STUDENT GUIDE TO REPORT WRITING

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Relative importance of the report

Environmental science involves more than doing lots of experimental work, field work or library research. You must be able to communicate your results and ideas to other people. If you cannot communicate the results of your work to others, there is little point in starting the work in the first place! Much of your practical work will be assessed from your written reports, so it is a good idea to learn the basic approach to report writing **now**, rather than at some time in the future, after you have got your marked reports back, for this reason!

In Environmental Science, the written work can take the form of any of the following: laboratory report, essay, project, literature review and field work report. In this document we intend to set general guidelines applicable to any of these forms of your submissions. Some units may have particular requirements stated in the Study Guide, but in general you should use this document as a guide to your written submissions in Environmental Science. Any of the above mentioned forms of written submission will be referred to in this document as a **report**.

By observing the correct approach to report writing, you help yourself in a number of ways. By getting the basic format, results and reference style correct, you avoid losing 'easy' marks from the outset. You can then focus on the 'science' of what it is you're looking at and concentrate on developing your ideas.

It goes without saying that the report writing process is just as important when you are a student as it is when you do environmental work professionally. So budget enough time to write a decent report. A report concocted the night before it is due usually looks that way.

When to plan the report

It is a good idea to plan out your report as soon as your experiment is underway. Doing this will help you see the relative importance of various aspects of your work, and you may even realise the necessity of collecting a particular piece of information during your experiment that you might otherwise have missed. Always write up sections of your work as you go along. Experience has shown many that sitting down and trying to write up a year's worth of information can be daunting.

The structure of your report

Most experiments and reports can be written up using the format described below. Some work however is more descriptive or observational and may not fit into this scheme, so do not feel obliged to force your project into this format. It is a good idea though to get used to this system as it is the preferred format of most, if not all, scientific journals and government reports; and more importantly the preferred system of most of your assessors.

The conventional format is as follows:

Abstract
Introduction
Materials and methods
Results
Discussion
Acknowledgments
References
Appendices

Important Point No. 1

Always write in past tense. You 'did' something, or 'measured' something. **Do not write in present tense.**

Abstract

This section should never be more than a short paragraph (100 to 300 words) and should state briefly what you found in your study (that is what you examined, where, what you found). Simply state briefly what your aims were, what you found and what you concluded from your study. If necessary you can list the points in note form.

It may seem a bit silly to put this section first. However in the 'high powered modern scientific world' sometimes your title and your abstract may be the only things someone will read, because they need to find out whether your work was relevant to theirs and they don't want to read the whole paper to find that out. This is why an abstract is so important.

Be assured though, markers will read your work all the way through!

Introduction

In this section introduce your work, state why the project was worth investigating and give a brief summary of the general and background information you have gathered from books, reports and/or journals. Describe (briefly) what it was you were working on and what your aims were. As a rule of thumb its often useful to try a three paragraph approach to your initial report writing:

Paragraph 1 - What it is you are investigating, why it is interesting
Paragraph 2 - What information is already known on the topic
Paragraph 3 - What were the aims of the study you have just done.

Make sure you connect the paragraphs together in a reasonable style.

Materials and methods

In this section you tell the reader how you did the experiment, the analysis or how you collected the data. Where did you do it? What did you do it on? What did you do it with? You should give only sufficient detail so someone can repeat your work if they desired. Do not get bogged down by listing every staple, rubber band or pencil that you used. It is also not necessary to give a list of all the material that you used at the start of this section. Just write this section as though you were explaining to someone else how you did 'it' so they could follow.

In many cases if you are following a lab manual you can make this section much more brief by referencing the lab manual and giving any modifications you used to the method described there. **Make sure that you do in fact show any modifications to the methods, as your markers will be looking for them**. An example of this sort of approach is:

"The dissection of the cockroach was carried out using the technique described in the practical manual (Environmental Biology, 1991), with the modification that a chainsaw was used instead of scissors". Don't forget to reference the lab manual in your reference section.

Results

An extremely important section. It is here that you describe what you have found. Introduce the reader to your results. It is **not** sufficient to list reams of tables and graphs as a result section. Point out trends in the data or interesting facts about it, and **then** refer the reader to them. For example "The amount of violence observed at bus stops was found to be directly linked to the hours spent watching American produced soap operas (Figure 1)". or "The species area curve illustrates that 25 samples were sufficient to sample 99 % of the animals in area A (Figure 2)".

The nice thing about ordering the way you present data, apart from good science, is that it helps to keep it clear in your own mind when you come to write the discussion. It also helps to point out to **you** what you actually obtained.

It is not necessary to include all of the raw data in this section: if necessary you can put it in an appendix. The same thing goes for laborious calculations. If you only want to show the answer of the calculations it is not necessary to include the whole mathematical schema.

It is not necessary to give the reader your information both as a graph and as a table. Some data lends itself to either presentation whereas other information clearly illustrates the point better as a table rather than a graph or *vice versa*.

Important point No. 2

There are several things which should be remembered when presenting tables and figures (for example, graphs, histograms, photographs). The first point is, don't assume that the reader knows what you are talking about. Treat the reader as an intelligent individual who has never heard of your results and has no idea of what the table or figure is. Do not assume that the examiner will *'know wot I mean'*. This is not the way to score marks.

So, a table or figure must have an informative **title** that explains what it is, and this title must be self-contained, so readers do not have to plough through the text to work out what they are looking at. It must also explain any legends or symbols used in the figure or table. Label the axes and state what units have been used.

By convention a figure legend is placed at the **bottom** of the figure and a table legend is placed at the **top** of the table (for example as shown in Figure 1 and Table 1 shown on the following pages). The reasons for this are buried in antiquity, but it is a good convention to follow.

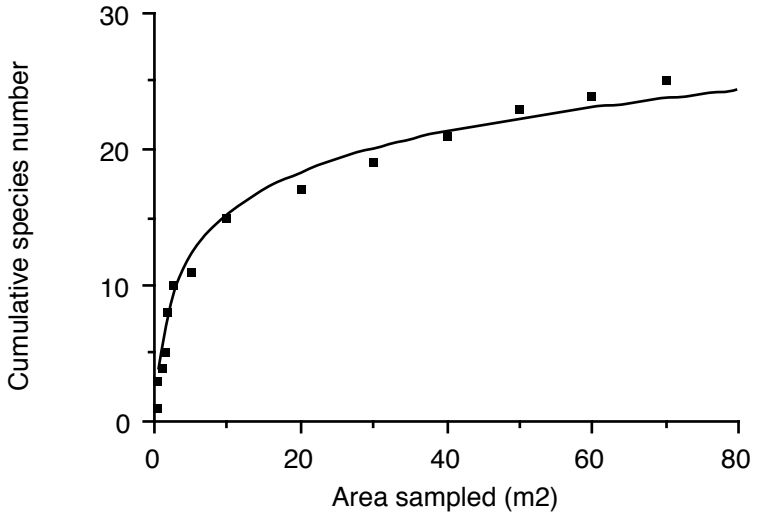

Figure 1. The number of species found in different sized sampling quadrats at Site A.

Try to present the information on an A4 page wherever possible. Huge fold out graphs and tables are often indigestible. Only if it is impossible to separate the results and discussion section should you combine them in one section.

It is not advisable to discuss your results in the results section. It is improper science to blur the boundary between objectives, raw results, and subjective discussion. The main purpose of the results section is to objectively point out what you have discovered and point the reader to trends in the data and so on. The reason **why** you got the results should be left to the discussion.

Table 1. The number of alcoholic drinks necessary to turn representative social groups somnambulistic when administered at an hourly rate.

Social group	Sample size	Number of drinks (mean)	Standard error (%)
University lecturers	12	10	20
Teachers	10	8	10
Lawyers	67	2	1
Doctors	21	7	13
University students	467	25	32

Important Point No 3

You should have only **Tables** and **Figures** in your reports. All illustrations, which maybe "graphs", "diagrams", "maps", "photos", "plates" should be referred to as a Figure.

Important Point No 4

Illustrations such as maps and aerial photographs or satellite images need to be adequately labeled. They need to have the following elements: title (part of the caption), scale (even approximate), **date** (especially relevant for aerial photographs and satellite images**), north sign**, **source** (for example Department of Land Administration). Maps may need a **legend** or a key to symbols and colours being used. If the map is at a very large scale (say 1:500) it is very useful to have a location diagram, showing perhaps the nearest landmark such as a road intersection. It is often better to draw a scale bar instead of quoting a ratio scale (e.g. 1:500), because when the page is photocopied, the scale changes due to distortion of the photocopy machine.

Discussion

This is the good bit. It is here that you get to express **yourself** the most (followed closely by the Introduction). It is here that you develop your thinking and logic. Why did you get those results? Are they different from someone else's? If so, what are the possible reasons? Do not be alarmed at the prospect of writing up an experiment that 'did not work'. It is not a waste of time, as many students seem to think. An experiment that doesn't work or didn't get the expected results is often more valuable than one that did, particularly if it makes you think about the limitations of the experimental technique. You also get the opportunity to give suggested improvements for the experiment, although this point applies equally as well to experiments that did 'work'.

Therefore, in this section you explain why you got the results, which you have just presented in the previous section, and relate them back to the aim you stated in the introduction. It is perfectly reasonable to refer to the results to back up one of your points. For example, "In this experiment we showed that the time of day indeed influences the ability to study (Figure 2). This was also shown in studies performed by Frankenfurter *et al*., (1989), and Greasemonkey and Screwloose (1987)".

The results you obtained in your experiment should be compared to information you mentioned from books and other sources in the Introduction and with other published information that it is relevant.

Acknowledgments

Here you get a chance to thank people who have given you material or helped with the work. It is particularly relevant to thank people who have given you money to do the work. If the document contains a preface, include acknowledgments there. The key point here is to be brief, do not gush, crawl or make it seem like some other person did all the thinking and the work (unless they did!).

References

Another important section. A **Reference** section is all the work you used (for example quoted, used information from, or discussed) in the production of your report. This work includes copied **photographs (including aerial photographs), maps, tables and figures**, not only **text**! A **Bibliography** is any article you looked at, and thought may be useful. Do not use bibliographies. You may have read 57 books but only reference the 5 you mentioned.

Attention to detail is very important here. Even though it seems fiddly, it is very important to get the details of your references right in your text and in your reference section. It is infuriating in professional journal to find that someone has referred to an article that is not in the reference section or has been misquoted you have little chance of finding it without a lot of hassle.

When you refer to authors in the text of your report, the preferred format is as follows;

Single author:	(Scronky, 1990) or Froople (1981)
Two authors:	(Frazer and Lucas, 1969) or Plantzen and Plonk (1978)
Three or more:	For example, an article written by Froople, Scronky and Frazer in 1981 is referred to as: (Froople *et al*., 1981) or Froople *et al*. (1981). The words '*et al*.' are Latin and are short for '*et alii*', which simply means 'and others'. You could also refer to the article in the text as "Froople and colleagues (1981) found that..." or "Froople and others (1981) showed...".

All references should show enough information so that someone else could find the article you mentioned. The 'standard' sort of format looks like this:

Author or Authors (Date) 'Title of the article or book'. Journal or Publisher. relevant page numbers.

So for a book:

Dell B. and Bennet I.J. (1986) 'The flora of Murdoch University'. (Murdoch University, Perth).

Environmental Biology (1990) 'Environmental Biology 1990 Practical Manual'. (School of Biological and Environmental Sciences, Murdoch University, Perth).

Roughly T.C. (1971) Fish and Fisheries of Australia'. (Angus and Robertson, Sydney).

For a scientific article:

McComb A.J. (1973) The South-West of Western Australia. Journal of the Royal Society, W.A. 56,1-2.

(note how you put the title of the journal (underlined), the volume number and then the relevant page numbers)

Untawale A.G. and Jagtap T.G. (1984) Marine macrophytes of Minicoy (Lakshadweep) coral atoll of the Arabian Sea. Aquatic Botany, 19, 97-103

For electronic publications:

Blinn, C (ed) Ecosystem management. A Current Selected Bibliography and Index (Online), Available World Wide Web: URL: gopher://minerva.forestry.umn.edu:70/11/ecosys (Accessed 4 November 1996).

Any other reference styles you will be able to obtain from the library or from looking at the reference sections of various books.

Yet another important point

Ensure that the references you have quoted in your text are actually recorded in the reference section and *vice versa*. Ensure also that your references are in alphabetic order.

Style, presentation and level

Everyone has their own style of writing and this style should show through even when your material must be pounded into a conventional format. Convey to your reader your enthusiasm for your investigation without using colloquial phrases ("Bonza crab experiment on the reef") or unnecessary scientific jargon ("most interesting investigation into the biology of a member of the common decapoda (Arthropoda: Crustacea) that occurs on the geographic stratification of our local coastal rock outcrops"). Write clearly and simply. **Try reading it out aloud** (pets are a good audience); if your sentences are such a mouthful that you stumble over them, they are not good.

So who do you pitch the report at? How much information is necessary? Your friends, parents and a professional environmental scientist may read your report. The best idea is to write it for an intelligent person (for example. a colleague who is also doing environmental science) who has a general knowledge of environmental science like you. You do not need to go into gobbets of detail, but you do need to explain new information or unusual methods that you alone know about.

Do whatever is necessary to include the readability. Do not hesitate to use the semicolon. Run-on sentences are very annoying; it is poor style to repeat a complex subject just to be exact. In some cases it may also be clearer to put paragraph indents, especially for separate mathematical formulae or separate quotations.

Typing of report produces a document that looks good, but typing is not essential. There are a number of things to check (that are more visible on a typed report), whatever method you use. **It is vitally important you do this**. What sounded perfectly reasonable to you at 4 am in the morning often does not sound reasonable to anyone else on the planet the next day. By proof reading you also ensure that you are not throwing away marks on stupid mistakes. Below is a checklist you should follow:

1. typographical and spelling errors in the text
2. mathematical or typographical errors in tables and graphs
3. omissions of headings, and captions on tables and figures
4. errors in the references
5. try reading the work carefully (and slowly), sometime after you have finished.

Writing well is not easy. Even great authors find it difficult:

> *'One fusses about style. One tries to write better. One takes pains to be simple, clear and succinct. One aims at rhythm and balance. One reads a sentence aloud to see that it sounds well. One sweats one's guts out.'*
>
> W. Somerset Maughan.

Latin abbreviations are often used in the text. The following list includes some of the most common ones. The abbreviations are written in roman type whereas the full Latin word is typed in Italics. It is preferable to use full English expressions. Use *for example* instead of 'e.g.' and *that is* instead of 'i.e.'. Some abbreviations are to be avoided altogether, for example, 'viz.' and 'etc.'. Use of 'etc.' in the text suggests both a lack of facts and a casual approach.

app. - appendix

e.g. = *exempli gratia* - for example

et al. = *et alii* - and others

etc. = *et cetera* - and so forth

i.e. = *id est* - that is

References on experimentation and scientific writing

Fowler F.P. (1969) 'A dictionary of Modern English Usage'. Oxford University Press, Oxford.

Heath O.V.S. (1970) 'Investigation by experiment'. Studies in biology No. 23. Edward Arnold, London.

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Woodford F.P. (1969) 'Scientific writing for graduate students'. Rockefeller V.P., New York.

12 November 1999