**WRITING A LABORATORY REPORT: NOTES TO STUDENT EXPERIMENTERS** last

Adapted by B. Smith from D. Mowshowitz and D. Blackman.

It is extremely important that you understand the need for, and format of, a good report. Scientific work of any sort is useless unless its results can be communicated to others. Over the years a particular format, or general outline, has evolved for the preparation of scientific reports. It is this format which you should get accustomed to using. **Generally a scientific paper has five sections.**

Each section should be titled and separated between sections. Before you start each section you need a title page with a title, your name and maybe the date.

    1) **Introduction**: Include a statement of the problem to be investigated, why the work was carried out, history and theoretical background of the problem, a brief statement of the general method of approach to the problem, and expected results.

    2) **Methods and materials**: This section tells the reader how and with what the work was done. The methods and materials section of a research paper is often glossed over by many readers, but, in terms of the report as a historical document, this section is crucial. You should try to strike a balance between an over-detailed description of even the most trivial items and a very sketchy statement that provides insufficient information. The important guideline is that another worker of similar training and ability, following your description, should get the same results. Note that this section should be written as a description of what you did, not as a set of instructions. **This should be in correct sentence form and paragraph form just as the rest of the report. Do not bullet unless otherwise instructed to do so.**

    3) **Results**: Here is the real meat **of a report**. In this section you should describe the important qualitative and quantitative observations is your work. Data should be tabulated and/or graphed and described. One of the common errors in report-writing is to forget to explain data and tables or graphs. Be aware that tables and graphs are not self-explanatory, and must be summarized for the reader.  
    **All graphs and tables should be numbered and provided with a title. Additional information which makes the data more comprehensible should be provided as needed.**

    4) **Discussion and conclusions**: This section serves two functions. First, it provides a place where the data may be fully discussed and interpreted, and second, it allows the author to delve into the realms of speculation. Here one may address questions like "why did something unexpected happen?" ; "what would happen if the reaction were carried out at higher pH?"; "why did the expected results not materialize?" In this section the author may (discretely) pat him- or her-self on the back, criticize other workers results, suggest improvements in methodology, etc.

    5) **References**: Some papers have no references, others have 200 or more. There is no correct number of references, but there is a correct philosophy and format: any time you refer to a previously reported idea, result, method, etc., you must insert a citation. Every quotation must be referenced. Not to do so is, at best, a violation of scientific and literary ethics and, at worst, plagiarism.  
    A. Where do the references go?  References may appear at the bottom of the page on which they are first cited, or listed at the end of the paper. The latter seems to be more convenient; the bottoms of pages in the report may thus be reserved for other footnotes.   
    B. How do you designate & list references?  In the body of a report, a reference may be designated in one of two ways -- by name of author or by number. If you list the references at the end of the paper, the order depends on which method you use, as follows:

1. By Author & date: One method is to place the last name(s) of the author(s) and the year of publication in parentheses, immediately following the referenced thought. As an example, one might write,

"A phosphorylated histidine residue has been proposed as an important component in the mechanism of action of succinylcoenzyme A synthetase (Bridger, Millen and Boyer, 1968)."

    If this method is used, the list of references at the end of the paper must be in alphabetical order, according to the last name of the first author.  
      
2. By Number: In the second method a citation may be designated by a number in parentheses (not a superscript; superscripts are reserved for footnotes). In this case, one would write:

"A phosphorylated histidine residue has been proposed as an important component in the mechanism of action of succinylcoenzyme A synthetase (6)."

    If this method is used, references are listed at the end of the report in the order in which they appear in the text, rather than alphabetically.

    C. What is the format of a reference? With either method of citation the format of the reference list should be as follows:

1. For a periodical: A reference to a periodical should include, in the order given:

1. - Name(s) of author(s), (last name, first initial).

2. - Name of periodical (use standard abbreviations).

3. - Volume number, underlined.

4. - Page on which article begins (or where it begins and ends)

5. - Year of publication, in parentheses.

For example: Bridger, W.A. Millen, W.A. and Boyer, P.D. Biochemistry, 1: 3608 (1968).

2. For a book: A reference to a book should include, in the order given:

1. - Name(s) of author(s), as above.

2. - Title of book, in quotation marks.

3. - Edition, if more than one have been published.

4. - Name of publisher

5. - City of publication

6. - Year of publication

7. - Volume number (if necessary)

8. - Page(s) on which the point cited is found.

For example: Lehninger, A.L. "Biochemistry", 2nd ed. Worth Publishers, Inc. N.Y. 1975, p.224.

Finally, there is a note about form and style. Philosophically, science should be independent of scientists, their times, and places of work. That is the actual discoverer of a principle is less important than the principle itself. If, for example, Watson and Crick had not developed the structural model of DNA, then surely someone else would have done so. In conformance with this philosophy scientific writing should be impersonal. **Thus, reports should be written in the third person, rather than the first.** It is also traditional to write scientific papers in the passive, rather that the active, voice. For example, one should avoid statements like, "I heated the protein solution to 100EC and formation of a precipitate was noted."

Reports should be written with care, typed if possible, but in any event, completely legible, as soon as possible after completion of the experiments described. The actual recording of data in the laboratory should be done in a notebook. Loose leafs are often the most convenient, but never write your data on loose scraps of paper or paper towels and always put your data sheets into your notebook immediately.