Writing Reports for the BIOL 395 Laboratory

Purpose of the laboratory report:
The ability to write a clear, concise laboratory report is an important skill that must be learned to succeed in this course. Moreover, report writing is a standard skill for many different fields. To acquire these skills will require time, hard work, and practice. You are encouraged to get help from as many different sources as you can. Here are several strong suggestions:

• Your lab notebook will be your primary source: keep it organized and complete.
• Write your report early, so that you will have time to edit and revise your report.
• Ask other people to read your report before you submit it. You are encouraged to go to the University Writing Center where tutors are very willing to help you.

Organization of the laboratory report:

You will be obtaining most of the information you need about writing your reports from the assigned textbook. The following are points we want to emphasize and directions related specifically to this course.

General information:

• Formatting: Reports submitted in hard copy should be double-spaced, single-sided. Label each page with your name and a page number in one corner.

• Writing: A scientific paper / lab report uses standard prose style, i.e., paragraphs, complete sentences, appropriate tense (usually past tense). Switching tense or viewpoint within a paragraph is not good writing. Your grade will be based, in part, on appropriateness and clarity of your writing.

• Vocabulary and spelling: Be sure you know what the words you are using mean. Make sure all spelling is correct – use a spell checker.

• Figures and tables: Anything that is not text should be labeled as either a figure or a table. Figures and tables are labeled and numbered separately, e.g. Figure 1 and Table 1. All figures and tables must be referenced specifically in the main text. For example, "Figure 2 shows..." or "Samples were all within the standard curve range (Fig. 2)."

All substantial tabular data should be presented as a table with a number and title, and any footnotes required to explain the table. Look at the textbook for examples of good form.
Figures are all presentations other than tables. They include graphs, gels, diagrams, etc. All figures require a number, title, and legend. The legend should include sufficient information to understand the figure without having to read the methods section of the report. Presentation is important. Points will be taken off for sloppy figures.

• Length: How long should the report be? Long enough for you to say everything that needs saying and no longer. It differs for each lab report. Generally this works out to be 10 +/- 3 pages.

• Citations: There is (almost) no quoting in science, and certainly none in writing scientific reports. If you include any quotes in your report, you will have a few points taken off the first time, and receive a zero for the entire section the next time. If you read a bit of information and want to include it, then absorb it, rewrite it in your own words, and cite it. The standard format we use for in-text citations is like this: single author (Bousum, 2008), two authors (Bousum and Kidd, 2008) or more (Bousum et al., 2008).

Major Sections:

The laboratory report should closely adhere to the following format. Each section has a clear place and purpose.

Title:

Indicate the title and the laboratory exercise number as in the syllabus. Be sure your name and the submission date are on the front page. Reports do not require a separate title page.

I. Introduction:

For the purposes of this course, the introduction may be shorter than generally seen in real scientific papers (a page or two). Be sure to include a clear identification of the subject of the report (what are we doing and why are we doing it?) and a brief description of the approach (a broad description, not a list of methods). Some background information (with citations) should also be included.

II. Materials and Methods:

This section describes what you did. Subheadings may be useful for organizing procedures. Like other sections, M&M should be written in prose form – meaning, no lists or bullet points. The preferred writing style is passive voice: “A was added to B and then vortexed for five minutes”, almost as though all the apparatus and tubes were just floating around doing all their operations by themselves. There may be rare times when I or we simply must be used, and that is acceptable.
Describe the materials and methods in detail: the steps you performed, the reagents you used, the centrifuge speed, etc. It should be sufficiently detailed that another person could repeat the work directly from your report. For example, “The cells were pelleted by centrifugation” leaves out several important pieces of information, such as which centrifuge, what kind of tube, how long, and what speed was used. Use of any new equipment should be described. On the other hand, don't include trivial details. I know this is hard to be confident about in your position, and you won't be penalized for including something we consider trivial. But, for example, don't mention that you threw your pipet tips in the dry waste container!

Always state what you actually did, not what the instructions say. For example, if the instructions tell you to make “an appropriate dilution for absorbance measurement”, you might state: "A 1:5 dilution of the sample was prepared for absorbance measurement at 260nm." If the instructions tell you to dissolve your pellet in 0.5 ml of TE buffer, and you accidentally dissolved it in 1 ml, say precisely that. You should also point out that "1 ml was twice as much buffer as suggested in the procedure, but a good reading was obtained (or wasn't)." Thus, it is important to keep detailed notes describing each procedure, even those you did not personally perform.

Explain the purpose of each step in the experiment. A brief phrase or sentence is sufficient; for example, “Five ul of 10% SDS were added to lyse the cells.” Thus, in order to understand the procedure, it is important to ask questions during class.

For experiments involving sets of dilutions or reactions, tables are a clear and useful method of presenting this information. However, do not include any results in this section. You can refer to a figure/table that is placed in the results section if procedural information is also presented there.

You often cannot (sensibly) present procedures in the same order that they are presented in the lab handout (or the same order in which you performed them). This is because the lab handout is a set of directions that is intended to efficiently get you through each part of the exercise in the 4 hours allotted. While one set of tubes is incubating for an hour, you may be working on another preparation. The order of presentation in the lab report should reflect related procedures.

III. Results:

In this section, you present the data you obtained and describe those results in words. The data should be presented in a clear manner by the use of properly labeled graphs, tables, drawings, or photographs. Each set of data should have a legend containing sufficient information to understand it without referring to the main text.

In the narrative part of the results, call attention to important points made by the data, and quantify when appropriate. For example, “Eight of the 10 nucleic acid samples contained at least 50% more RNA than DNA”; “Gel lanes 1, 4, and 5
showed evidence of DNA degradation, so these samples were not included in the calculations.”) Carefully identify and distinguish units of quantity (such as mg or ml) and concentration (mg/ml) throughout the report.

**Calculations**, when necessary, should be put in this section. Every step in calculations needs to be explained. (Pretend that you are explaining how to do these calculations to someone who has never done them before and you should do well.) Show the general equation first, then how your values plug in. Units in calculations must be followed closely. Equations and calculations can be set apart from the general paragraph structure on separate lines. However, they should be included in the portion of the narrative that describes the relevant part of the experiment.

The Results section should be organized so that it flows logically from one part of the experiment to another. **Subheadings** that match the subheadings in Materials and Methods can make reading (and writing) easier for longer reports. For each experimental procedure, a sentence or two should describe the purpose and approach, followed by the results obtained. You shouldn’t repeat any detailed procedures in the results section, but you often need to refer to them. For example, ”We calculated protein concentration using the BCA Assay. Figure 1 shows the standard curve generated from this assay”; “In order to measure the fragment lengths, we ran the samples on a 2% agarose gel (Fig. 3).”

**Do not interpret the results or draw conclusions** until the Discussion Section.

**IV. Discussion:**

The Discussion includes **interpretations** and any **conclusions** you have drawn from your results. We will also provide you with a set of questions to answer. These questions should be answered separately at the end of your Discussion as a list – rewrite the question or simply number them as they appear in the lab instructions. Examples of additional information that may be appropriate in a Discussion section:

- Whether your results were expected or unexpected.

- Possible sources of error or ambiguity. For example, if errors or difficulties in carrying out the procedure may have had an effect on your results, do not simply say, “We made some mistakes that might have affected our outcome.” Be specific. For example, “Because the lysate was quite viscous and difficult to pipet, we may have taken more than 2 ul for the DNA determination. This would lead to an overestimate of DNA content.”

- A comparison of your results with those of others (in your class or in the literature). Possible explanations for results that differ from others.
V. References/citations:

Any information you obtain from outside sources must be properly cited. You do not need to cite the lab handout itself. A minimum of 4 references is required, and these must be from books (maximum of 2) and journal articles. If you choose to use any of the references at the end of the lab exercise handout, these cannot be included in the 4. You may use as many references as you want beyond the minimum, and respectable internet sites are OK. You will have to submit, along with your report, the front page of the 4 required articles or book chapters you used. Your TA may have more specific instructions on this requirement.

For your references and citations, use a style recommended by the McMillan book that includes complete article titles, and be consistent. Pay careful attention to the proper methods for citing internet sources. The following website is one (of several) good sources of information about citation styles in science:

http://bcs.bedfordstmartins.com/resdoc5e/RES5e_ch11_s1-0001.html

Your Teaching Assistant may choose to specify the reference style s(he) wants in your reports.