Instructions for Authors of Laboratory Reports

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All published scientific reports conform to a basic outline. Every report must include elements of the following seven sections: title and authors, abstract, introduction, materials and methods, results, discussion, and references. However, different scientific journals require adherence to their own individual format. In the back of any scientific journal appears a section called "Instructions for Authors" where the editors spell out the requirements for submission of a paper. If an author submits a manuscript for review and it does not conform to the guidelines, he or she runs the risk of having the manuscript returned for revisions before it will even be considered for publication, or worse, having it rejected outright.

Consider the instructions which follow as the format for submission of lab reports to the journal for *"MC Biology"*. **Follow them closely**. Although your grade for a report **never** simply reflects how well you follow a format, it certainly is a valid starting point. A well organized paper not only helps you think more precisely about your experiment, it communicates to the editors that you have made a sincere effort to follow their instructions. Having all the manuscripts submitted in the same format is less distracting for the editor and allows him/her to focus on the data and its interpretation.

The Seven Sections of a Scientific Report

I. TITLE & AUTHORS

The title should be short and succinct. It can either be a description, such as "Photosynthesis in Spinach Under at Variable Wavelengths" or it can state a provocative new finding - "Acquired Immune Deficiency Syndrome (AIDS) is caused by HIV".

In scientific publications, all the authors directly involved in the research described in the report are listed in the order of their relative contribution. **Your report will have only one author. You are responsible for writing your own lab report.** The other members or your investigation group should be listed separately.

II. ABSTRACT

This is really a summary of the report. It should be a single, short paragraph. In a few short sentences you should: 1) introduce the topic, 2) state the **purpose** of the experiment, 3) give a **brief** statement of the methods employed, 4) concisely state the **most important findings**, 5) and finally **draw a general conclusion** about the results. Abstracts should be written last, after the rest of the report is completed

III. INTRODUCTION

The introduction should provide the scientific background from which you can explain **WHY** you performed this particular set of experiments. You should **refer to previous works, citing them properly**. Always progress from the **general** topic **to** the **specific** phenomenon your experiment was designed to investigate. Describe the scientific basis for procedures and techniques, but do not list all the details of the methods. State your major findings clearly, giving specific values of significant data. (Do NOT summarize all the data contained in your report.) Conclude with a sentence or two about what you believe your results show.

IV. MATERIALS and METHODS

Describe the experimental procedures followed to obtain the data. Describe only those that could influence the outcome of the data. State the theoretical reasons for performing each major step. Divide this section into subsections based on the different types of purifications or assays performed.

The most common errors made in writing this section are either that it is much too long, or that key numerical values are omitted. Your guide should be that if a colleague (in this case, someone who has completed the laboratory exercise at least once) reads your Materials and Methods section, he or she should be able to duplicate the conditions of the experiment. The materials and methods section of your lab report should be an exact record of how you carried out the experiment. You should describe what you did in lab. Do *not* simply copy what is written in your lab manual because parameters will vary. Even if you did not make them up yourself and simply used solutions prepared by someone else, you should list the molar concentrations for all ingredients and pH 's for all buffers. These should appear ONLY in the body of the text and NOT **(that's *NOT*)** in a big list at the beginning or end of the materials and methods section. Finally, remember that this section is not a lab manual. Do not list steps numerically, and keep to passive voice (see below).

It is imperative to be *concise*. It is very easy to get bogged down in trivial details when writing the materials and methods section. DO NOT LIST EVERY PIPETTING STEP, but generally state each major task. Try not to get discouraged. Although writing a materials and methods section takes practice, once learned it is a skill you will always retain.

V. RESULTS

This is the *most important part of any scientific report*. Results often need to be presented in multiple formats. First, you must always write a **text** for your results, describing what you observed under each particular circumstance of an experiment. Sometimes you will need to enhance the presentation of your results by adding **figures, graphs and tables**. If you have a large quantity of numbers to report, you should present the data in a table. If you put numbers in a table you must *still* explain the results in a text format. This does **not** mean that you simply restate all the numbers that appear in the table. Rather, you need to describe to the reader which of the data are significant and why. The same practice applies to figures. Simply drawing a picture and labeling the observable structures is not enough. It is a good beginning, but you must also describe what you observed in the text of the results section.

Tables and Figures must be numbered sequentially in the order in which they appear, and they must all have a **TITLE** and a **LEGEND** describing exactly to which experiment the numbers or figures pertain. When you refer to a figure in the text, write

"As can be seen in Fig. 1, ..." or " The data in column 3 of Table 2 indicate a trend toward...". ***Never include a table or figure without referring to it in the text.***

Legends for figures and tables should briefly describe the manner in which the data was obtained. Do not confuse *legends* with *keys*. Legends should resemble a mini-methods for the particular experiment which generated the data depicted in the figure or listed in the table. Legends should never describe the data: reserve that task for the text portion of the results section. Legends are separate from the figure, placed either below them or on a separate page. Keys simply define symbols used on graphs or charts and are integrated into the figures. They are sometimes helpful but never sufficient. To reiterate, all figures and graphs require **legends.**

Remember, in the results section you are simply *describing* the data collected. You should not draw general conclusions. For example, you might observe that the movement of an unknown cell was similar to a ciliated protozoan, but you would not conclude that the cell *was* a ciliate until you had discussed all the data in relation to past observations in the DISCUSSION section of the report.

VI. DISCUSSION

The goal of this section is to describe WHY you got the results you did. This is the part of your report where you must relate your data back to all those other scientific works you described in the introduction. For each of your key findings (results) you should indicate how they corroborate or refute the body of scientific data that has been accumulated up until now. This section should be several paragraphs long because you trying to convince the reader of a reasonable explanation of why you obtained the results reported in the previous section. In order to relate your data to the body of scientific work, references should be cited throughout this section, properly and appropriately.

VII. REFERENCES

Incorporate what you learn from your readings into your introduction and discussion sections to bolster your arguments. **At least two references other than your textbooks and other than the internet should be cited.** These should be primary research articles**.** This means that you will have to go to the library and find books and journal articles. Encyclopedias are not acceptable references. Although they do not count as one of your two references, you may cite information you retrieve from textbooks and from the internet. However, it must be meticulously referenced (see below for format). The list of references given at the ends of the chapters in your textbooks are excellent places to begin looking for primary source material.

Whether material is paraphrased or included as a direct quotation it must be referenced. Direct quotes must appear bracketed by quotation marks - otherwise it is considered **PLAGIARISM** (see below).

Results or claims from other works must be properly referenced when included in any section of your report. Any work you cite in the text, whether it is a book or a journal article, is referred to by the **authors' last names** and the **year of the publication**. The full reference is typed in the list of references at the end of the report. This list should include only the works which you cited in your report, not all the books and articles you have ever read on the subject. See instructions in section 5 under the STYLE AND FORMAT below for

exactly how to punctuate citations in the text and in the list of references at the end of the report.

PLAGIARISM

Plagiarism is the taking of ideas or direct copying of text or figures without giving credit to the original authors. Often in lab you will be working in groups, discussing your data with colleagues, even writing oral presentations as a group. However, when it comes time to write your reports to hand in, you must do this all on your own. Any infractions that violate the code of academic conduct will be dealt with severely, according to the policies of the individual instructors.

Specific Instructions for Style and Format

1. All reports must be **typed** and **double spaced** using a font size of at least **12 point**. The text portion (excluding title page, figures, tables and the list of references) **may not exceed 5 pages**.

2. The following sections should appear in this order and they should be have these labels:

Title and authors (you shouldn't label this section)
ABSTRACT
INTRODUCTION
MATERIALS and METHODS
RESULTS
DISCUSSION
REFERENCES

3. Use the passive voice, and the third person throughout your manuscript. Write: "Spinach disks were exposed to different wave lengths of light at a distance of 10 cm. " ***NOT*** "We shone different colors of light onto spinach leaves..." ***NOR*** "Shine different wavelengths of light on spinach...".

4. Tables and Figures must be A) **NUMBERED** sequentially in the order in which they appear, and they must all have a B) **TITLE** and a C) **LEGEND** describing exactly to which experiment the numerical data or figures pertain. Labels on data table columns and rows, or graph lines, should have meaning. If they are labeled numerically or alphabetically, a key should be provided in the legend. Remember to **label the axes** of graphs and include all **units of measurements** on both graphs and in tables. **Legends should describe the method used to obtain the data.** Interpretation of the data should be reserved for the discussion section *only***.** Figures and tables should include enough information so that they can be completely understood if read separately from the rest of the manuscript.

5. References must be included in your report in two ways. **First**, you must CITE the work in the body of the text, when you refer to an idea stated in that reference. **IF YOU COPY TEXT DIRECTLY FROM ANY SOURCE, THOSE WORDS MUST BE SET OFF BY QUOTATION MARKS.** A citation in the text should look like this:

(Smith and Jones, 2005)

where 2005 refers to the year the reference was published.

Second, you must list *all* of the works cited, and *only* the works cited at the end of your report in alphabetical order according to the last name of the first author. If you read an article, but do not cite it in your report, do not include it in your list of references. The reference section must be properly punctuated. Follow the examples given below.

For a journal article appearing on pages 10-15 of the 100th volume of the Journal of Genetics published in the year 2007 write:

> Smith, J., Brown, H., Jones, P. 2007. The construction of a plasmid suitable for teaching the principles of genetic engineering. *Journal of Genetics*. **100**, 10-15.

Please note that if you access a journal article on line, for example through PubMed, the reference should follow the format for a journal (see above).

For a chapter entitled "Construction of Plasmids" from a book of 550 pages entitled "Teaching the Principles of Genetic Engineering":

> Jones, P., Smith, J., Brown, H. 2009. Construction of plasmids. in *Teaching the Principles of Genetic Engineering*. A. B. West and C. D. East, eds. North Andover: Merrimack Press. 550pp.

Finally, internet references must include the name(s) of the author(s) if available, the date it was retrieved, title of the work, a description of the format, the name of the organization providing the information and name of the home page, and the complete URL number.

> Chisholm, R. (7/19/1999). *Dictyostelium* aggregation in myosin light chain mutants. (video and text). Cellular Slime Mold home page. http://...(etc.)

Some Final Words on Writing: Examples and Editing

Examples are the best teachers. Go to the periodicals room of McQuade Library and examine a recent copy of the *Journal of Cell Biology* or the *Journal of Biochemistry* or the *Proceedings of the National Academy of Sciences* (some of these may be on microfiche). Although you will undoubtedly have some difficulty understanding the scientific concepts at first, you should be able to pick out the seven sections of a scientific report, get some tips on how to cite references, and how to present figures and refer to them in the text. The more articles you read, the more you will pick up. Eventually, you will be able to understand the science as well as the format.

The best way to improve your writing is to **READ** what you write! Learn to become your own editor. If something sounds awkward, or doesn't make sense – fix it. Writing is re-writing, especially when you are learning. If you are having trouble explaining a complex thought, move away from the keyboard and pretend you are explaining it to your mother, or your high school English teacher. Then write it down in simple terms. Working hard to improve your writing skills in academic field will yield better results in all your subsequent endeavors, regardless of the academic discipline.

Check List for Lab Reports

Peer review (evaluation of experimental data by colleagues) strives to maintain the integrity of all published scientific data. Editors of scientific journals make certain that the articles published in their journals conform to the correct style and format. All basic reporting of scientific results conforms to the format set out in the *"Instructions for Authors"*. Having all the information from a individual studies presented in an orderly fashion helps scientists to evaluate the work on the basis of its scientific merit. The checklist below contains most of the basic points for which your editors (instructors) look as they read and evaluate your papers. Use this as a guide when you edit your own work before passing it in.

ABSTRACT – A one-paragraph summary

1) Is the entire abstract a single, short paragraph?
2) Are each of the following covered in at least one sentence:
   - statement of introduction
   - statement of the problem/objective
   - brief statement of the method followed (not materials)
   - results
   - conclusions drawn
3) Was past tense, third person and passive voice used throughout?

INTRODUCTION – Follow the inverted pyramid model. Progress from the general scientific issue to the specific problem being investigated.

1) Did the author clearly define the scientific problem being investigated
2) Was enough scientific background given to allow the reader to interpret the results?
3) Were there references cited? (follow instructors directions)
4) Were the citations given in standard format?
5) Were the references cited properly (Avoid direct quotations. Lack of proper citation results in plagiarism, even if it was the result of neglect or laziness.)
6) Were the references cited appropriately (They should bolster the theoretical claims made by the author. Were they unrelated to the topic?)
7) Was the specific, scientific problem being addressed outlined?
8) Was the hypothesis clearly stated?
9) Was there a *brief* outline of the experimental approach?
10) Was the theory supporting the techniques briefly described?
11) Were the final results clearly summarized, giving pertinent data values?

MATERIALS AND METHODS – A record of how the experiment was carried out. List all things that could influence the data. Eliminate extraneous details. Be concise.

1) Do **NOT** include a list of reagents used.
2) Were reagents listed properly when a particular technique was mentioned?
3) Did the authors keep to past tense, third person and passive voice throughout?
4) Were important details omitted? (e. g. calculations or specific formulas, concentrations of solutions, incubation times and temperatures, etc.)
5) Omit trivial details! (e. g. how tubes or plates were labeled, which pipette was used)
6) Was this section as concise at it should be or was it too long?

RESULTS – A description of the data. Describe in appropriate detail the data collected in the experiment. Be careful not to include raw data. Refer to figures and tables in a meaningful way. Direct the reader to notice specific significant results.
Text – State the hypothesis or purpose of the experiment. DO NOT FOR GET THE TEXT!!!
1) Are the data presented in clear and ordered fashion? (This does not have to be in the order in which they were obtained, but rather the order in which they make sense scientifically.)
2) Do lists of numbers appear in the text when they should be in a table? (Never repeat a list of numbers in the text that is and should be in a table. Only some of those numbers will be important to take note of.)
3) Are figures and graphs referred to in the text properly?
4) Is the significance of key data points explained in the text,?
5) Is the significance of high and low values explained specifically?
6) Is the significance of trends and correlations explained in the text?
7) Did authors comment on statistical significance correctly? Did they define "standard error" or "standard deviation". What does overlap of "error bars" mean?
8) Did the writer avoid drawing conclusions (to be saved for the discussion section)?

Tables & Figures – Should be able to stand alone. The information in the legend should describe the details of the experiment, not evaluate the data.
1) Does each *figure* and *table* have a NUMBER?
2) Does the number assigned to a figure or table correspond to the order of its first mention in the text (i.e. is the first figure discussed in the text Fig. 1)?
3) Does each figure and table have a TITLE?
4) Does each figure and table have a LEGEND?
5) Do the legends describe HOW (by what method) the data was obtained? That is, do the legends resemble a "mini methods"? Legends should *not* describe the data.
6) Do tables contain only processed and not raw data? (unless otherwise instructed)
7) Do tables include statistical data when appropriate?
8) Are sample calculations given?
9) Are rows and columns of tables *and* data points and lines on graphs given meaningful labels (not "Tube #1", but "550 nm", for example)?
8) Are the axes of graphs labeled? Are the ***units*** of measurement given?
9) Are figures appropriately labeled, pointing out special features as appropriate? (Base pairs of DNA, contents of a lane on a gel, where the nucleus is in a cell, etc.)
10) By reading just the information provided with the figure or graph, can you understand the data that is presented without referring back to the text (i.e. can each figure "stand alone")?

DISCUSSION – Why is the data important or significant? What is the *scientific* explanation for these results? (This section should NOT be a list of what you think went wrong with the experiment.)
1) Was the objective of the experimental study re-stated in the first few sentences?
2) Was all of the data adequately discussed in light of the theory described in the introduction?
3) Were specific data points, trends and correlations mentioned to support a hypothesis?
4) Was the significance of the data related to the scientific theory outlined in the introduction?
5) Were references quoted?
6) Were they quoted appropriately and correctly?
7) Remember that results can *never prove* a hypothesis, they can only *support* a hypothesis.

REFERENCES - List of Works Cited – Make sure you understand what a primary source is!
1) Are all the references cited in the text listed in this section? (Follow instructor's directions for type of reference required.)
2) Are the references actually cited in the report?
3) Is the format listed in "*Instructions for Authors...*" carefully followed?