BIOC 463a
2004-2005

How to Write a Lab Report

As stated in the Course Syllabus and in class, a major goal of BIOC 463a is to help you develop the skills that are necessary to write a scientific paper in a format suitable for submission to a professional journal. Because this is a novel endeavor for many students, and can be quite laborious, we will gradually ease into the process of writing a paper over the course of the semester. You will be given the "Instructions for Authors" from **BIOCHEMISTRY** and a manuscript submitted to that journal will be available for you to examine. The purpose of examining the article is to serve as an example for the layout of your lab report as well as the use of references, figures/figure legends, and tables/table legends. You might also consider visiting **BIOCHEMSITRY** online (available via any BMB computer or computers in the Science Library) and seeing what a published article looks like after it has been "manipulated" by copy editors. Finally Dr. Marc Tischler has put together a very informative scientific writing guide, BMB_Sci_Writing.pdf, which can be accessed via the BIOC 463A homepage.

Initial considerations you should have when writing a paper are:
"Why did I do this experiment?"
and
"What does the data that I collected tell me about the system I am studying?"
and
"How can I relate this information to another researcher?"

If you can answer these three questions and present the material in a manuscript in a manner by which the reader can also answer these questions, then you have succeeded in writing a good paper.

Second, a good way to regard a scientific manuscript is that it is a means by which you tell the scientific community a story about the system you are studying. **A story has a beginning (the Introduction), a middle (the Results), and an end (the Discussion or Conclusion)!** Using this analogy, stringently avoid a flash-back approach to writing. If ever you are unsure about how well you have written a paper, read it OUT LOUD! Your eyes and brain may lie to you, but your ears never do! If it sounds as if it is poorly written, then it is poorly written!

Finally, in the initial experiments we ask you to compose figures from the data that you have collected. Many people write their papers "around" or based on the figures that they have composed. My personal preference is to write a paper in the following order: Materials and Methods, Results, Discussion, Introduction, References. Also, before beginning to write your report, we suggest that you be able to answer all of the questions that are in your lab protocols. Often these questions will also help you begin to develop an approach to how you want to write the paper.

Format for Report

The format for you reports will be based on standard formats for manuscripts being submitted for publication.

Title Page:

1. Here you need think up a creative short title for the report.
2. Below the title you list the authors: yourself and your lab partner. The convention for authors on research papers is: first author is the one who did most of the work; last author is usually the principle investigator (i.e. head of the lab); in between authors are people who made a significant contribution to the manuscript, either in collection of data, data analysis, or interpretation.
3. Affiliation: i.e. Department of Biochemistry and Molecular Biophysics, University of Arizona, Tucson, 85726 or whatever is your major department.
4. Funding information: This work was supported by grants from …we will omit this part of the title page.

Abbreviations: Any abbreviations that you have used in the text must be listed on this separate page. Typically, you footnote the first abbreviation in the text, and use the footnote for that first abbreviation listed on this page

Introduction: This provides as brief description of the purpose of the experiment. For full manuscripts, you usually cite (e.g., bring attention to) what is already known about the subject material.

Materials and Methods: Here you describe how you carried out the experiments, the material used, and instrumentation. For instance: " In order to prepare phosphate buffers at different pH values, solutions were prepared using 0.1 M stock solutions of KH_2PO_4 and K_2HPO4. Volumes of each stock were based on the Henderson-Hasselbach equation: pH = pKa + log ($[K_2HPO4]/[KH_2PO_4]$) (c.f. Table 1 in Results)(Ninfa and Ballou, 1998). The pH of each solution was measured using an Orion Model 7 pH meter equipped with a Sensorex S700C electrode.

For Expt. 1, you need to describe how you did the temperature dependence, and also how you measured conductance.

In the Materials and Methods, you DO NOT present any data. Also try to avoid using the possessive "I"!

Results: Here you present the data you collected. Again, remember, you are telling a story about your system, so you should have a good idea what you want to say before you begin. As stated above, often it is easiest to build you story around Figures and Tables.

Example: Table 1 lists the molar fractions of 0.1 M KH_2PO_4 and K_2HPO4 stock solutions used to prepare phosphate buffer solutions at the given pH values. The molar fractions were determined based on the Henderson-Hasselbach equation (Ninfa and Ballou, 1998):

(1) $pH = pK_a + \log ([K_2HPO4]/[KH_2PO_4])$.

(Note: I have now included the Ninfa and Ballou reference twice, in Material and Methods, and again in Results. This is common. Also, note that I have included (1) in the equation. All equations should be given a number, in ascending order.)

Figure 1 shows a plot of pH vs. the fraction of conjugate base ($H_2PO_4^{2-}$), F_{CB}. The solid line represents a theoretical curve based on equation 1, while the experimentally determined data points are shown as individual data points. The data obtained is (or is not) in good agreement with the theoretical curve, except at the extremes of the plot (i.e. very low and high F_{CB}). We can attribute this deviation to the fact that…. *(here you offer some reasonable explanation*). From the plot shown in Figure 1, we calculate that the pKa for phosphate buffer, within the pH range covered, is _____. This value is in very good (or very bad) agreement with the value ($pK_a = 6.8$) cited in Ninfa and Ballou (1998, c.f. Table 1-3).

Table 2 lists the temperature dependent behavior of 0.1 M potassium phosphate and TRIS buffers. The change in pH as a function of temperature was determined from the following equation:

(2) *give equation used*.

The experimentally determined values for each buffer are _____ for phosphate and _____ for TRIS buffers, respectively. These values are in good agreement with literature values (Fasman, 1992). A reasonable explanation for these results is…. *(give a short description of what you think controls this phenomenon)*.

Discussion: Here you can either expand on the ideas you presented in the Results section, or give a brief summary of the results and a brief conclusion about how they fit into the overall picture that you are presenting in the manuscript. For purposes of this experiment, just give a summary of the Results and what they mean.

References: You will notice that throughout the above description, I have included references to a variety of sources within parenthesis. Throughout the course of the semester, we will hand out photocopies of data (tables, figures, etc.) or manuscripts on which I have included the original reference. **You are expected to make use of this information and cite the appropriate authors whenever necessary.** Different journals have different requirements for listing references. Some use a numerical system, while others give the last names of

the authors and the date of the publication (as I have done above). Note, also that there are certain conventions followed for journal vs. book references. Follow the "Instructions to Authors" format for the journal **BIOCHEMISTRY**.

Tables: All the tables are organized together. Generally, for each table, a legend is provided. A legend for a table, as well as a figure (below) should contain pertinent experimental information, such as buffer conditions, etc.

Figure Legends: For each Figure, you need a Figure Legend, in which you describe any symbols used, and any other pertinent material needed by the reader in order to understand the data presented. A figure legend should contain all the information necessary for an investigator to determine exactly how you performed the experiment. While this may seem redundant (see Materials and Methods, above), it is very useful for the reader.

Figures: Figures are placed together in numerical order. Make sure you put the Figure number at the bottom of each page.

Supplementary Material: In this section YOU WILL include examples of important or complicated calculations you have used in working up your data. Things that can be excluded: trivial equations such as $C_1V_1 = C_2V_2$.
Things to be included:

1. Determining concentration from absorbance using extinction coefficients.
2. Concentrations of weak acid and conjugate base from pH and pKa using Henderson-Hasselbach.
3. Ionic strength calculations.
4. etc.

It is important to show that you UNDERSTAND how to do the math in your lab reports, rather than simply allowing a program like Excel do the math for you and then demonstrate at some future time that you really do not know how to do the calculations!!!