INSTRUCTIONS FOR LABORATORY REPORTS

The purpose of a scientific paper is to communicate ideas and the results of experiments in a clear, concise and organized manner. The results of experiments or new ideas are of little use if they are not reported or not reported in an understandable fashion.

The purpose of you writing a lab report is much the same: to gain experience in organizing, analyzing data and to present and discuss it in clear, concise and organized manner. Writing such reports is an important aspect of what scientists do.

Strive for clarity and simplicity in your report. Do not try to affect a “scientific” style of writing. On the other hand, you should use the correct scientific/biological terms where appropriate. Write in the active voice whenever possible.

Avoid direct quotations of sources that you cite. Read the source, synthesize the aspects that are essential to the point you want to make and put it in your own words. What should be cited?: Specific data that bear on your point, or ideas and findings that would not usually be found in a textbook. For example, you would not cite “Most insects are heterothermic ectotherms.”, unless this were controversial (it is not). However, if you wrote “Mus musculus has 15 times the metabolic rate of Schistocerca gregaria”, you would need to cite the source of this information.

Your lab report should contain the following elements (see pp.163-164 in Pechenik, 4th ed. for a summary). Some courses may require you to write an abstract. In this course, please do not write one.

Title

The title should be short and informative and should accurately portray the scope of the paper and the study.

Introduction

In no more than three paragraphs, explain the rationale for doing this lab exercise or experiment. What are the questions it intends to answer? Questions or hypotheses should be stated as specifically as possible. [Bad: “The purpose of this experiment was to test the effects of some drugs on cardiac function”. Better: “The purpose of this experiment was to examine whether digitalis and pilocarpine affect either the rate or strength of cardiac muscle contraction.”]

The introduction should start broad and general and then narrow to the questions/goals of the report (the introduction should resemble an upside-down triangle). Start with a statement addressing the general significance of the topic (e.g. Cell division is a fundamental process in organisms). The purpose is to tell the reader what the paper is about and why anyone would care. Then briefly inform the reader about what is known and what is not known about the topic. We don’t expect this to be exhaustive, but you should set up a gap in knowledge that will be addressed by your paper. [if there is no gap in knowledge – why do the experiment or report on it?] Then state your goals/questions/hypotheses. In general, biologists usually do not state a null hypothesis and alternative hypotheses. Instead, biologists usually state a purpose or a question or two. This focuses the paper so that the reader knows exactly what the paper is about.

Methods

Describe how you carried-out the experiment and analyzed the data with sufficient detail so that another person could repeat it. Include such information as: species, number of animals used, number of trials...
performed, size/weight of animal or preparation, crucial aspects of dissection or handling of animal/preparation, duration of each trial, concentration and temperature of solutions used, type of equipment used, etc. These are just some examples of information that needs to be included. Check the Methods section of an original research article in the library to get an idea of the level of detail required.

You should omit the obvious (we used a timex watch to monitor the time intervals; we walked 10 m; data were recorded on data sheets; we took turns so that each person in the lab group had a turn). Include everything that could affect the outcome of the experiment and the quality of your statistical inferences. Standard statistics can be cited simply (e.g. T-tests were used to compare means).

**Results**

This section objectively describes the observed results and trends of the study - logically presented and clearly shown. It should be a narrative, not simply a recitation of the results. Start the results with a topic sentence that immediately tells the reader the first, most important, main point. You must synthesize this from the data. Do not use a bland or meaningless topic sentence (e.g. The treatments had significant effects). Do not send the reader off to a table or a figure and ask the reader to figure it out (e.g. Numerous effects were found (Table 1)). An example: Pilocarpene raised heart rates more than the other compounds (Table 1). Then use several sentences to back this up or fill in the details. Consider making comparisons here (e.g. Pilocarpine had twice the effect of Blanquetcarpine), but do not simply redraw the figure or table with words (e.g. treatment with pilocarpine produced a mean heart rate of 90 bpm etc.). If you have several results that build to tell a story, order them so that you tell the most compelling story. Do not necessarily stick to the chronological history of what actually happened. In general, each table or figure usually deserves its own paragraph. This section should be written in the past tense as the results were obtained prior to the writing of the report.

Tables and graphs are useful for presenting data and should be easily comprehensible. They should be organized and labeled precisely. Tables or graphs alone are not sufficient for the Results section. A brief description of the data is an essential part of this section. Each graph and table should be explicitly referred to in the text. The text clarifies the results of the study and points out the most important features of graphs and tables. You must tell the reader what you want him/her to see; you cannot expect the reader to find without guidance, items that you think are important.

**Discussion**

You interpret the results in this section and state your conclusion [Good: “hypothesis supported or not supported”. Bad: “theory proved or disproved”]. The discussion is where you should use qualifying terms like “likely”, “tends to support”, and “suggests”. This is not where you use bold statements like “prove” and “disprove”. Do the results you’ve reported agree with the expected results based either on theory or previous empirical studies? You may find it useful to relate your results to those of previous studies (cited properly). If the results did not support your hypothesis (or did not agree with your expectations), you should try to address the following questions. Were there aspects of the methods that limited your ability to test the hypotheses? [Please avoid glibly attributing discrepancies to “experimental error”.] How might the original hypotheses be modified to agree better with the results? If your results support the hypothesis, what are the major consequences? What other studies could be done to further test the hypotheses?

The discussion should start by very briefly repeating the major result that is most important (e.g. Osmoregulators had much stronger effects on heart rates than did adrenaline and related compounds). Then you want to relate / compare your results to what is known. This may or may not include some statement regarding what might have been expected. The goal of the discussion is to place your results into the context of science. The discussion is not a stream of conscious outpouring of unrelated ideas. It should be carefully-thought out. The discussion is also the place where you may address the hows and
whys of what occurred. At the end of the discussion you may include some statement of the broader implications of the results (such as how the results might be applied to some question that is important to human society), but be careful here because there are always limitations to the generality of an experiment. These limitations may also be addressed. You may also address what the next steps are for overcoming these limitations or for improving the experiment. In general, it is a bad idea to focus your discussion on what went wrong with your methods and certainly never end on such a sour note. When you come to the end of the discussion, try to end with something positive (like the take-home message).

Avoid going too far afield. The discussion should describe the significance of the specific study that you have carried out to the broader subject being studied, but it should not be the occasion for reviewing everything you know or can find out about the subject.

**Literature Cited**

In the body of the text, cite references by author and year of publication (Jones, 1989; Jones and Smith, 1990; Smith et al., 1991). After the Discussion, in the section titled LITERATURE CITED, list the sources you have cited alphabetically by author. When there is more than one source by the same author, list in chronological order. IMPORTANT: DO NOT USE APA STYLE. USE THE STYLE SHOWN ON p. 77 of Pechenik.

**Specifications and Requirements**

1. The report should be typewritten on white paper (8.5” x11”).
2. Use a standard 12 point font in black. Double space.
3. Use 1” margins all around.
4. Do not make a separate title page. The first page should include the course number, title of report, and name of author(s). The introduction should follow immediately.
5. Do not bind the report in a folder or plastic cover. Staple the pages of the report in the upper left-hand corner.
6. Number all pages.
7. Figures and tables (numbered and each on a separate page) should follow the REFERENCES.
8. Follow the format of the American Journal of Physiology except that you will not write an abstract.
9. Literature Cited: You will need to cite at least 3 sources in your report. We will provide you with 2 or 3 sources, but you must dig up at least one source on your own. I will leave the sources we provide in the lab. The source(s) that you find need not be on the exact topic of your paper, but they must be related. For example, you could compare what you found to data found in a report on the effect of the substances you used on heart rate in a different kind of animal. Or you could find more information about the physiology or ecology of *Daphnia* that may help explain the context of your results or the underlying mechanisms of the effects you saw. It helps to be creative.
10. I have left a copy of one of my papers in the lab for you to see as an example of how your paper should look. Note that there will be a few differences: 1) You will not have a separate title page; 2) You will not write an abstract; 3) You will make citations by author and year in the text.
Evaluation Criteria and Other Matters

1. How long should your report be? We recommend that they be 5-7 pages, plus Literature Cited and figures (graphs).

2. You should cite at least 4 sources from the primary literature in your paper. We will provide several sources for you, but at least one of the sources you cite you should get on your own.

3. Follow the instructions for writing laboratory reports in Pechenik.
   - Pay specific attention to the citation style
   - No one really cares what the authors of other papers “said” or “wrote”. What did they observe or find? Unless they write something that is particularly pithy or insightful, do not quote other authors. Instead, describe the outcome of their work and its meaning using your own words.

4. How will we evaluate your report? We will look for the following things.
   - originality of thought
   - clear and thorough data analysis and presentation
   - logical arguments
   - thorough and thoughtful reference to the literature
   - good spelling, grammar and syntax

5. We will also categorize your report according to the following general descriptions:

   An excellent report communicates ideas effectively and presents arguments in a logical order using an understandable and acceptable style and grammar. It also demonstrates a clear conceptual understanding of the issues addressed and of the data presented. It supports arguments creatively and with relevant information. It makes connections among the various types of information presented and draws conclusions that follow logically from the arguments presented.

   A good report shows many of the characteristics of an excellent report, but will do so less consistently and less thoroughly. Good papers are high quality overall, but have several points that must be corrected (by contrast, excellent papers have few, if any, flaws). Good reports have a mixture of the characteristics of excellent and fair reports.

   A fair report addresses issues tangentially, does not communicate ideas effectively, and/or does not fully develop logical arguments. Style and grammar are adequate, but may need substantial reworking. Fair reports exhibit an incomplete or incorrect conceptual understanding of some of the issues and data discussed and do not make full use of the potential to synthesize and integrate relevant information. Fair papers fail to make strong connections between arguments and conclusions.
A poor report fails to address the relevant issues in an understandable fashion and fails to make clear and logical points, and/or fails to use adequate style or grammar. Poor reports exhibit a general misunderstanding of one or more major issues and do not adequately incorporate appropriate information in support of arguments or misuse information that is presented.