Biology Department Fall 1996

Lab Reports for Biology

Please follow the instructions given below when writing lab reports for this course. Don't hesitate to ask if you have questions about form or content. Above all, remember to write with **precision, clarity, and economy**.

Writing Your writing should be in ***full sentences*** and ***easily understood***. It should conform to the conventions of standard written English (sentence form, grammar, spelling, etc.). Good writing is as important in science as it is in other disciplines because one's ideas have little impact, no matter how important they may be, if they are not well communicated. While style is mostly an individual characteristic, everyone should strive for presentations that are easily understandable as well as grammatically correct. One reason for emphasizing clarity is that writing and thinking are closely related; as many people have said, "fuzzy writing reflects fuzzy thinking." When people have difficulty translating their ideas into words, they generally do not know the material as well as they think.

Style Scientific writing is usually in the past tense because one reports on experiments that have been completed. The writing should not be too self-referential (e.g., "I ground up the..."), although you may use the word "I" if doing so makes the writing easier to read. Writing that is predominantly in the passive voice is deadly to read (e.g., "acorns were eaten by the squirrels"), so use the active voice as much as possible (e.g., "squirrels ate the acorns"). Remember: ***past tense, active voice***.

Presentation The first page of a lab report should be a title page with the title of the report, your name, the date, the course (e.g., Biology 210), and your lab partners. There should then follow text that is a minimum of two pages and a maximum of five double-spaced, typewritten pages in length (tables, figures, and references do not count in this total). All writing should be on only one side of the page, and the reports should be stapled in the upper left-hand corner. The best length is shorter than the maximum, so don't expand a shorter report to reach a five-page limit. It is important to ***write concisely***. The report must be typed or word-processed. Neatness and clarity of presentation are almost as important as clarity of thought.

Audience Write the report as if you were writing to other students who are taking a similar course but have not done this experiment. Assume that they have some familiarity with the subject matter but no expertise. Do not write specifically for the instructor.

Collaboration You may talk about the lab exercise as much as you like while in the laboratory. Outside the lab, though, you should ***not*** discuss ***your writing*** of the report with anyone else, other than a tutor at the Writing Center. It is essential that you write your own report. You ***may*** and are encouraged to discuss the experiment itself with anyone at anytime to ensure that you have understood it.

References If you use outside sources, and you should, then cite those sources in the body of the report and list the references in a literature cited section. Citations should be made with a standard scientific format (**not** by footnotes); cite the author and date of publication only, so that a quick look at the Literature Cited can provide the reader with all necessary information. When there are more than two authors, simply list the first author and et al., along with the date. You should not use direct quotations from the references; paraphrase information and give credit to the source of the idea. The following are sample citations:

> "Garrett (1989) showed that a gene in yeast ..."
> "... is found in the urinary bladder of the turtle (Gapp et al., 1990)."
> "... as reported recently (Miller, 1986; Pfitsch & Pearcy, 1989)."

You should list a reference for every idea not your own. Plagiarism is more than copying material word for word; it is also using someone else's ideas or phraseology without giving reference to the other work or other person. Fortunately, the reference format is so simple that it is very easy to include references to all the work that one has used (Williams, 1983). If the idea is not published but is provided by a lab partner or someone else, give the reference as a personal communication (N. Cutler, pers. comm.). Be aware of the difficulties that arise when one uses material from another source and changes only a word here or there without acknowledging the source. Such actions are plagiarism, even though the statement may not be word-for-word the same as in the original. Just remember the basic rule: ***list a reference for every idea or statement not your own***.

Format There are four fundamental sections to a scientific report, with acknowledgments, literature cited, and appendices being additional sections. An underlined heading should be given at the beginning of each section (optional for the introduction). Keep in mind that the lab report is parallel to the experimental process (D. Flynn, 1988):

Experimental Process	*Lab Report*
What is the problem?	Introduction
How did I solve the problem?	Materials and Methods
What did I find out?	Results
What does it mean?	Discussion

Introduction - Begin with broad statements, including enough background information (with reference to outside sources) to set the stage for your experiment. Then narrow down to your particular study, explaining why it is of interest. Specify the objectives of the experiment, and make your hypotheses clear. One to three paragraphs is usually sufficient. Do not regurgitate the lab handout; write your own introduction.

Materials and Methods (or just Methods) - Summarize ***briefly*** the entire process that was followed and the materials that were used, and then refer to the lab directions and to any flow charts you have included for the details. Do note any differences in the procedures you actually followed from what was specified in the lab directions. Anyone who reads your report should be able to duplicate the experiment. This section should be a small part of the report, so don't expand endlessly. ***Do not*** include results here.

Results - The data and results are given here in summary form. All results should be described in a ***narrative***; don't just list measurements. One of the most common mistakes beginning students make is to omit the narrative in the results section. The narrative should be more than just saying, "Table 2 shows the percentage of students with different blood types." You should state and explain the actual results, e.g., "Most students had type O blood, while the fewest had type AB (Table 2)." Data must be presented in figures (graphs) and in carefully planned tables, rather than as raw data. All tables and figures should be ***titled and numbered sequentially***, and the axes should be well labelled with clearly marked units. In addition to the title, each table and figure should have a legend (1 to 3 sentences) which explains what is being presented. A sample table and figure are given at the end of this handout. If the whole thing can be typed, it is a table; if lines have to be drawn, then it is a figure. Each table and figure should be put on a separate page and referred to by number in the results narrative. Tables and figures follow the text of the report (after the literature cited). Sample calculations may be included in an appendix at the end of the report.

Discussion - In this section the results should be ***interpreted*** and their significance ***explained***. Begin the discussion by interpreting your specific results and end it more broadly by placing your results in context. Don't declare the experiment a success or failure; ***evaluate*** the results in view of the purpose of the experiment. If erroneous results were obtained, discuss the results you expected as well as those you received. You may also compare methods or discuss difficulties, but if you list sources of error, you should estimate how important each source of error may be. If you were to do the experiment again, what if anything, would you do differently? It is inappropriate to include statements such as "I learned a lot from this experiment..." The discussion is a very important section; it is your chance to show how well you understand the ideas and techniques involved and to relate your results to the ideas expressed in outside sources (the literature cited).

Acknowledgments - The acknowledgments section is optional. If you wish to thank someone, such as a lab partner or a tutor at the Writing Center, for help in understanding the experiment or in organizing the report, you do so here. Scientists regularly acknowledge others for helping with experiments or commenting on written drafts.

Literature Cited - List any publications referred to in your paper alphabetically by first author; do not number them. Every item in your bibliography should be referred to in the body of your paper, or it shouldn't be listed at all. If you use information from an intermediary source, you should list the original reference but should also note the intermediary: "...cited in...". We will use the following standard forms (some journals use variations of these), shown in order for: (1) an article with one author, (2) an article with more than one author, (3) a book, and (4) a chapter from an edited volume:

Reynolds, P.D. 1992. Mantle-mediated shell decollation increases posterior aperture size in *Dentalium rectius* Carpenter 1864 (Scaphopoda: Dentaliida). Veliger 35:26-35.

Gapp, D.A., R.N. Taranto, E.F. Walsh, P.J. Favorito, and Y. Zhang. 1990. Insulin cells are found in the main and accessory urinary bladders of the painted turtle, *Chrysemys picta*. J. Exp. Zool. 254:332-337.

Stokes, D., L. Stokes, and E. Williams. 1991. The Butterfly Book. Little, Brown and Co., Boston. 96 pp.

Pearcy, R.W., and W.A. Pfitsch. 1994. Consequences of sunflecks for photosynthesis and growth of forest understory plants. Pages 343-359 *in* E.D. Schulze and M.M. Caldwell, editors. Ecophysiology of Photosynthesis. Springer Verlag, New York.

Appendix - Appendices are optional. You may use them to include your laboratory handout, sample calculations, sets of raw data, etc.

Final Check The last thing to do before turning a report in is to ***read it***. Correct all typographical errors and other mistakes, and ensure that you have said what you wanted to say!

This handout was written by E.H. Williams, Hamilton College, with modifications by D. Gapp, N. Cutler, and E. Cuebas-Incle.

Sample Table:

Table 1. Frequency of ABO blood types in Biology 210. The results are given as both the number and percentage of students with different blood types, and they are reported for both Monday's lab and for the entire course. The data are from 1981.

Blood type	Monday Lab number	Monday Lab percentage	All Sections number	All Sections percentage
A	6	23.1	47	32.9
B	4	15.4	26	18.2
AB	0	0.0	7	4.9
O	16	61.5	63	44.0
Totals	26	100.0	143	100.0

Sample Figure:

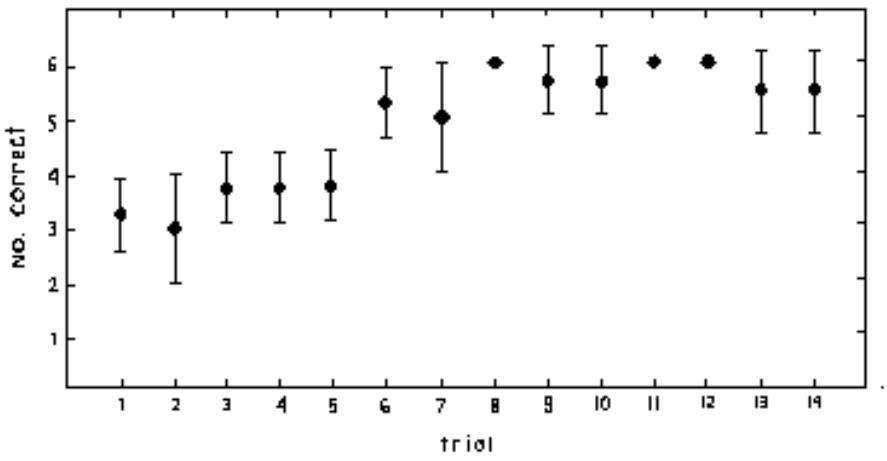

Fig. 1. Mean scores of all squirrels in the training trials. The scores represent the number of correct (rewarded) choices in the first six artificial caches visited. The trials took place over a 3-4 week period.