deviations or 10 standard errors are commonly used for summary statistics. If that is what you used, then let your reader know. When presenting results of statistical tests make sure that you give: the test used (e.g., analysis of variance, Mann-Whitney *U*-test, Paired *t*-test), any transformations used (e.g., arcsine square-root transformed proportions), the *P*-value, and the test statistic with the
number of degrees of freedom or '\( n \)'. In the Results section, clearly explain the meaning of any statistical results, including significant interaction terms.

**Commas and lesser forms of punctuation**

Every student should be familiar with the proper usage of commas and should use a semicolon appropriately at least once in their life. Commas indicate a brief pause and are important to the understanding of any complex sentence. Examples of most of the following rules can be found in the text of this paper.

<table>
<thead>
<tr>
<th>Use semicolons:</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>to separate a series of citations or elements in lists;</td>
<td>(Day and Quinn 1989; Closs and Lake 1994; Walter et al. 1994)</td>
</tr>
<tr>
<td>when a conjunctive adverb, such as 'however', 'thus', 'therefore', or 'consequently', is used to join independent clauses;</td>
<td>Mites are not microscopic; however, they are the smallest terrestrial arthropods.</td>
</tr>
<tr>
<td>in place of a comma + conjunction when emphasising the meaning of the second of two independent clauses; and</td>
<td>Mites are minute; they are the smallest terrestrial arthropods.</td>
</tr>
<tr>
<td>to separate a series of phrases with internal commas.</td>
<td>Look at the 4 elements in the column on the left.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use commas:</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>after introductory phrases, interjections, or nouns in direct address;</td>
<td>Another day, another 50,000 mites counted.</td>
</tr>
<tr>
<td>to set off phrases or clauses that do not limit or define a subject (i.e., are not essential to the meaning of the nouns they modify);</td>
<td>Students, even those with advanced degrees, often use commas incorrectly.</td>
</tr>
<tr>
<td>to set off quotes within a sentence;</td>
<td>She said, 'Use commas!', and I did.</td>
</tr>
<tr>
<td>where appropriate in dates, addresses, and numbers;</td>
<td>See the first example.</td>
</tr>
<tr>
<td>to separate items in a series; and</td>
<td>Examples of this rule abound in this paper.</td>
</tr>
<tr>
<td>to set off nouns or phrases in apposition when necessary for clarity.</td>
<td>Tetranychus urticae (Koch), the two-spotted mite, attacks over 200 species of plants.</td>
</tr>
<tr>
<td><strong>Do not use commas when they are not needed.</strong></td>
<td>Over 200 plant species are attacked by the two-spotted mite Tetranychus urticae (Koch).</td>
</tr>
</tbody>
</table>
Some useful references


PLAGIARISM AND CHEATING
(http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-policy.html)

"The submission of essays, assignments and homework is an essential part of the learning process and a vital way of assessing students' understanding of a subject. The submitted work must therefore be a student's own work. This does not mean that students may not make use of the work of others. However, in quoting or paraphrasing material from other sources, those sources must be acknowledged in full. It may be useful to seek the help of a tutor, lecturer or demonstrator in preparing the piece of work, and to enlist the help of fellow students in sorting out ideas, but the final product must be written by the student in his or her own words. Plagiarism occurs when students fail to acknowledge that ideas have been borrowed. Specifically, it occurs when:

- phrases and passages are used verbatim without quotation marks and without a reference to the author
- an author's work is paraphrased and presented without a reference
- other students' work is copied or partly copied
- other people's designs and images are presented as the student's own work
- laboratory results of someone else are used without appropriate attribution
- items for assessment are written in conjunction with other students (without prior permission of the relevant staff member)
- a piece of work has already been submitted for assessment in another unit."

If in doubt, seek the advice of your lecturer.

(Reviewed: November 2013)